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World Wide Web Interface Study: Final Report

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INSTITUTE FOR SIMULATION AND TRAINING

Contract Number: 64-12-323F
Defense Modeling & Simulation Office
31 March 1997

World Wide Web Interface Study

Final Report

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World Wide Web Interface Study

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I. Introduction

Numerous organizations across the Department of Defense (DoD) are involved in modeling and simulation (M&S). Many of these have developed a World Wide Web (WWW) presence in order to share information and ideas related to programs that are of interest to their organizations and supported communities. The Defense Modeling and Simulation Office (DMSO) has established the Distributed Interactive Simulation Modeling and Simulation Resource Repository (DIS MSRR) to capitalize upon the existence of this information by creating a network of related, though unique, nodes which will register items of interest to the general and specific modeling and simulation communities. The nodes will "register" existing information as a "resource" allowing community members to quickly determine if information is available as well as to view and/or retrieve the actual information. One of the principles of the DIS MSRR construction is to "point" to resources where possible. By so doing, the original information is maintained by its owner on the owner's server. Using a WWW system design, the DIS MSRR allows for community users to access this central source of resources while preserving owner control of the information/resources.

The complexity of the information and the breadth of its scope pose unique challenges to the DIS MSRR design; multiple nodes under individual Information Domain Coordinator (IDC) and Node Administrator (NA) control serving a world-wide community of scientists, managers, information users from US military, US government, industry, and academia. Of obvious concern are issues related to information structuring to assist users in locating desired resources, speed of the retrieval process via existing commercial and private networks (performance), and the type and physical layout of user controls.

The term web and the acronym WWW are often used interchangeably. For the purpose of this report, "web" will be used when referring to the WWW.

II. Purpose

During Phase I of this project, the study team examined and recommended for further research key web page design factors considered important for development of DIS MSRR web nodes. For example, topics considered included: "performance" (speed of page delivery) as a trade off to graphic intensity; location and types of navigational elements; format and style of graphics; general page layout; and support for multiple browsers. The findings from Phase I were reviewed by DMSO and used to generate a set of web page design guidelines to aid DIS MSRR web development efforts. The project team then began Phase II and assisted existing Node Administrators in adjusting their designs to more closely follow the DIS MSRR guidelines.

III. Methodology

The methodology used in this study was based on an iterative data collection approach. This approach ensured that information obtained from earlier sources (beginning with the comprehensive literature review) was used to help focus the gathering of information from other sources as the study progressed. This approach also allowed the study team to be flexible with regard to what information was collected and in identifying alternative sources of information that could have

affected the study results. For example, a review of existing web sites sponsored by large business organizations was included after the study began. This was added because it was felt large organizations did not have the resource constraints of smaller organizations, but did have an overriding need to promote their company and its products and services in an effective manner. Thus, these companies could "afford" to use graphic images extensively, as well as cutting edge design applications, but could choose not to if they thought it would have a negative impact. Similarly, as progress ensued, the team identified the need to include data collection about the effects of various web browsers. Data was collected from the following sources:

- **Comprehensive Literature Review**
Written publications presented online and using traditional formats (i.e., books, magazines, journals and conference proceedings) were reviewed.
- **User Survey - Paper-Based**
A paper-based survey was used to collect web user preference information from attendees at the semi-annual Distributed Interactive Simulation (DIS) Standards Workshop held in Orlando, FL.
- **User Survey - Online**
An online version of the survey was posted on the DIS MSRR node. This survey was a slightly modified version based on the results from the paper-based survey and included two items used to determine computer monitor characteristics of respondents.
- **Review of Large Organization Web Sites**
A review was conducted of Fortune 100 organization web sites.
- **Browser Review**
A review was conducted of web browser usage and considerations based on usage statistics obtained through the DIS MSRR web server.
- **Graphic Image Experiment**
An experiment was conducted to determine the visual preferences of subjects viewing a series of color and black-and-white photographs.

In addition to the above information sources, key findings from this study were incorporated within the DIS MSRR web site (no longer online). A presentation of the DIS MSRR home page and accompanying explanation of the modifications that were implemented based on the research results of this study are presented at Appendix D.

IV. Results

Results for each of the data collection sources, except for the user surveys, are described separately followed by a brief summary that points out important trends across the various data sources. Information from the paper-based and online user surveys are presented together, due to the similarities in these data collection instruments.

Traditional/Online Literature Review

A comprehensive literature review was conducted to determine what characteristics are important for design considerations. Books and magazines were included in this review. Due to the dynamic nature of the web, information may become outdated quickly once printed; therefore, online materials (style guides and related references) were also included. From these sources, an initial list of over two dozen specific considerations were compiled.

Appendix C contains the detail for each of the 122 web design publications identified as being relevant to this project (over 500 publications were considered for inclusion). Based on an initial review of these publications and the team's own extensive experience, several attributes were identified for further classification and consideration. It should be noted that when compared to the relevant "human factors" literature precepts (as noted in the appendix), striking similarities are noted, namely information organization, navigation, and "look and feel" issues.

A final reduced set of seven characteristics emerged by combining characteristics that were shown to have substantial overlap after the data collection and analysis effort had begun. These seven characteristics are listed below. In general, these characteristics should not be viewed as independent, given that many of the characteristics are used in combination on a single web page.

1. Use of HTML forms
2. Use, placement, and format of graphic images
3. Organization and structuring of information
4. Use of web design languages and tools
5. Use of navigational features
6. Overall aesthetics and appearance
7. Factors influencing delivery and functional performance

Use of HTML forms

While forms can be useful for many operations, most of the style guides reviewed did not provide detailed information on their suggested use, placement, etc. If forms are used, they should be short and simple. It is acceptable to place the form either in the middle or end of a web page consisting of normal text. Placing the form on a separate page is also a consideration. As far as design is concerned, location of field names (labels) should be consistent, either to the right or left. Location of field names becomes even more important when check boxes are used. Confusion about the specific use of a given check box can result if consistent placement of field names is not followed. Pre-formatted columns or tables are helpful for solving check box displays. Some of the reasons to use a form include: updating and processing data, searching a database, and sending email.

Use, placement, and format of graphic images

Buttons are a very popular aid to facilitate web navigation. A few simple navigational buttons should be made available on all pages. These buttons should be consistent from one page to the next. For example, do not use different buttons for the same purpose on each page. When consistent navigation buttons are used throughout a site, the current page should be indicated by the

appropriate button. Buttons should be small, discrete, pushable objects.

Backgrounds have also been researched. A general consensus has not yet been found, but here are a few of the opinions expressed by web designers. T. Karp's "Art and the Zen of Web Sites" states that text is hard to read on colored, textured, and graphic backgrounds, so a white background is suggested. On the other hand, David Siegel, who is writing a book on web site design, suggests light backgrounds (green, blue, yellow, pink) instead of white. He has reached his opinion through research which indicates that off-white colors during long periods of work are less stressful to the human visual system. Siegel also suggests not using gray as a background color. Other designers suggest using a light background for presentation of text and dark backgrounds for graphics. Another designer suggests that backgrounds be a light color saved in JPEG format and compressed.

The two types of graphic files most frequently used in web page design are JPEGs (mainly used for pictures) and GIFs (used for line-art images such as icons and graphs). Once a JPEG image is created, it should not be edited later. There are benefits and downfalls to using a JPEG and GIF. For example, a smaller file can be generated by using a JPEG, but the increased picture quality will not be seen unless the browsing computer is capable of viewing millions of colors. Therefore, GIFs and JPEGs are generally comparable in appearance on most machines. Until this last year, most browsers did not support inline JPEGs. For this reason, the majority of graphics on the web are GIFs. GIFs are also the only image format capable of displaying a transparent background.

Other general suggestions to follow when using graphics on a web page include using an "alt" tag, or alternative tag, for text-only browsers or those users who have turned off graphics and height and width parameters. The "alt" tag provides a text description of what the graphic is. When height and width parameters are included in the graphic tag, the browser can immediately begin outlining the layout of the page. In other words, there's no lengthy delay while the browser downloads and then computes graphic height and width. Using height and width parameters speeds up the delivery of the page display. Here is an example tag incorporating each of the suggestions:

```
<img src = "images/help.gif" alt="Help" width=10 height=5>
```

To avoid long download times for end users, graphics less than 25kb in size are suggested. If a large graphic is necessary, provide a thumbnail (smaller version) and link it to the larger graphic. Thumbnails are faster to download and allow the user to determine whether he or she needs to view a larger version. Graphic file size can be reduced by using less colors in the image. A utility called GIF Wizard, offered by Raspberry Hill Publishing, can be used to do this.

Organization and structuring of information

A home page should be simple and have key words to attract many users. Since normal human eye movement in many countries including the US begins at the top left and works to the bottom right, information at the top should be more important and the information at the bottom should support the preceding information. An alternative suggestion is to place general information at the top of a page with links to more detailed information on subsequent pages.

Other general items to consider are: all pages in a web site should stand alone since they may or may

not be read together; if long lists are to be included on a page, a clickable alphabet is recommended; a table of contents and search mechanism should also be included; a detailed title helps users remember your site when they bookmark or hotlist your URL. One designer suggested a summary of the page's content since some browsers do not display page titles. Consider using a long date so non-US users can recognize it. Copyright notices, although recommended on each page, are not necessary.

Many web pages contain links. When creating links, write your page as if no links are present (e.g., do not say "click here" because this can be distracting, and some users may not have a mouse). Also try to describe the link by using meaningful words or phrases; do not link a single character. Before linking to someone else's site, many web designers suggest either a courtesy note be sent or permission to create a link be sought. Since sites are constantly changing, it is necessary to test all links periodically to check for inactive links or changes in URLs. A page with no links is referred to as a dead-end page. To avoid dead-end pages make certain to include some type of link to either the home page or another relevant site.

Use of web design languages and tools

The majority of the research findings discuss the use of Hyper Text Markup Language (HTML). HTML is the language used to create web pages. Styles differ between web designers, but there are some general principles which everyone should follow.

To ensure proper display of HTML tags and that hypertext references are still valid, use programs like WebLint (<http://www.fal.de/cgi-bin/WeblintGateway>) to check HTML syntax and Dr. HTML (<http://www2.imagiware.com/RxHTML>) to test hypertext links in a web page. Use of modern software products for managing the overall site structure, identifying broken links, missing files, etc. is highly encouraged and ensures visitors are presented with only working links.

Beyond HTML syntax, organizing and structuring of HTML tags within the page is also advised. A structured layout of HTML tags makes reading and editing easier. A few blank lines and spaces can make a world of difference when searching for a mistake. Comments can be used to identify major sections (`<!-- your comment -->`). Blank lines, extra spaces, and comments are ignored by web browsers, and not displayed in the final presentation of the page.

File naming is another widely discussed topic among web designers. Most suggest the file should end with the extension `.html` unless the file is on a DOS system. On a DOS system, use `.htm` (see Table 1). The experience of the IST web study team has found the latter file naming, `.htm`, to be most effective regardless of the type of system on which the HTML files reside. Until IST web clients requested copies of their respective web pages to place on a laptop (running Windows 3.11) for demo purposes, the file extension was never given much thought. Once HTML files were placed on Windows 3.11 machines, however, the `.html` extension was soon discovered to be a problem. Since these machines could only recognize a three character file extension, any links made to `abc.html` simply would not work. Massive efforts were required to modify HTML pages every time a local version was requested by a client. In efforts to solve this problem, several tests were performed. The conclusion was that HTML links would operate locally on a PC, MAC, or

UNIX computer as long as the 8.3 file naming convention was used, and therefore the use of .htm not .html has been practiced.

Locally Referenced: 	Not Locally Referenced:
---	---

Table 1. Hypertext Links

As a result of the tests performed above by the IST web study team, another problem was identified. The hypertext links of HTML files also needed to be changed to function locally on a PC, MAC, or UNIX computer. All hypertext links, unless referencing an external web site, should be written relative to the point of reference. This kind of referencing may also be referred to as "writing the file locally."

Use of navigational features

A general consensus based on this review is that navigational aids are necessary on every page. What kind and to what extent is currently being debated. The majority of people believe that some type of aid should be available on all pages within a site. This aid can be a "home" icon, a text link, or a more detailed graphic utilizing an imagemap. Many people addressed the issue of using "back" buttons. These buttons can often be misleading considering that not every user came from the same location. Some have suggested using a "previous" button; however, some people feel it is as misleading as a "back" button.

The minimum aid a page should offer is a link to the site's main or "home" page. Others have suggested the use of a menu or navigation bar at the top or bottom of the page. Wherever the navigation aid is offered, if a graphic is used, a text supplement should be supplied for text only browsers. In most cases, adding an "alt" tag (alternative text) inside the image tag can solve this. To maintain consistency, the same navigation bar, icons, or tags should be used. Vocabulary should stand on its own and a search mechanism is suggested if the site is complex.

Overall aesthetics and appearance

Page appearance is affected by many factors. For example, reading a document on a computer screen takes 20-30% longer than reading it from paper. Another consideration is that the span of a person's eye movement is normally about 3 inches, while most web pages are at least 6 inches. The recommended web page size is 470 pixels long by a maximum of 625 pixels wide (assuming design for standard VGA monitor displays).

A majority of the style guides suggest using short pages with no scrolling. Scrolling is not recommended because it can be cumbersome to scroll through long pages. Also, scroll bars indicate to the user that there is more information available, but do not indicate the amount of additional information.

Documents which are intended to be read as a whole such as manuals should be available on a single long page for easier printing. Many designers conclude that multiple short pages are better than long pages.

Numerous style guides suggest limiting a web page to a maximum of two to three screens. Long paragraphs are difficult to read on a computer screen, so short paragraphs with links are suggested. A recommended paragraph length is four sentences or less. Text should be limited to eight to ten words per line. Line lengths can be restricted by using a blockquote. For ease of reading, columns are also suggested.

Other things to consider when designing a web page include: use the same design principles for all web pages in a web site; use editing elements such as italics, bold type, and exclamation points sparingly; do not use the blink feature; and use a footer to designate the end of a page. A solid-color background is a better choice than a complex tiled background, because text is easier to read from a simple background. When creating graphics, it is a good idea to set the transparency value to the background color. This will ensure that the image's background will match the background selected for the web page.

Factors influencing delivery and functional performance

There is a trade-off between conserving bandwidth and speeding the performance of a web page. Although many suggestions are given on this issue, no definite guidelines have been established. Two areas of performance that are frequently addressed are web page loading time and the volume of images per web page.

The average suggested loading time for a main/homepage is thirty seconds or less. Web designers should check the loading time for each web page included on a web site. Since the average user accesses the Internet at 14.4 kbps, designers should consider downloading using a variety of modem speeds.

Balancing appearance with performance can pose design problems. For example, a complex graphic used as a headline may be more visually appealing but will take longer to download than a text headline. Many designers suggest specifying the height and width of the graphic in the HTML coding, in order to quicken the loading time. Browsers that do not recognize these tags will simply ignore them. Various designers agree that the color palette and bit-size of a graphic should be reduced, when possible, to keep the size of the image file to a minimum, and thus decreasing download time.

Numerous other factors affect performance. For example, the amount of memory required to load a web page is reduced when the same icons and tags are used throughout the web site. This takes advantage of the memory cache on the client computer. Setting the web browser so that the text on a web page will download before the graphics speeds performance. Images that are saved as 'interlaced' will fade into focus as they are loaded, saving bandwidth. Also, using thumbnail versions of graphics, which are very small, and linking them to larger versions on a separate web

page conserves bandwidth. Both JPEG and GIF graphics are commonly used in web pages, and each type has negative and positive qualities which will be discussed further in the final report.

Human Factors Literature

In addition to traditional literature from authors engaged in web design or use, a special search was conducted to consult the field of human factors engineering. There is an extensive human factors literature base dealing specifically with a variety of topics related to the design of graphical user interfaces, including visual displays, controls, and information processing (see e.g., Woodson, 1981). It was felt, however, that a full review of this literature base would go beyond the scope of this project. Instead, a review of recent publications that specifically targeted web page design was conducted. This section of the review is treated separately for two reasons: 1) the information and issues within this area are considered by the study sponsors to be of special importance; thus it is useful to separate this information from the remaining literature review; and 2) by separating these information sources, it is possible to compare the results from the human factors literature review with that of the more general web design literature review to determine any similarities or differences.

The field of Human Factors Psychology is grounded in empirical research, thus it was not surprising that many of the publications that were reviewed indicated a need to collect data throughout the web design process. Several publications provided design process guidelines that, when used, would help to ensure user acceptance and overall design effectiveness. However, as was noted by Neilson and Sano (1996), the design evaluation process is typically an ongoing endeavor. This is due, in part, to the fact that user preferences vary considerably and thus total agreement among even a small set of users is a highly unlikely occurrence. In their article describing the user interface design of the Sun Microsystems's internal web, Neilson and Sano (1996) reported using a sequence of four design studies over a two-week period. Each study involved no more than four participants; thus information was collected and analyzed quickly and results were immediately used to help make critical design decisions. The final study, involving a think-aloud walkthrough of a web page mockup, proved to be an especially useful evaluation tool for identifying necessary design modifications just prior to initiating HTML authoring activities. This article demonstrates that use of mini-studies, such as those conducted by Sun Microsystems, can have a tremendous positive impact on the web page design process, and can be completed with a relatively small expenditure of time and resources.

An article by Aaron Marcus (1993) is also instructive with regard to the need for collecting data during the web design process. It should be noted that his design process can be used to develop any graphic user interface, of which web design is only one. According to the design process model described in his article, there are five components that must be addressed in order to produce an effective web page/site: metaphors, mental models, navigation, look, and feel. Metaphors include fundamental terms, images, and concepts incorporated within the design. The mental model refers to the essential organization of information, tasks, functions, and roles embodied within a web page/site. Navigation involves the movement through the web page/site via menus, control panels, etc. Look refers to any appearance characteristic including typography, color, symbols, animation, charts, tables, illustrations, and even acoustical cues. Feel, on the other hand, involves user

interaction elements such as input methods (e.g., mouse, keyboard, etc.) and how outputs are generated. Web design, according to this process model, would ideally be conducted using a cross-functional team of individuals knowledgeable in the areas of graphic art/design, marketing, human factors, software engineering, and technical writing. The design process would necessarily include a series of usability tests, to include web page mockups similar to that described by Neilson and Sano (1996). As web authoring and associated browsing capabilities expand to include greater use of multimedia, hypermedia, three-dimensional and "intelligent" interface environments, the need to use skilled interdisciplinary teams and to conduct usability testing becomes essential (Marcus & van Dam, 1991).

Human factors research and design principles have been applied to developing effective user-computer interfaces for computer aided instruction (CAI) for over two decades. A report written by Williams, Hamel, and Shrestha (1987) presents 53 design characteristics for developing effective user-computer interfaces for CAI. In the report, the characteristics were grouped into five design categories: brevity, consistency, compatibility, flexibility, and responsiveness. The following outline is a breakdown of design characteristics considered by this study's authors to have relevance to web page design. The characteristics are organized by the design categories mentioned above. In some instances, wording changes were necessary to more closely align a given design characteristic to focus on its application to web page design.

Brevity

Brevity is the ability to present information in a concise manner and/or minimize the amount of information that must be attended to. Design characteristics that are related to brevity include:

- Large portions of text should be separated into meaningful "chunks;"
- Graphic displays used with text should take up no more than 25% of the screen area;
- Main menus/submenus should have a maximum of 5-9 choice options;
- Use color, borders, highlighting, or text style cues rather than blinking to focus attention; and
- Keep the field width for a given line of text to 40 characters or less.

Consistency

Consistency refers to providing predictable expectations to help orient users. Design characteristics that are related to consistency include:

- Functionally alike screens/components (e.g., buttons, etc.) should be formatted similarly;
- Labels and graphic cues should be used consistently;
- Critical information (e.g., choice options) should be presented first and in a prominent manner;
- Delays in receiving feedback should be consistent;
- The overall information/design structure should be evident to the user via menus or maps;
- Symbols should remain constant throughout the web page/site; and

- Location within a multi-screen segment should be indicated on the web page (e.g., use of page numbers).

Compatibility

Compatibility refers to the adherence to common conventions in order to increase transfer of knowledge and experience by the user. Design characteristics that are related to compatibility:

- When ordering sequentially, numbers should be used rather than letters;
- If needed, clarify instructions by providing relevant examples;
- Where responses or choices are required, keep relevant information concerning response/choice options on the screen;
- Branching options should be limited to three levels;
- Text should be displayed by row, as opposed to double column format;
- To make items distinct and separate, use opposite colors;
- Provide graphics to illustrate or clarify potentially ambiguous text;
- For menu selections, left justify selections and use column formatting; and
- Always provide needed directions/instructions before presenting menu selections.

Flexibility

Flexibility involves providing the opportunity for users to tailor interactive elements to fit their personal preferences. Design characteristics that are related to flexibility include:

- Provide the capability to review previously displayed web page(s);
- Allow the user to exit web page/site easily;
- Increase ease of access to critical or frequently used options/controls; and
- Allow users the option of choosing the level of detail of information and feedback.

Responsiveness

Responsiveness involves providing the user with the right information or right amount of information at the proper time, including how to operate the system. Design characteristics that are related to responsiveness include:

- If delays are unduly long, provide an indication that the system is operating normally;
- Feedback and directions should be clearly distinguishable from normal informational text;
- Access to help capabilities should be easily available; and
- It should take no more than five seconds for text and graphics to fill the screen.

The topic of time delay, which is the amount of time the user must wait for elements of the web page to download, received a significant amount of attention in the human factors literature that was reviewed. Time delay is particularly interesting because it is directly related to other web page design characteristics, such as the use of graphics. As reported previously by Williams, Hamel, and Shrestha (1987), the maximum wait time for a given screen display (i.e., web page) should be no

longer than five seconds. This is a seemingly reasonable period of time. However, in the field of hypertext development, a much shorter time delay of 1/4 of a second has been identified as the rule of thumb (Akscyn, McCracken & Yoder, 1988). This 1/4-second guideline is referred to as Akscyn's Law, based on a presentation by Rob Akscyn at the 1987 Hypertext Conference, and has been supported by a subsequent response time study by Patterson and Egidio (Nielson, 1989). Akscyn's Law states that a 1/4-second delay is the optimum wait time when accessing hypertext links, because anything slower is disruptive and anything faster may interfere with the user's ability to discern that a new link has been accessed.

In an article discussing the issues surrounding hypertext time delays, Mark Bernstein (1996) made the observation that web links are often quite slow and unpredictable. This may be due, in part, to network traffic and an increase in the use of graphic images. Thus, instead of moving toward conformity with Akscyn's Law, web design is moving in the opposite direction toward unpredictability and longer delay periods. In his article, Bernstein (1996) provides several options for dealing with longer time delays. One solution is to replace multiple short delays with a single longer delay. This could be accomplished by pre-loading graphics or applets when a web page is first accessed. Another solution would be to mask the time delay by providing partial information to the user (e.g., by showing parts of a graphic image as it becomes available). The latter approach would conform with the first design characteristic in the responsiveness design category, which states that if delays are unduly long, the user should be provided with an indication that the system is operating normally (Williams, Hamel, & Shrestha, 1987). Also, providing a user with the option to download larger graphic images or large text files as a separate function of the web page is a possible option that would conform with the flexibility-related design characteristics presented previously.

Despite widespread use and rapid growth in available resources on the web, there appears to be a lack of systematic, quantitative hypermedia usability research that is directed specifically toward developing an underlying set of web design principles. This lament was the focus of Simon Shum's (1996) report describing the proceedings of a recent hypermedia symposium. Shum pointed out several reasons for the lack of research, including the rapid advances in web authoring/browsing capabilities, the ease with which changes can be made to existing web pages/sites, the existence of readily available principles based on prior graphical user interface research, and the seemingly unlimited capabilities for web page settings and applications. The ability to easily modify a given web page or an entire web site may reduce the perceived need for a unified set of web design principles. If the appearance and functionality of a web page/site are less than optimal, then new design elements can be implemented until a viable solution is found. Eventually, basic design principles will become evident as experienced, astute designers continue to derive their own sets of guidelines. The downside of such an approach is that a great deal of time and effort will be spent making futile design modifications. These modifications will, in turn, reduce user effectiveness and increase web site maintainability. It is worthwhile, therefore, to take the time now to craft a set of design guidelines that are grounded in empirical human factors research. Toward this end, the study team has included as part of this report, findings from an experiment conducted in-house that explores visual preferences of users that have been shown a series of computer generated color and black and white graphic images. It is hoped that by reporting this experiment interest will be

generated in conducting similar studies that have direct impact on establishing robust web design guidelines.

Web Users Survey - Paper-Based and Online Formats

In order to identify the web user preferences, especially those involved in the area of M&S, two survey formats were utilized. The first survey was paper-based and is presented in Appendix B. A second survey, presented in Appendix C, was conducted after the results of the first survey had been analyzed using an online format. Most of the items included in the online version were the same as those in of the paper-based survey. However, several items were modified to clarify their meaning or to adjust the answer choices. Also, two innovative data collection items were included in the online version which provided for a more precise measurement of the characteristics of respondents' computer monitors.

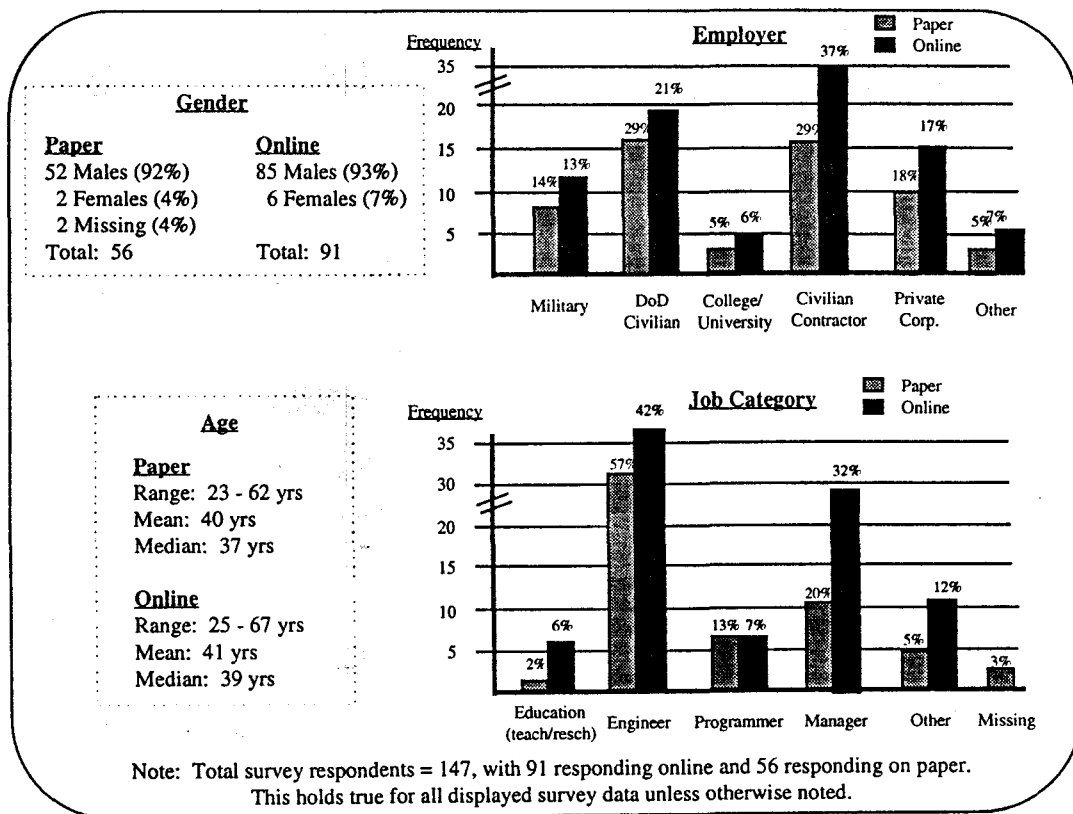


Figure 1. Demographic Breakdown of User Survey Respondents

Figure 1 provides a comparison of the demographic breakdown of the respondents for each of the two survey formats. A total of 147 web users participated as survey respondents (91 responded via the online survey and 56 responded to the paper-based survey). Survey respondents were not asked

to provide their names because a follow-up was deemed unnecessary, and it was reasoned that by not asking for this information a greater number of participants would complete the survey.

It can be argued that the respondents to this survey are representative of the typical DIS MSRR users given that a) the demographic and computer configuration characteristics (see Figures 1 and 2) of the respondent group are similar to historical online data gathered over the 12 months prior to the writing of this report via the IST web server, and b) 93% of the paper survey respondents indicated that they had accessed the UCF or IST server at least once over the 12 months prior to the administration of the survey. It should be noted that respondents to the online version of the survey had to access the survey via the DIS MSRR node on the UCF-IST server.

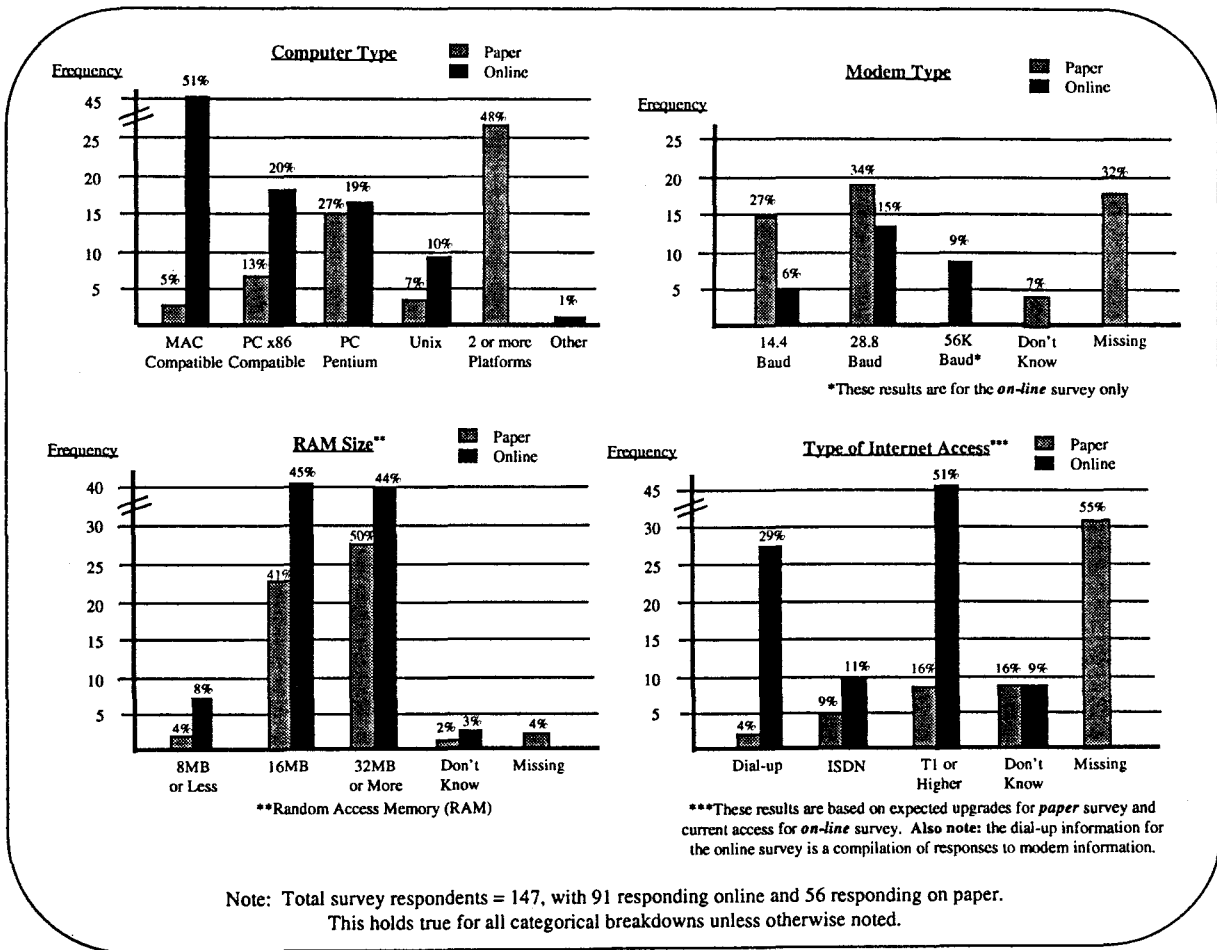


Figure 2. Computer Hardware Usage

Figure 2 provides a summary of computer hardware being used by the respondent groups. It is interesting to note that many of the respondents appear to have relatively up-to-date, and in some cases, advanced computing power in terms of the type of computer they are currently using and the size of random access memory (RAM). Also, for those respondents that use modems to access the Internet, 34% (paper) and 15% (online) indicated they used a 28.8 baud per second (bps) modem.

In response to survey items concerning Internet connectivity, 91% of the online respondents had knowledge of the type of connection they were using. The majority (51%) of these respondents reported having access to the Internet via "T1 or higher" technology, while 39% of the paper survey respondents expected their organization would implement such an upgrade within a year of the survey. In addition, of the 16 paper survey respondents that appeared to have direct knowledge of the type of upgrade that would be implemented, a majority (56%) indicated it would involve use of a T1 (or higher) connection. At first glance, it appears that there is a noticeable difference between the two respondent groups involving the type of computer platform being used. Of respondents to the online survey, 51% reported that they use a Macintosh (MAC) compatible computer, while 5% of respondents to the paper-based survey use a MAC. However, 48% of the paper-based survey respondents indicated that they had access to "2 or more platforms;" thus it is possible that many or most of these respondents had MAC compatible computers.

In general, the types of computer hardware used by both respondent groups are similar. A potential difference between these groups may involve Internet access; however these differences are masked by the fact that many of the paper-based survey respondents chose not to respond to this item.

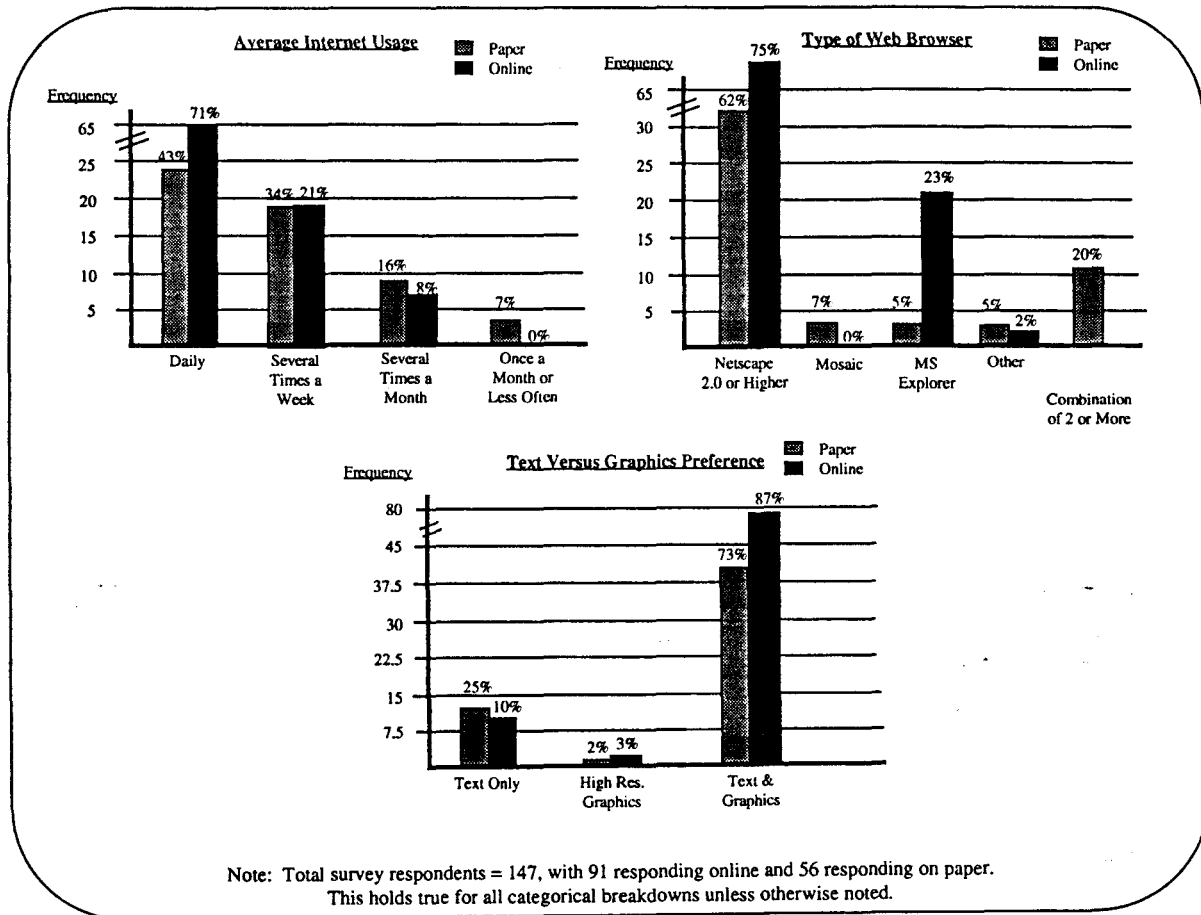


Figure 3. User Preferences

Section 3 of the survey focused on user preferences. Figure 3 presents a graphic summary of the user preference information. Reported Internet usage for all respondents was high, given that 86%

of the respondents (77% of the paper survey and 92% of the online) used the Internet to conduct searches on a weekly basis, or more frequently.

The survey items concerning how long respondents would wait for information and their preference for text versus graphics was considered to be especially cogent for this study. This is because the responses affect several of the seven design characteristics used to guide the literature search.

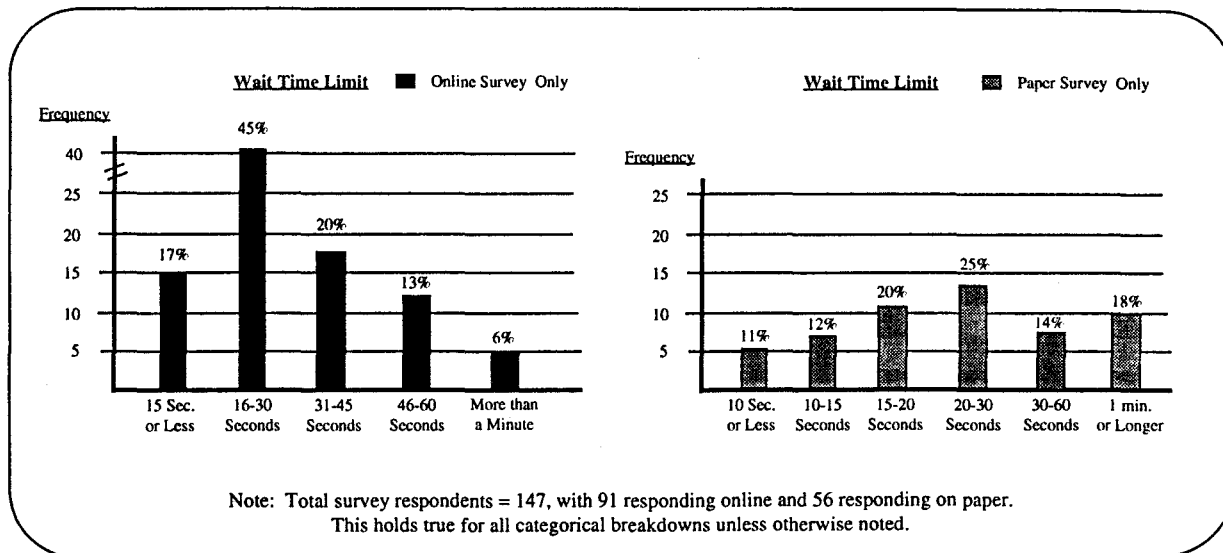


Figure 4. User Wait Time Limits

As can be seen in Figure 4, limits on how long respondents would wait to view search information was spread out across the one minute time spectrum presented. This result is consistent with user preferences involving text versus graphics. That is, a large majority of respondents (total of 82%) indicated they preferred both text and graphics; thus it is not surprising that some respondents indicated a tolerance for experiencing longer waiting periods in order to view a page having graphic material. Nearly half (46%) of the respondents were willing to wait longer than 30 seconds to view information, and a total of 11% (18% paper, 6% online) would wait longer than a minute.

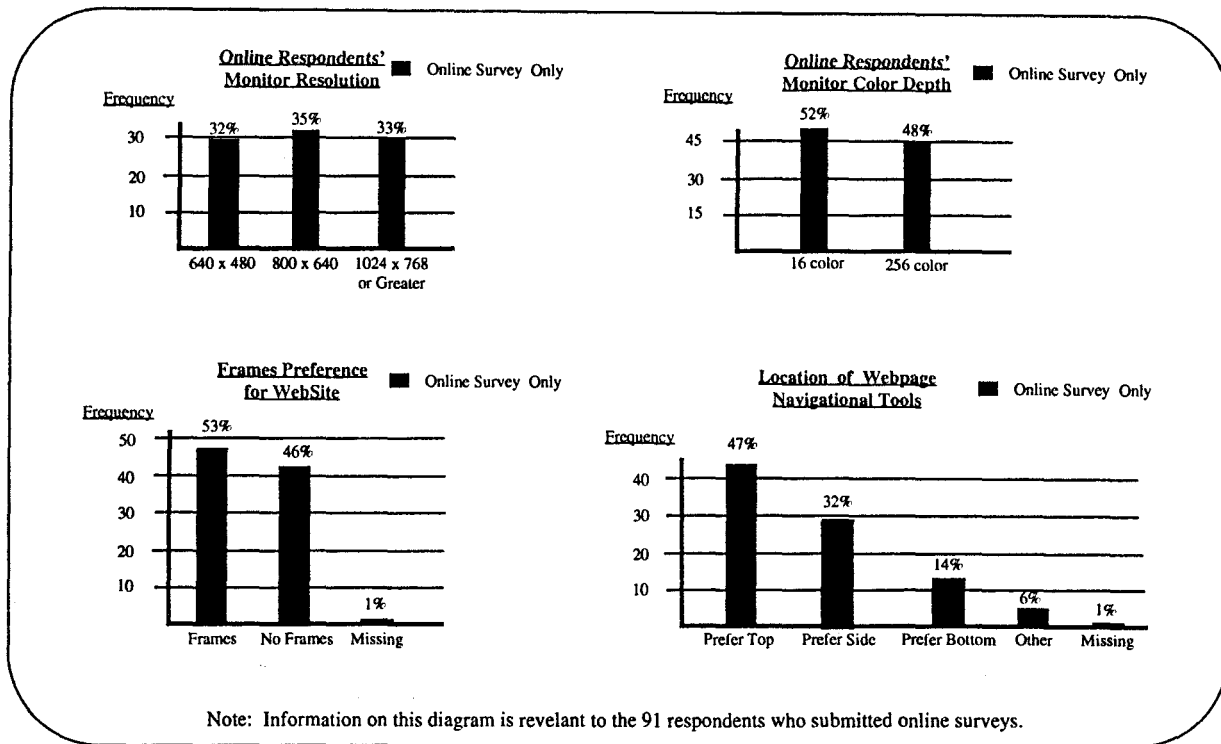


Figure 5. User Preferences and Monitor Characteristics of the Online Respondents

Responses to several of the items involving web user preferences (see Figure 5) were along the line of what was expected by the study team based on previous experience maintaining web sites. For example, all but two of the paper survey respondents preferred having the capability to both browse a site and conduct online searches. Finally, the item on placement of navigational tools may have been misleading in the paper survey. Several respondents commented on the placement of navigational buttons on the menu of the Internet browser (i.e., Netscape, America On Line), rather than the placement of navigational buttons on individual web pages. The original intent was to determine where users preferred web page-specific navigational buttons to be located. The item was modified for the online survey to reduce misinterpretation and yielded a finding that the majority (79%) preferred a top or side location for navigational tools on a the web page.

Review of Fortune 100 Organization Web Sites

The purpose of examining the Fortune 100 companies on the web was to see if similarities on web design characteristics exist. After conducting a search using AltaVista, a web page titled "Fortune 100 Companies on the Internet" was found at the following URL: <http://www-1.openmarket.com/personal/grant/f100.html>. This web site lists the Universal Resource Locators (URLs) of Fortune 100 companies that are currently available on the World Wide Web.

At present, 85 of the 100 companies have developed a Web presence. For the purpose of this report, results from a review of 85 sites will be reported. Of the 85 sites examined, 73 have been accessed successfully, eight did not have a DNS entry, one could not find the file, and three sites were

attempted twice before they could be accessed fully. The online table indicates the sites reviewed to date.

While examining these sites, several factors were considered with regard to web design ...

- Did the page load quickly?
Over two-thirds of the web sites loaded quickly, while 15% took a significantly long amount of time to download. Only one site warned the user about the download time and provided a chance to turn off the graphics.
- Were graphics utilized, and if so, what type?.
Almost 20% of the sites indicated their pages were viewed "Best with Netscape." Graphics were used by almost every site. Use of GIF files for presenting graphics was employed most frequently, while JPEGs were used approximately 20% of the time. Nine sites contained animated GIFs. Only one site contained a Java applet.
- What kind of background was used?
Two thirds of the sites used white for a background color. Gray, black, and yellow were also used as background colors. Two sites used image-based backgrounds.
- Were there alternate ways to view the pages, such as text only or a foreign language?
One third of the companies offered an alternative way to view their site, the most popular being a text-only format. Two sites offered a version in a foreign language.
- What kind of navigation aids were available, and where were they located on the site?
A problem faced by many web users is the tendency to get lost within a site. This is a result of the user uninformed on both the structure of the web site and the level of the information they have accessed within the site. Approximately 20% of the companies attempted to address this problem by offering a site map or an outline of their site's information structure. One-third of the companies provided a search mechanism. A little over 5% of the sites offered suggestions on browsing techniques. Text and image maps were presented by many companies. Over half of the sites examined had an image map. Ten percent (10%) of the sites offered no navigational aids, such as a tool bar, back button, or home button. Fifty percent (50%) of the companies offered navigational aids at both the top and bottom of the page.
- Were there any interesting or unusual design techniques employed, or other design characteristics worth noting?
Fifteen percent (15%) of the sites were awarded the "Top 5% of Web Sites" award. Two sites were designed by companies other than the host of the site, the remaining sites were apparently designed by an individual or department within the company that hosted the web site. The Boeing web site was awarded the "Top 10 Winner for Best Corporate Sites." Only the JC Penney web site offers a frequently asked question page.

In addition to looking at the sites, several of the Webmasters of the Fortune 100 web sites were contacted via email, and asked to provide information about the factors involved in planning and designing their web sites. Only one company, Coca-Cola, responded: "The site is designed to be accessible to the maximum number of users, requiring no special, high-bandwidth technology to allow visitors to enjoy its various components." Coca-Cola also stated that they change their site frequently to encourage users to return.

The results of this review indicated that 85 of the Fortune 100 companies had a web site. Over two-thirds of the sites downloaded relatively quickly to the reviewer's computer, while 15% had loading times of one minute or longer. It is interesting to note that only 10% of the respondents to the Users Survey were willing to wait a minute or longer for a site to download. In addition, over 50% of the Fortune 100 sites provided additional navigational methods (i.e., site maps or search engines) while 10% offered no navigational aids.

Image maps were very common within the Fortune 100 sites that were reviewed, as were graphics and backgrounds; and only one Java applet was found. Over two-thirds of the web sites used white as their background choice. A sample of the sites visited were further studied to determine the size of the homepage file in kilo-bytes (K). Of the ten company pages examined for file size, the largest was Mobil Oil (109 K) and the smallest was Citicorp (43 K). By comparison, the new DIS MSRR node design is currently 27 K, which is approximately half the size of the smallest Fortune 100 site reviewed.

Web Browser Review

Web browsers interpret HTML in varying ways. This is due to the version of HTML being supported. Some manufacturers support only the approved HTML standard while others try to support "proposed" standards for future HTML versions. Still others introduce totally new functionality in order to influence users' choice of browsers. To further complicate the problem, functionality is also different based upon the computer platform from which the browser is run (e.g., PC, MAC, UNIX, etc).

Information on web browser use is extremely important as it further defines the web page/site design as well as affects a site administrators ability to maintain web-based information. As can be seen from Table 2 (which presents IST general access statistics for the period 1-14 November 1996), Netscape browsers are by far the most used. The detailed report presented in Appendix ?? shows which specific versions of Netscape are in use, but this high percentage is indicative of the

<u>IST General Access Statistics</u>	
Logged web browser agents accessing www.sc.ist.ucf.edu	
Last updated: Thu Nov 14 16:47:43 1996	
130343 hits measured this run.	
<u>Percent</u>	<u>Browser</u>
86.6%	Mozilla (Netscape)
0.60%	NCSA Mosaic
0.32%	Lynx
0.30%	HTTPConnection
0.27%	Enhanced NCSA Mosaic
0.19%	Microsoft Internet Explorer

Table 2

industry trend.

For maintainability reasons, it is not feasible to provide a separate page for each different browser. An alternate method for handling the problem is to determine one or two browsers to support and "write off" all others. Here, clever design can again assist the developer. From the early web days, the text browser (Lynx) serves as the lowest common denominator across browsers. By designing web pages to provide content for the Lynx browser (a text-based system), content is available to all other browsers by default. Once content is ensured, the developer need only consider the aesthetics to present to the majority of users. Since our statistics over the last three years continue to indicate the absolute dominance of Netscape, that is the default browser for which most web design strategies are targeted. However, given that Microsoft Internet Explorer is free, many government agencies are adopting it as a standard. Luckily, there are few (although significant) differences between the capabilities of these two browsers. When designing web pages, viewing from both of these browsers' current releases will ensure best results. It should be noted that current versions should always be used because supporting older versions limits information delivery options as well as increases support costs.

Graphic Image Experiment

This study focused on whether color images evoke a stronger emotional response and generate greater interest in the subject than monochrome (gray-scale) images, and whether gender is a factor in these responses.

Literature Search

Research into the effects of color in instructional media has determined that color materials are effective as cueing devices, Berry (1991), Schwier and Misanchuk (1995), Steinberg (1991), and others. However, conclusions have in large part been equivocal regarding the application of color to graphics, and generally negative in regard to color photographic images in instructional materials, Josephson (1993), and others. Color effectiveness studies have previously focused on recall, attention, and recognition tasks but have not, for the most part, addressed psycho-cultural factors related to color images in instruction. To make informed decisions about the use of color, the combined effects of physical, cultural, and psychological factors related to the processing and perception of color and images must be understood.

Waltz and Berry (1991) found that realistic color and black and white images require higher levels of processing than non realistic color which is processed in a less analytical, more abstract way. The results of a fifteen year study at the University of Pittsburgh, Berry (1991) supported the use of color as superior to monochrome materials as a cueing device but that non realistic color images interfere with recall by providing irrelevant information.

Cultural perceptions that affect reactions to color were studied by Sexton (1974) who found that attribution of good and bad is related to color. The study revealed that bad is associated with the color black while good is associated with red and white. In a related study Johnson (1994) investigated the relationship between colors and semantic terms. He found that subjects chose a reddish, dark gray when responding to negative words and chose a light gray in response to positive

words. Active words elicited a weak red while passive words elicited a blue gray. He suggested that the study of communication should be centered less on words (verbocentrism) and should give more credence to other symbols particularly those involving color.

In a study of the effects of applied color, Josephson (1993) showed that color positively affected photograph recognition and affects how readers look at a page as well as the scan path order. Although the number and duration of fixations was found to be the same whether color or black and white photographs were used. However, Berry (1991), found that realistic color is superior to black and white in recall tests while all forms of color aid in immediate recognition. Berry also found that after a period of two weeks, non realistic color resulted in significantly higher recognition scores. Recall and mental effort related to photographic images were studied by Gilbert and Schleuder (1990) who found, like Berry, that images with color and more complex elements were easier to remember, while added complexity did not result in more reported mental effort as well.

Color also appears to affect the level of interaction with an image. Nelson (1985) found that monochrome forces the viewer to participate while color allows the viewer to be passive, suggesting that color be used to attract attention and to set the mood. From an instructional design perspective, his research indicates that color images might be most effective in creating an initial positive response, but that deeper interest and involvement would depend more on developing receptive aesthetic skills (visual literacy).

Method

Fifteen photographic images were selected from commercial stock images and a book of photographic history, including landscape, portrait, still life, product, news, and advertising images. The images were grouped according to similarity of subject, lighting, and overall effect, then scanned and scaled to approximately three quarter screen size. 24 bit Color and 8 bit greyscale versions of each image were created and presented on a 15" Macintosh color monitor at default resolution, ensuring the images were of photographic quality.

Test subjects individually evaluated each of five monochrome and five color images respectively which were layered on the screen. Color and greyscale images were of the same group or type (as described above) but were not versions of the same photograph, except for two color versions of monochrome images viewed earlier in each session. This was done to determine if perceptions of the color image were conditioned by first seeing it in monochrome.

Test subjects, comprised of five females and five males ranging in age from 24 to 55 years-old, were selected from volunteers working at a university research institute in a variety of administrative and research support positions, including two staff artists. Of the ten subjects, nine held degrees (one doctorate, two masters and six bachelors) and one had no college degree. To indicate overall visual literacy, subjects were asked if they participated in visually oriented activities such as photography or painting, and whether they attended art shows or the theater, or regularly visited art museums. Two subjects did not participate in any of the activities listed, one attended events but did not participate in visual activities, and seven subjects indicated they participated in visually oriented activities and attended events. Subjects were instructed to categorize each image then answer five

questions related to the emotional impact and interest evoked by each. They were told to complete the study questions based on their first reaction when shown an image.

Subjects were tested individually in an environment that approximated a home or small office study area. Images were changed by the administrator as requested by the subject. The time needed to answer questions for each image was recorded to determine if there was a consistent difference in the time spent viewing the two treatments. Possible responses to questions two through five were no/none (category 1), somewhat/possibly (category 2), or strong/yes (category 3). Question one had four categorizations possible for each image.

Results

The data indicate that color and gray-scale images evoke the same number of none/no emotional responses overall while color generates 14% more somewhat/possible responses. Gender specific responses showed that females are 44% more likely to have a strong emotional response to both color and gray-scale images. Females tended to have stronger responses to gray-scale images than males.

Levels of intellectual stimulation were lower than emotional levels for all images with most responses as somewhat/possibly. Color images, however, evoked 63% more yes/strong responses than gray-scale images among both males and females.

Responses indicating a desire for outside study of the subject based on gray-scale images viewed were twice as likely to be moderate than strong or none, while color images evoked a 76% chance of being pursued for additional studies (moderate and strong responses combined). Females were generally moved to additional study by gray-scale images while males responded more positively to color.

Responses as to whether an image seemed dated showed that 77% of the images were not perceived as dated by either gender. When an image was perceived as dated it was more than twice as likely to be viewed as such by a female respondent rather than a male. Males were more likely to indicate that interest in a subject would be negatively affected by what was perceived as a dated image.

Image classification was generally the same for gray-scale and color by both male and female subjects, with females more likely than males to place an image in more than one category. Classification did not affect other responses of the subjects.

Conclusions

Results of this study indicate that color and monochrome images are equally effective in generating emotion and interest when viewed out of context. That is, when the image is viewed by itself at nearly screen size and is of photographic quality. Female viewers appear to be more likely to experience stronger responses to images and are more likely to initiate action relative to the subject of the color images based on those responses. Males, however, are more likely to pursue additional study of subjects viewed as gray-scale images. There is no indication that how an image is categorized has a significant effect on subjects' responses although female subjects were more likely to place an image in multiple categories.

The responses of the trained artists in the sample indicate that the individual's level of visual literacy affects the level of emotion and interest generated by an image. The artists generally expressed stronger interest in the more abstract, and artistic images and tended to respond more strongly to monochrome images. This is similar to findings by Csikszentmihalyi and Mihaly (1990) that the challenge of an image cannot exceed the visual skills of the viewer if a meaningful interaction is to occur.

This study generally supports previous research that found image color by itself has little effect on viewer involvement. Since non image color has been found to have an effect on scan path, attention, and motivation, further study could focus on the impact of non image color (text, graphic elements, etc.) on responses to image color.

It appears that all elements of an instructional page or screen design, including images, must be studied in the aggregate to determine which applications of color will have the most effect on the learner. Studies based on findings by Sexton (1974) and Johnson (1994) related to relationships of color to good/bad and active/passive feelings could further define the effects of color images in context.

The role of gender as it relates to affective responses to color is not clear. Based on this study, gender seems to be a significant factor in so far as female respondents indicated stronger emotional responses to both color and non color images and were more likely to initiate study of the subject based on these reactions. A larger sample must be studied before these findings can be verified.

Summary

Context is apparently the key to understanding the role of color in instructional design. Non image color by itself has been shown to have significant effects on learners while color images by themselves seem to have limited effects. Further studies should evaluate color versus non color images within the context of the overall page or screen design including all graphic and cueing elements. Perhaps the most significant effect of color images in educational media may be their ability to guide the emotions and not just the eye of the learner.

Major threats to the validity of this study include selection bias (small, non-random sample), expectancy effects (subject), and possible instrumentation inconsistencies. More accurate data could be gathered by using one group of subjects to respond to monochrome images and another for color responses. In so doing, versions of the same image could be used for each group.

V. Study Conclusions

General

While there exists a strong inverse relationship between an ornately designed web page and speed of performance, the trade off does not necessarily have to spell doom. In fact, so many factors make up both "ornate" and "performance" that clever employment can result in highly attractive designs while compromising little to performance. The primary influence on attractiveness seems to be the use of color. Using a simple background or changing colors in a table can result in very profound

contributions to the overall look. Similarly, graphical elements such as logos, bullets, and buttons add much to a design's attractiveness. Even when larger graphics are appropriate, techniques can be employed to reduce the file size from "disastrous" to "highly tolerable." Thus, the need to create multiple versions to suit multiple purposes is generally unnecessary.

Performance

The team's research and experience indicate a relatively recent awareness of this issue by web designers. Apparently, with the huge increase of home access (modem speed implications), businesses are now designing their sites to ensure downloads are as quick as possible. In fact, since the project's inception, some sites have totally reworked their designs to remove large graphics, employing clever use of tables and colors to highlight their material while keeping it attractive to viewers. This is not to say this is the answer, however. Many sites continue to use their large color logos on every page and build major pages using complex graphic imagemaps. But the trend is clear; a "lean and mean" (but still visually appealing) design is on the rise.

Layout

The literature review was inconclusive on this issue. While it has been addressed extensively in Human Factors Engineering discussions concerning computer screen design (particularly related to Microsoft's Windows environment), virtually nothing was found relating to the web experience. However, much was available by observation. Examples of virtually every conceivable location and style was evident during our online reviews. The more pleasing and seemingly effective designs set navigation and reusable choices (e.g., help, feedback) on the left-most side of the screen in an apparent column. This is likely attributable to the method in which HTML is formed and executed (that's the only place it can reside that guarantees it will remain constant).

Supportability

This issue surfaced during the course of review and discussion. Since it is highly related to the purpose of the project, it should be addressed. Using complicated graphics and "loose" relationships cause difficulties more files are used. A few techniques have recently emerged which address this issue. They involve the use of frames and databases.

- Frames. This refers to an extension to the HTML standard to allow "windows within windows" where information in each window differs. Recent browsers appear to support frames similarly so the use of frames is not necessarily limited. However, observation shows very sloppy, ineffective use of this technique. Only after reviewing the site <http://www.antivirus.com> did we see a truly effective implementation. The layout followed the "two-column" approach, but implemented the two columns with frames instead of tables. Immediately, this addresses performance, aesthetics, and supportability. Since the left-most frame remains constant, the common-use and navigation elements need not be re-loaded but are always available. With that design intact and providing the color, the main content window frame can be switched quickly and contain mostly text (a very fast presentation). Since the navigation frame never

changes but is used everywhere, maintenance is greatly simplified.

- Databases. As the web grows, more often a need exists to share organized items of information, not just text paragraphs. Recent products allow existing databases (typically SQL and Microsoft Access) to be directly addressed (read and written) by web interfaces. By employing relational databases, maintainers can minimize the level of effort for updating information. In the DIS MSRR context, a database can be used to store all the resource metadata so that multiple relationships for display are included. Even though an item may appear associated to many paths (taxonomy entries), it needs to exist in the database as a single entry; maintaining this data is now a "snap." This is but the beginning of the utility for linking databases to the web design. Entire graphical elements, multimedia, and text may all be combined and served from a database. The huge labor support costs will shrink while utility and speed of implementation rise.

VI. Study Recommendations

Following are recommendations based on the information collected and associated analyses performed as a result of this study or as result of the concurrent MSRR node development process.

- A standard information taxonomy should be adopted by each node. Information taxonomies are time consuming and difficult to create. No taxonomy makes perfect sense to everyone; therefore, adopting a single taxonomy does not necessarily tax any particular user (especially if alternate methods of locating information are available and simple to use). The additional advantages will not be cited here as they fall outside the project scope (but are available upon request).
- Nodes should employ databases to serve the resource pages thereby reducing maintenance, simplify data sharing, and speed development.
- Standard site design (layout, navigation, options) should be adopted by all nodes to facilitate users' learning about the entire MSRR system, not just a single node.
- Each node should have strong visual identities to avoid confusion. While the entire MSRR should be "seamless," loss of the Information Domain identity could be detrimental to local communities.

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Appendix A - User Surveys

15th DIS Standards Workshop

Part I. Biographical Information

1. Age _____ 2. Gender ___ M ___ F
3. Employment Setting ___ Military ___ DoD Civilian ___ College/University ___ Civilian Contractor
___ Private Corporation ___ Other (specify) _____
4. Occupation Category: ___ Education (teach/research) ___ Engineer ___ Programmer
___ Manager ___ Other (specify) _____

Part II. User Characteristics

5. Do you have an email account? ___ Yes ___ No ___ Don't know
- 6a. Do you have access to the Internet? ___ Yes ___ No
- 6b. If so, where do you have access to the Internet? ___ At home ___ At work ___ Other (Specify) _____
- 6c. Is your organization expecting to upgrade your Internet connection in the next 12 months? ___ Yes ___ No
- 6d. If yes, What type of connection will you upgrade to? ___ Dial-up ___ ISDN ___ T1 or Higher ___ Don't know
7. If you use a modem, what is the speed of your modem? ___ 2400 or less ___ 14.4 ___ 28.8 ___ Don't know
8. Which Internet browser are you currently using? ___ Netscape 2.0 or Higher ___ Mosaic ___ MS Explorer
___ Other (specify) _____
9. What type computer are you currently using? ___ MAC compatible ___ PC x86 compatible ___ PC Pentium
___ Unix ___ Other (Specify) _____
10. How much RAM does your computer have? ___ 8 MB or Lower ___ 16 MB ___ 32 MB or Higher ___ Don't know

Part III. User Preferences

11. On average, over the past 6 months, how often did you use the Internet to search for information?
___ daily ___ several times a week ___ several times a month ___ once a month or less often
12. Have you accessed information from the UCF and/or IST server in the past 12 months? ___ Yes ___ No
13. When conducting an Internet search, on average, how long will you be willing to wait in order to obtain this information?
___ 10 sec. or less ___ 10-15 sec. ___ 15-20 sec. ___ 20-30 sec. ___ 30-60 sec. ___ more than a minute
14. When accessing sites on the Internet, what characteristics do you prefer?
___ Text-only, no graphics (Give me speed in access)
___ Text and graphics (Some multimedia, as long downloading is still quick)
___ High-resolution graphics (Prefer aesthetics over speed)
15. Where would you prefer to have Internet navigation tools/buttons located on your computer screen?
___ Top ___ Left side ___ Right side ___ Bottom ___ Do not use them
16. Would you prefer Java-enhanced web sites? ___ Yes ___ No
17. When accessing sites on the Internet, which do you prefer?
___ A search engine only
___ The capability to browse the entire site, with no search engine
___ Both a search engine and the capability to browse the entire site

Online User Survey

User Interface Survey

Directions: The purpose of this survey is to determine the preferences of Internet users in terms of important webpage/site design characteristics. This survey is designed to be completed in 5 minutes. Please complete the biographical information below, then read and answer each of the survey items. Information from the survey will be combined with other related research findings based on an ongoing study conducted by the User- of Central Florida's Institute for Foundation and Training (UCF-IST) and sponsored by the Defense Modeling and Simulation Office (DMSO). Survey responses will be treated in a confidential manner and only trend information from the surveys will be used.


Part I. Biographical Information.

1. Age:
2. Gender:
 Male
 Female
3. Employment Setting:
 Military DoD Civilian College/University
 Civilian Contractor Private Corporation
 Other (please specify)
4. Occupation Category:
 Education/teacher/researcher Engineer Programmer
 Manager
 Other (please specify)

Part II. User Characteristics

- 5a. What type of computer do you use at your primary Internet access location?
 PC Pentium PC X86 Mac compatible Unix
 Other (please specify)
- 5b. How much RAM does your computer have?
 8 MB 12 MB 16 MB 32 MB Or Higher I don't know
6. What type of network linkage do you currently have for your primary access to the Internet?
 14.4 28.8 56K HDN T1 or Higher Don't Know None
7. Which Internet browser are you currently using?
 Netscape 2.0 or higher Mosaic MSN Internet Explorer
 Other (please specify)
8. On average, how often do you access the Internet to conduct work-related activities?
 Daily Several times a week Several times a month Once a month or less

Part III. User Preference

9. When accessing an Internet (web) page, in what location on the page do you prefer to have that web page's navigation controls?
 Top Along Side Bottom
 Other (please specify)
10. If you had a choice of the following, which would you prefer?
 A well designed web page that uses frames.
 A well designed web page that does not use frames.
11. After selecting a hyperlink, how long will you wait before clicking on the STOP button?
 1-15 sec. 16-30 sec. 31-45 sec. 46-60 sec. more than a minute.
12. When accessing sites on the Internet, what characteristics do you prefer?
 Text only, no graphics (Gifs are speed in access)
 Text and graphics (Some multimedia, as long as downloading is still quick)
 High resolution graphics (prefer aesthetics over speed)
13. With your browser window fully open, what is the largest number on the resolution that you can clearly see, without scrolling the window?
 640x480 Resolution
 800x600 Resolution
 1024x768 Resolution (or greater)
14. Look at the gray image. The colors should range from white to black. Please select the description that fits what you see.
- 
- There are only 4 distinct colors. (16 color depth)
 The colors are dithered and grainy. (256 color depth)
 The colors are smoothly dithered. (at least 22k color depth)

15. In the space below, please provide any additional comments concerning web page design or personal preferences involving what factors you feel are important for maximizing the usefulness of web-based information.

Message Text

Survey

Appendix B - Fortune 100 Web Sites

Name of Company	Ranking	URL
Aetna Life and Casualty	42	http://www2.pcy.mci.net/marketplace/aetna
Allied Signal	72	http://www.allied.com/
American Express	55	http://www.americanexpress.com/
American International Group	26	http://www.aiginc.com/
Ameritech	76	http://www.ameritech.com/
Amoco	21	http://www.amoco.com/
AMR	49	http://www.amrcorp.com/
Anheuser-Busch	85	http://www.budweiser.com/
AT & T	5	http://www.att.com/
Bank America	46	http://www.bankamerica.com/
Bell Atlantic	63	http://www.ba.com/
Bell South	44	http://www.bellsouth.com/
Boeing	29	http://www.boeing.com/
Bristol-Myers	86	http://www.bms.com/
Caterpillar	61	http://www.cat.com/
Chase Manhattan	95	http://www.chase.com/
Chemical Banking Corp.	73	http://www.chembank.com/
Chevron	18	http://www.chevron.com/
Chrysler	11	http://www.chryslercars.com/
Cigna	38	http://www.cigna.com/group/index.html
Citicorp	17	http://www.citicorp.com/
Coca-Cola	48	http://www.cocacola.com/
Columbia/HCA Healthcare	97	http://www.columbia-hca.com/
Compaq Computer	100	http://www.compaq.com/
ConAgra	24	http://www.healthychoice.com
Dayton Hudson	30	http://www.shopping2000.com/shopping2000/fields
Delta Airlines	80	http://www.delta-air.com/index.html
Digital Equipment	65	http://www.digital.com/
Dow Chemical	33	http://www.dow.com/
Dupont	14	http://www.dupont.com/
Eastman Kodak	43	http://www.kodak.com/
Fleming	51	http://www.fleming.com/
Ford Motor	2	http://www.Ford.com/
General Electric	6	http://www.ge.com/
General Motors	1	http://www.gm.com/index.cgi
Goodyear Tire and Rubber	81	http://www.goodyear.com/
GTE	34	http://www.info.gte.com/
Hewlett-Packard	22	http://www.hp.com/
Home Depot	77	http://www.homedepot.com/
Intel	90	http://www.intel.com/
International Business Machines (IBM)	7	http://www.ibm.com/
International Paper	60	http://www.jpaper.com/
ITT	23	http://www.ittinfo.com/
JC Penney	32	http://www.jcpenney.com/
JP Morgan and Co.	87	http://www.jpmorgan.com/

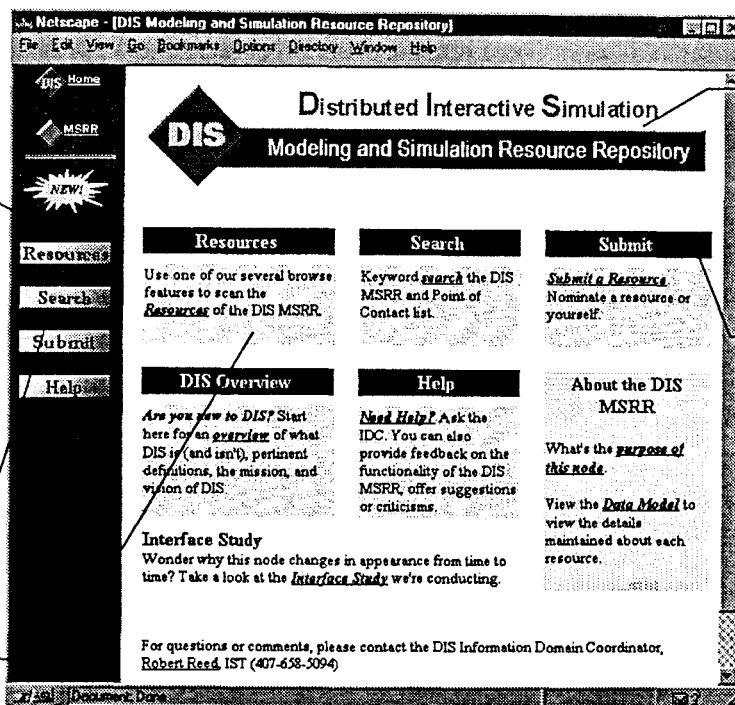
Johnson & Johnson	52	http://www.jnj.com
K-Mart	15	http://www.kmart.com/
Kroger	25	http://www.kroger
Lockheed	70	http://www.lockheed.com/
Loews	64	http://www.bulova.com/
McDonnell Douglas	69	http://www.mdc.com/
MCI Communications	66	http://www.mci.com/
McKesson	78	http://www.mckesson.com/
Merck	59	http://www.merck.com/!!rgGWJ!oTErgGWJ!oTE/
Merrill Lynch	40	http://www.ml.com/
Metropolitan Life Ins.	27	http://www.metlife.com/
Minnesota Mining & Mfg.	58	http://www.3m.com/
Motorola	28	http://www.mot.com/
Mobil	8	http://www.mobil.com/
Nations Bank	71	http://www.nationsbank.com/
Nationwide Insurance Enterprise	96	http://www.nationwide.com/
New York Life Insurance	84	http://www.nylife.com/
NYNEX	67	http://www.nynex.com/
PepsiCo	20	http://www.pizzahut.com/
Price/ Costco	47	http://www.pricecostco.com/
Proctor & Gamble	19	http://www.proctor.del
Prudential Insurance	13	http://www.prudential.com/
RJR Nabisco Holdings	57	http://www.nabisco.com/
Rockwell International	94	http://www.rockwell.com/
Safeway	54	http://www.swy.com/
SBC Communications	89	http://www.sbc.com/
Sears Roebuck	9	http://www.service.com/shopping2000/sears-tools/index.htm
Sprint	75	http://www.sprint.com/
State Farm Group	12	http://www.statefarm.com/
Sysco	99	http://www.sysco.com
Tenneco	68	http://www.teneco.com/
Texaco	16	http://www.texaco.com/
Travelers Inc.	37	http://www.nestegg.iddis.com/smithbarney/
UAL	62	http://www.ualftetr.com/
United Parcel Service	35	http://www.ups.com
United Technologies	31	http://www.utc.com/
US West	91	http://www.uswest.com/
Wal-Mart	4	http://www.wal-mart.com/
Xerox	41	http://www.xerox.com/

Appendix C - DIS MSRR Node Design

Toolbar remains constant as the content side of the screen updates.

Icons are used to enhance the appearance of the page, but are downloaded once due to the use of HTML frames.

Descriptions are provided to help the novice user navigate the site.



Bright, primary colors are used to enhance appearance. File size of graphic was reduced by 70% using various techniques.

Although appearing to be a graphic, the header of each column is really an HTML table cell that uses a background color. Pages are aesthetically pleasing and load fast.

Column headers are also 'clickable' to aid the experienced user's navigation of the site.

Figure C-1. DIS Node Home Page

The DIS MSRR node design has exceeded original expectations. In fact, the design could actually be packaged for use by other MSRR nodes requiring configuration changes only. The package could include the entire interface, graphical elements, and database routines (including registration entry, taxonomy detail, and administrative tools). This could greatly contribute to 1) simplicity of installation and setup, 2) establishing a common "look and feel" while maintaining a unique identity, and 3) facilitating data and information sharing among the nodes to include regular updating of the taxonomy and resource database. The result could be swift implementation of an Information Domain while minimizing both start-up and long-term support costs.

The complexity of the information contained in the DIS MSRR and the breadth of its scope pose unique challenges to the DIS MSRR design; multiple nodes under individual Information Domain Coordinator (IDC) and Node Administrator (NA) control serving a world-wide community of scientists, managers, information users from US military, US government, industry, and academia. Of obvious concern are issues related to information structuring to assist users in locating desired resources, speed of the retrieval process via existing commercial and private networks (performance), and the type and physical layout of user controls. For these reasons, the DIS MSRR node was created dynamically from a database. Conventional web site creation methods (coding hundreds of HTML files), were simply not feasible to collect and display hundreds (even thousands) of resources in a timely manner. The entire DIS MSRR node was generated on-the-fly thus making

updates to the resource database immediately available to the next user making a request. The data model of the DIS MSRR resource database is displayed in Figure C-2.

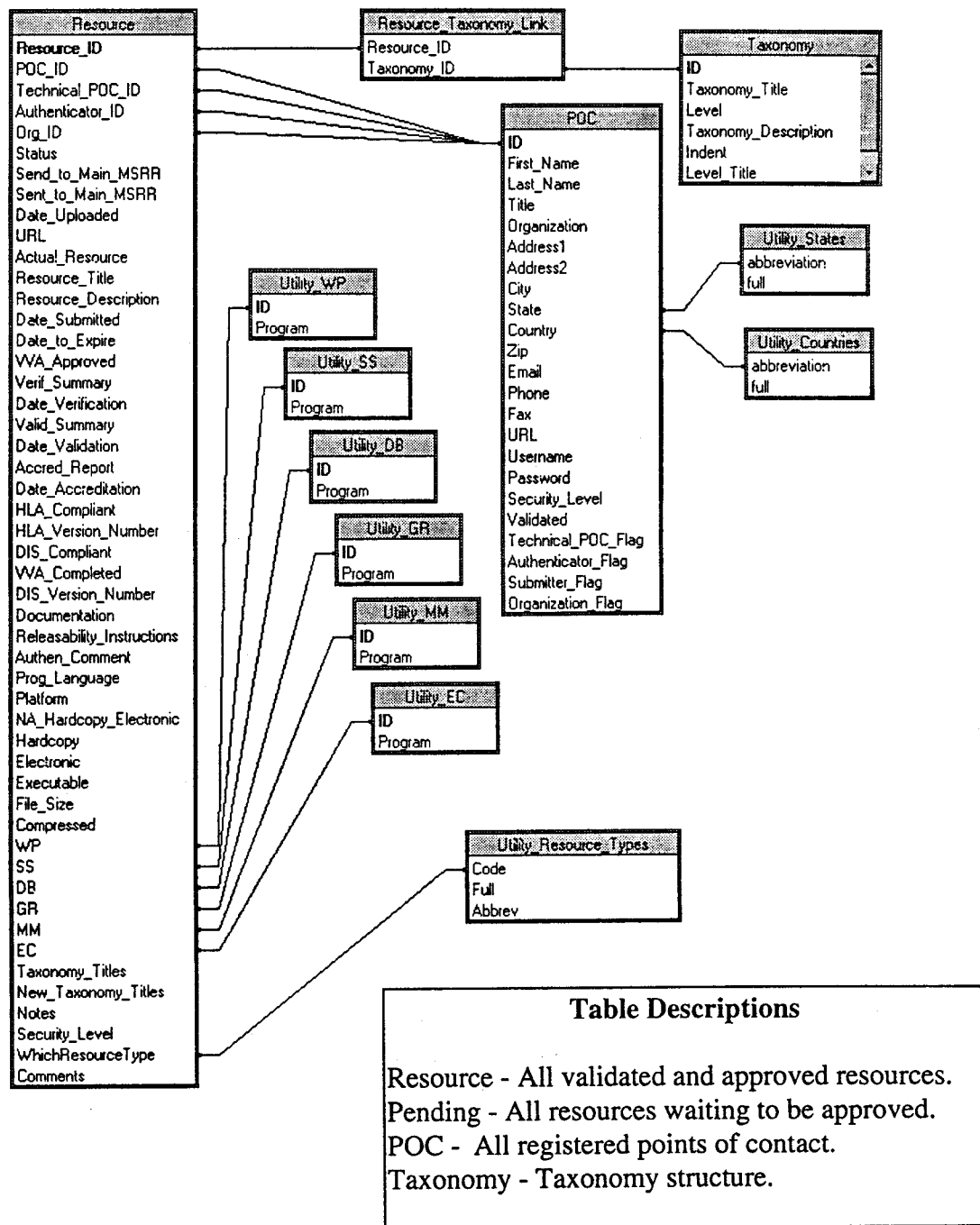


Figure C-2. Data Model of Resource Database

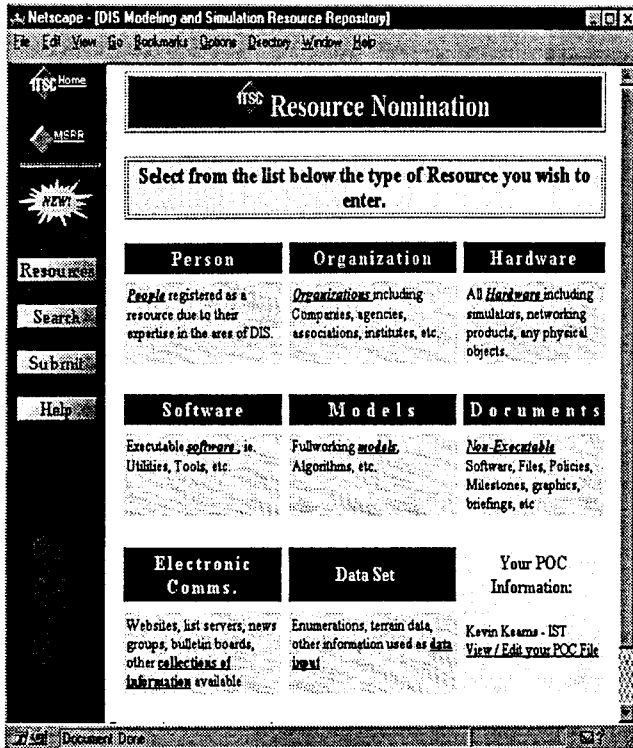


Figure C-3. Resource Nomination Page

To understand the complexity of the data model, the process of submitting a resource must be understood. To start, the person submitting a resource, must register with the MSRR. At the time of registration, name, address, phone, email, etc. are collected and a username and password are given to grant access to classified areas of MSRR nodes or to submit resources.

Assuming the above process has taken place, the submitter logs in to the node and is presented the Resource Nomination page (see Figure C-3). Depending on the type of resource being submitted (person, organization, hardware, software, model, document, electronic communication, etc.) the DIS MSRR dynamically presented an input form with the appropriate questions. Once submitted, the resource was entered into the pending resource table (see Figure C-2) and a predetermined chain of approval process began. The approval chain can

consist of one or more people and even allows for a hierarchy of approval.

Once the resource is approved by the last person in the chain of approval, it is immediately available on the web site. Selecting the 'Resources' button from the toolbar on the left side of the page displays several methods of browsing the DIS resource database. Figures C-4, C-5, C-6, C-7, and C-8 show some of the viewing options available.

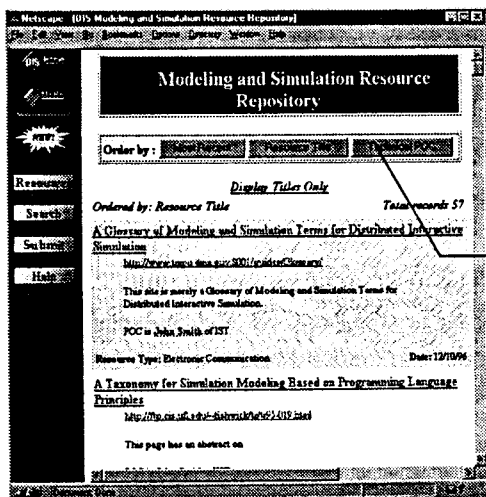
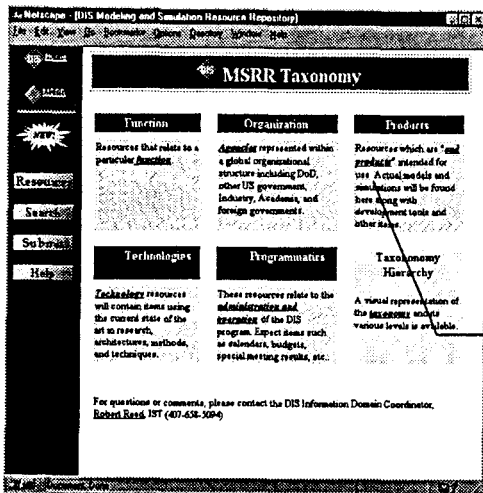


Figure C-4. View All Resources

Resources can be viewed all at once in alphabetical order, by technical point of contact, or in order of submission (most recent).

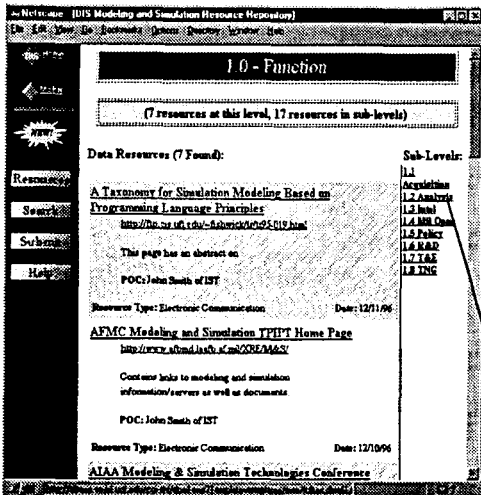
Using the buttons displayed at the top of the page, switching between the various different views is simple and easy to do.



Resources can also be viewed through the 'drill down' method by following a taxonomy. The graphic to the left depicts the top level of the taxonomy - Function, Organization, Products, Technologies, and Programmatic.

Brief descriptions are provided for each of the taxonomy items.

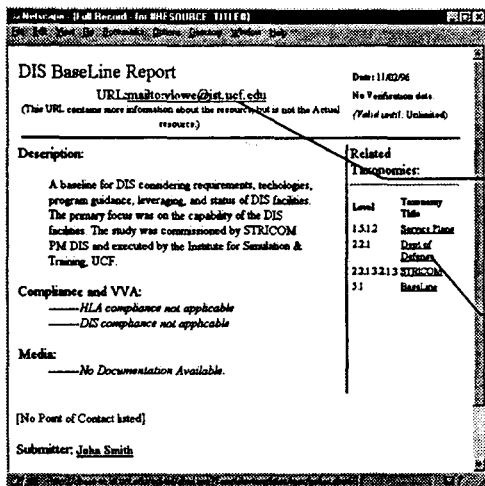
Figure C-5. View Resources - Drill Down



Selecting 'Function' from Figure C-5 above presents the graphic at the left. Any resources associated at this level appear in the middle section with a title and brief description.

Sub-levels of 'Function' are presented on the right to drill down further.

Figure C-6. Drill Down - Function



Selecting the title from Figure C-6 displays all information collected about the resource.

A hypertext link to the resource URL is provided at the top of the page.

The resource may also be associated with other levels in the taxonomy. If so, hypertext links to the other levels appear on the right side of the page.

Figure C-7. Resource

Another method available to view the DIS resource database is the sitemap. Our review of Fortune 100 companies (Appendix D), indicates approximately 20% of the companies use sitemaps as a navigation tool. Due to the complexity of the DIS MSRR taxonomy, a sitemap was also deemed an appropriate tool for navigation. Using a table of contents structure, immediate access is provided to all taxonomy items (albeit in text form) and the count of data items at each break point. Figure C-8 displays the DIS node sitemap.

Sitemaps are also very useful to webmasters and business managers faced with the challenges associated with rapidly growing web sites and changing content. In the process of creating the DIS MSRR, the IST team reviewed several other analysis tools used to facilitate site management and visualize a web site. Two worth noting are:

- **Astra SiteManager** is a visual web site management tool. SiteManager scans your entire web site, highlighting functional areas with URLs and color-coded links. It finds broken links or access problems, identifies key usage patterns, and can even access dynamically generated pages. A comprehensive map of your site is created showing each sub-URL graphically in it's map area with statistics in a separate window/frame. Figure C-9 shows a screen shot of Astra SiteManager. More information about Astra SiteManager can be found at: <http://www.merc-int.com/products/astraguide.html>

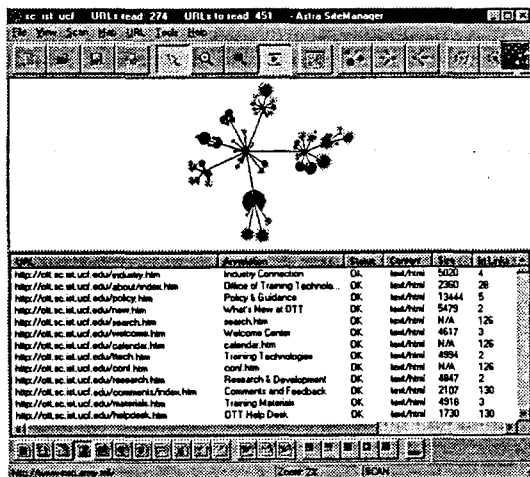


Figure C-9. Astra SiteManager

Sample from the DIS MSRR Sitemap ...

- Function (24)
 - Acquisition (3)
 - Analysis (3)
 - Intel (1)
 - Mil Opns (0)
 - Policy (5)
 - DoD M&S Directives (3)
 - DoD M&S Master Plan (0)
 - CTF (0)
 - Environment (0)
 - Human Behavior (0)
 - Infrastructure (0)
 - Rep of Systems (0)
 - Share Benefits (0)
 - Service Plans (1)
 - R&D (4)
 - CTF (0)
 - T&E (0)
 - TNG (1)

Figure C-8. Sitemap

- **Hit List** is a log analysis tool used to generate reports from web access logs. There are over 250 report options that can be used to construct customized reports including graphs, tables, and text (e.g. Number of Visitors, Request by Day of Week, browser usage, trends, etc.).

Using Hit List's reports, webmasters and marketers can improve their web sites through better management of content and technical resources. More information about Hit List can be found at:

<http://www.marketwave.com/ng/>

DIS Node Characteristics:

As the DIS MSRR node design was worked, the seven characteristics identified below were constantly reviewed. In some cases there was no "evidence" of design change requirement, only experience and common sense (e.g., supportability). As work progressed, some very specific objectives were set in order to address those characteristics:

Simplicity. Each page should be "clean" with graphics used to enhance understanding or functionality. Pages should fit within a single screen where possible. Graphics, colors, and placement should be coordinated to enhance, not detract from essential/important elements.

Simplicity is achieved through the use of Hyper Text Markup Language (HTML) frames. HTML frames, essentially a window within a window, allows a defined section of the page (in this case the left side of the screen where the toolbar is found - see Figure C-1) to remain constant while a separate section is updated. Using this HTML feature, a clean, simple interface is presented. Icons appearing in the toolbar are used to improve the aesthetics of the page, but are small in size and only require downloading once since the toolbar frame remains constant as other web pages are accessed.

To improve navigation of the node, it was felt necessary to provide descriptions for the information categories accessible from the home page. Descriptions enable the novice user, or someone new to the node to determine how best to find the information being sought. Although the descriptions are short, two problems arose: 1) fitting the page within a single screen, and 2) the ability to quickly access all of the categories was hindered for the experienced user because scrolling was necessary. The solution was to use HTML tables. Column headings provided quick links for experienced users and there was still enough room to provide descriptions of each section immediately below the headings for novice users. The final layout, presented in Figure C-1, caters to both the novice and experienced user. This same layout, where appropriate, was carried through the entire site.

Logical placement of elements. Tools expected to be available on subsequent pages are grouped together. Most frequently needed tools placed more prominently.

The first user survey conducted resulted in a set of mixed responses as to the placement of navigation tools. The question was interpreted as referring to the navigation buttons already offered by web browsers, such as back, forward, home, etc. The question was modified for the online survey to reduce misinterpretation and yielded a finding that the majority (79%) preferred a top or side location for navigational tools on a web page. Review of the Fortune 100 companies found similar results. The conclusion was to place the DIS MSRR toolbar on the left side of the page.

Careful thought was given to the utilities that make up the toolbar. As the documentation review of human factors materials suggests in Appendix A, a long list of options does not prove beneficial to end users. The rule of thumb to follow is 7+2 options. The options selected must also be functionally useful. The utilities placed on the DIS node toolbar were chosen because their use could logically be needed at any point during browsing.

The seven utilities provided on the toolbar were:

- 1) Central DIS MSRR link - Access to the Central DIS MSRR is available at any point within the site,
- 2) DIS node home page link - DIS node home page can be returned to at any point within the site,
- 3) What's New - Displays the resources most recently added to the DIS node,
- 4) Resources - Methods of viewing the resources can be reached at any point in the site,
- 5) Search - Searches the DIS node resource database,
- 6) Submit - Submit a resource,
- 7) Help - Sends email to the DIS Node Administrator and IDC,

Performance. Consideration for modem access (14.4k) users is high. While separate versions could be created to serve different users, the first attempt is to find a single solution (see "Supportability"). A trade off between number and size of graphics will be maintained to keep each page below 50k where content and communication permit.

The original goal to create a page whose total byte count was under 50kb was far exceeded with the creation of the DIS node home page. As discussed in the interim report, our first design of the home page resulted in a total byte count of 27kb. Although the first design was still way under the 50kb maximum, we did even better in the final design. Shown in Figure C-1, the final byte count for the DIS node home page is 17kb.

While trying to keep download time to a minimum, a new method for using table background color was discovered. The background color of a table cell was determined to be an effective means of enhancing the appearance of the page without using graphics, thus keeping byte count to a minimum. For example, although appearing to be a graphic, the header of each column on the home page is really an HTML table cell. Each table cell uses a background color and all titles are hypertext to quickly jump to each section. The appearance of a 'button' is achieved without graphics. The page is aesthetically pleasing and loads fast.

Various other techniques such as, reducing the number of colors, locking color combinations and modifying colors were used to reduce the file size of the graphics. A utility named Gif Wizard, by Raspberry Hill Publishing (<http://www.raspberrymill.com/gifwizard.html>), proved useful for shrinking the Gif file size. After applying the techniques mentioned, the header graphic was reduced to only 4kb, a 70% reduction from its original file size.

Appearance. Although pleasing appearance is not a high priority, appearance does contribute to utility, communicability, and perception/image. Therefore, pages will strive to achieve aesthetics while simultaneously being streamlined. Graphical elements must serve a purpose beyond aesthetics where used unless the total byte count of such graphics is less than 5kb or 3 sec download at 14.4.

color monitor and higher. The page layout also follows HTML standards to ensure the same display on the browsers most commonly used. Bright primary colors were used to enhance the appearance of the DIS MSRR web site.

Supportability. All elements and pages go through scrutiny concerning maintainability. Various techniques will be employed to ensure the node will be able to keep pace with new information coming in while balancing labor and support costs.

Placement of the toolbar inside a HTML frame reduces maintenance costs. To understand this statement, the nature of how HTML frames work needs to be understood. HTML frames allow two or more files to be combined into one. In the case of the DIS node design, two files are combined. The toolbar information resides in one HTML file and specific content pages reside in another. As pages are accessed, the toolbar remains constant while the content side of the screen is updated. In this manner, all subsequent content pages take advantage of using the same toolbar, one file. Therefore, when the toolbar requires an update, edits are made to one file, not every file within the site. The use of frames in this instance, reduces maintenance costs.

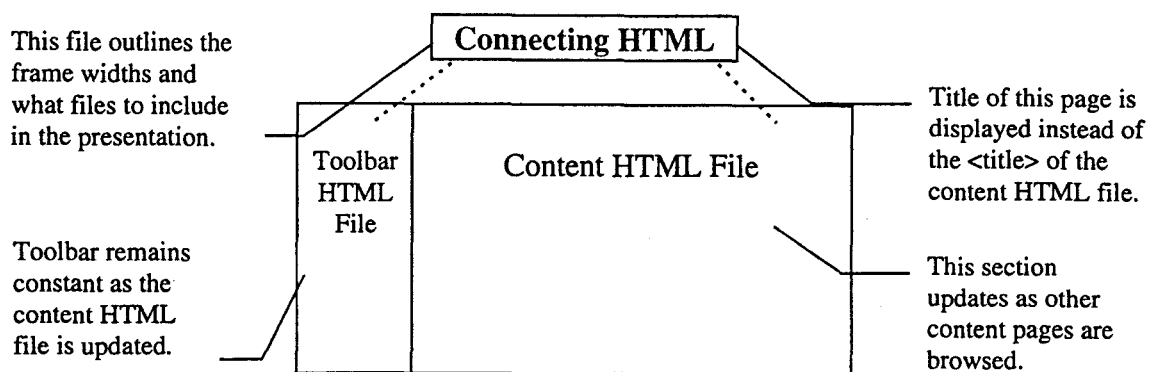


Figure C-10. Frames Explained

There are a few concerns however when using frames that are important to point out. The information displayed within <title> tags does not change as the content page changes. The current frame standard causes the connecting file's (see Figure C-10) <title> information to display as the title of the presented page. The problem with this is that the title bar never changes when the content side of the screen is updated, if the same connecting file is used. Because the title never changes, bookmarking a specific page is difficult. The bookmark repeats the same title for every page bookmarked. As of yet, the only way around this problem is to create a series of different 'connector files' between the toolbar file and every content page. The DIS node's use of frames is still thought to be a clean and extremely functional method of presenting information, but further investigation is needed to solve the problems mentioned.

