User Centered Design Strategy for the Design of Visual Data Displays

by

Paul Thomas Possien

A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Industrial Design

Auburn, Alabama
December 13, 2010

Keywords: data display, interface design, industrial design

Copyright 2010 by Paul Thomas Possien

Approved by

Bret H. Smith, Chair, Professor of Industrial Design
Chris Arnold, Professor of Industrial Design
Rich Britnell, Professor of Industrial Design

Abstract

In the last thirty years digital technology has revolutionized the way that we interact with products. Most digital products, such as phones, GPS devices, digital music players, and digital video and still cameras, make use of data display systems as the primary method of navigating and controlling the product's functions. While many of these product categories didn't even exist thirty years ago, they are all using data display principles that were created in the 1980s. These principles of ergonomics and display from the 1980s have little or no relevance to many of the crucial design decisions required for products in production today. The outdated and limited human factors approach of the 1980s, while still useful in determining many qualities of form interaction and use, is woefully inadequate to address the many user interaction needs that have come about as a result of interactive data screens that control a wide variety of complex tasks and information in many of today's products. With the advent of website computer languages such as HTML, millions of users, many with little or no formal training, have been able to develop websites for the World Wide Web. These webpages are data display systems. In fact, of all of the data display systems mentioned so far, this type of data display system is the most complex and complicated. Many "self taught" web developers and more

than a few design professionals obtain most of their information from a combination of books and online resources like blogs and user groups. The problem is that this type of information rarely discusses design principles that are critical to the effective design of data display systems. As a result, the web is riddled with data display systems that are extremely ineffective in meeting user needs.

Acknowledgements

To my parents, family, and friends, thank you for your continued support over these many years and for always expecting the best out of me. To my beautiful loving wife Adrienne, thank you for always being there for me and encouraging me along the way. Most importantly, thank you God for your provisions and blessings all throughout my life. Bret H. Smith, I am forever grateful for your help, advice, time, and direction throughout this long process. You gave me a chance at the very beginning to do something that no one else has. Your efforts in investing in me are the reason that I have been able to get through in a timely manner. To Chris Arnold and Rich Britnell, thank you for your time, advice, and direction.

Table of Contents

List of Figures

1. Introduction to Problem

1.1 Problem Statement

On August 6th, 1991, Tim Berners Lee formally introduced the world wide web to the world (Arthur 2010). Since then, the web has exploded with an estimated 1 trillion websites as of January 1st, 2010. Each of these sites connect the user to information using a visual interface (screen), making the internet the visual interface providing the most complex and diverse product experience on the planet. It would reasonable to assume that lessons learned from the web would be transferred down the electronic food chain to phones, cameras, GPS devices, palm pilots, and other devices that use data display systems. Unfortunately this is not the case. In fact, these display systems use guidelines that were developed in the 1980's based, primarily, on the needs of airplane cockpit displays. While some of the information from these studies is useful, much of the information is irrelevant in the context of data display systems.

This thesis will offer a set of guidelines that will address potential problems of data display systems here and provide "design based" solutions. These guidelines will cover aesthetics, navigation, logical display, industry standards and branding.

1.2 Need for Study

After a review of the most prominent sources for ergonomics, including Dryfuss' *The measure of man and woman'* and Salvendy's *Handbook of human factors and ergonomics,* as well as Pheasant's *Body space,* Sanders and McCormick's *Human factors handbook* and Grandjean's *Fitting the task to the man, 4th edition,* as well as numerous other articles and texts, it became obvious that there was a gap in human factors recommendations. None of these sources provide guidelines for the design of displays that take into account the interactive nature of information and need to match the display design with user interactions as well as technical requirements. In addition to this, none of the sources listed above take into account the latest cognitive research regarding the importance of aesthetics in guiding user interactions with product and controls.

In fact, a search of the literature reveals that the recommendations that are available for displays are based upon a study conducted in the early 1980s, despite the fact that the devices that use visual interfaces today, such as cell phones, cameras and GPS devices, have little in common with the devices that were the subject of the studies in the 1980s.

The failure of research and human factors texts to keep up with changing user needs brought about by advances in technology is most obvious in the area of interactive website design. The internet allows users to access a wide variety of information, from text to graphics to audio and video, each of which must be organized and grouped in ways that make it possible for the user to locate the

desired information easily and accurately. Layouts, navigation, colors, fonts, and so forth. all have the ability to help users navigate through internet sites—yet none of these elements are effectively addressed in the existing recommendations. Moreover, when used incorrectly, these elements can make user interaction more difficult. One need not go far to see how poor use of these elements makes sites difficult to navigate. Within fifteen or twenty minutes of searching the internet one can encounter dozens of sites where the layout, graphics, fonts, color and other visual choices actually make information more difficult to find. Numerous do-it-yourself books give users tutorials and tips on how to create a website, but rarely do any of them offer advice on the visual design or the creation of effective user navigation systems. The absence of this type of information, along with the lack of clear examples of the difficulties created when these elements are not taken into consideration, clearly indicates the need for user-centered guidelines that address the design of websites that provide effective user interaction and are aesthetically pleasing. This is the focus of this study.

1.3 Definition of Terms

These are typical terms used in data display systems and design that need clarification:

Adobe Dreamweaver – a web development application for use in creating HTML websites.

Aesthetics – the study of the mind and emotions in relation to the sense of beauty.

Content Specialist – a group of specialists that supervise the validity of entering information.

Control Stereotyping – when experience engraves a corresponding pattern on the brain. For example, even when steering an unfamiliar motor car, it is to be expected that turning the steering wheel clockwise will turn the wheels to the right (1997 Grandjean).

Contributors – users that provide content for an internet site.

CMS (content management system) – a program used to manage workflow in a collaborative environment.

CSS (cascading style sheet) - a style sheet language that allows global control of the look and layout of a document and is written in a markup language. Its most common application is to style web pages written in HTML.

Drupal – a free and open source content management system written in PHP.

Dynamic Website– a type of web page that has been prepared with fresh information using a database to power the new information. This type of website makes use of forms that collect and display content when a selection is made instead of displaying static, preformed pages.

Ergonomics – the science of understanding human interaction.

End Users – the users that are in need of service.

File versioning – the ability to track individual file changes, what the exact changes were, when they were made, and who made them. These are standard features of any CMS.

Flash - a multimedia platform used to add animation, video, and interactions to Web pages.

HTML (Hyper Text Markup Language) – a fundamental computer programming language use in website production.

Hypermedia – a term used to describe web-based media that makes connections between terms and references.

Interface - a point of interaction between two systems.

Java - implemented as part of a web browser in order to provide enhanced user interfaces and dynamic websites.

Navigation - refers to users' searching for information in a purposeful way by using a controls found on a visual display system.

Node – a unit of content, in a CMS.

PHP (PHP Hypertext Protocol) – a general-purpose scripting language that was originally designed for web development to produce dynamic web pages.

Static - a type of web page that is delivered to the user as a series of discrete screens or pages.

Site map- a list of pages of a web site accessible to users.

Taxonomy – The description, identification, naming, and classification of data. This is the main method of creating hypermedia connections in a CMS.

Template – a predetermined layout used to maintain consistency and control.

The Getty – a university based in Los Angeles, CA, that used a CMS to fix its website problems.

User Interface – the point(s) of interaction between a user and a device or system.

User Roles - definition of what information each user can view or edit.

Webmaster – the administrator responsible for maintaining a website.

1.4 Assumptions

For this thesis, books, periodicals, and online articles will be used as a reference to information. It is assumed that the information given by these sources are accurate and based on factual information. In addition, the authors cited from these sources are assumed to be credible and knowledgeable in their respective fields.

The author of this thesis comes from a design background and is knowledgeable in the field of design, form, and problem solving, CMS, and the creation and structure of web display systems. His purpose in researching this area is to develop meaningful standards based on user considerations and technical requirements for interface display systems The goal of the study is to create Industrial Design guidelines to guide interface designers in creating more engaging, dynamic, “user centered”, display systems.

1.5 Scope and Limits

This research study will focus on interface design principles with an emphasis on web-based interfaces. The example created for this study will use the CMS Drupal for the web. The information and principles learned from the web interface will be applied to all display systems.

1.6 Anticipated Outcome

The predicted outcome from this study is a series of guidelines for industrial designers and interface designers that will allow them to create interactive visual displays that engage the user and deliver an informative and pleasant experience for the end user.

1.7 Literature Review

1.7.1 Hypermedia

Hypermedia is a term used to describe web-based media that makes connections between terms and references. For example, a picture of a green apple might connect to Apple Inc., and a connection from that connection might be to the stock values of the company or to its various logos, or it might connect to Apple records and from there to the Beatles. The fact that all these connections, or paths, are possible does not necessarily make them advisable. Stuart Malin, the chief systems and information development officer at Jay Doblin & Associates in Chicago, claims that someone could create a working software program that would permit you to pursue all the associative routes described above, as well as thousands of others. Indeed, it would be easy, less than two days effort. But the end result would be at best an amusing novelty, and at worst a human factors disaster (Malin 1989). In its purest form, hypermedia does not distinguish between major and minor connections without the application of design wisdom. The hapless end user can quickly be buried in enormous amounts of irrelevant imagery and useless information. All one needs to do to prove this is to conduct an internet search of a term like “crystal” to see how unfiltered associations can rapidly obscure rather than illuminate information (about 226,000,000 hits as of 12:36 central time, 2010). This illustrates the danger of using hypermedia without design. Just because a connection or reference can be made does not mean that it needs to be made.

The late 1980s and early 1990s saw the introduction of a series of "stand alone" games and interactive experiences all making use of hypermedia as the method of connecting the various pieces of data. In the 1990s hypermedia principles were extended to the internet in the form of an authoring language that allowed information on the internet to include pictures, text, and links. The language that made this possible is "Hyper Text Markup Language" or HTML. Since then the web has exploded with an estimated 1 trillion websites as of January 1st 2010. The biggest drawback of HTML is that it does not gather or compile information; it simply provides a visual interface for information and connections. Despite this limitation, HTML allows users to create engaging sites that use video, flash, java, and so forth. all with relatively few commands- (Fleishman 1995).

HTML is constructed from a series of short codes typed into a text-file by the site author. These codes are called tags. An example of a tag is Design . The word "Design" would be displayed centered on the page. The text is then saved as an html file, and viewed through a client, also known as a browser, like Internet Explorer or Firefox. This browser reads the file and translates the text commands into a visible form. These HTML files can be created using anything from a rudimentary text-editor like Notepad to a powerful graphical editor like Adobe Dreamweaver.

1.7.2 Static and Dynamic Websites

Websites can be divided into two basic types: static websites and dynamic websites. In a static website, pages are created one at a time with the images, text, layout and code created and placed on each of the individual pages. This means that every page must be constructed and edited independently. Each page is individually saved on the server just as it will appear when viewed on the internet. Because each page is created separately, any changes to it must also be made separately, whether the changes are in graphics, text, or code. This limits the sites ability to be updated. If, for example, the site designer creates a large website and later needs to change an item that is shown on each page, such as a logo or an icon, the webmaster must change the logo or icon on every single page of the website one page at a time. If the webmaster misses a page, the missed page will display the old logo. The more pages and the more changes required, the more likely that some changes will be missed and that the website will lose its uniform appearance.

In an effort to address this limitation, Cascading Style Sheet files, more commonly called CSS files, extend the power of HTML files by allowing some site decisions to be applied globally. A CSS file can control fonts, colors, and dimensions. If every page is linked to the CSS file, then revisions of the style sheet will make corresponding global changes to the colors, images, and fonts of the site. However, the CSS file cannot alter the information content in the HTML

file. For example, a CSS file cannot remove a paragraph of content from a page because the paragraph is HTML content.

When java script, CSS files, and PHP snippets of code control a page, the page is commonly referred to as Dynamic HTML or DHTML. The term DHTML is somewhat misleading. For example, while a page may have a piece of code that enables a dynamic real-time calendar, the core content of the site remains static; the core content must still be updated one page at a time.

HTML and DHTML sites are frequently created using authoring tools such as Adobe Dreamweaver. Dreamweaver and other web authoring programs make it possible to hide the HTML code details of page from the site creator. These types of authoring tools allow site designers to create web pages and sites without having to know HTML commands. These types of programs also make it possible to incorporate DHTML into a webpage much more easily than with a standard text editor. Unfortunately, the software creates extra code to accommodate for those who do not know how to use code. The redundant or unnecessary code results in extra load time and often increases errors when the pages are later edited or updated. As a result, these pages often load and operate more slowly than sites that do not contain redundant code.

In a true dynamic website, a page does not exist as an individual and complete page on the server. The server in real time pulls together the content and constructs the pages according to a predetermined framework established by the webmaster as the user clicks on a selection (VanDyke, 2008). A dynamic

website also allows changes to be made globally. If a link needs to be reworded, the correction can be implemented across the site by making the change in the appropriate location of the formatting framework. For example, one can change the word “Home” to “Front” on every single page with one change to the framework. As a result, corrections to text-based selections are easy to make globally within the site.

One might ask, with the benefits of a dynamic website compared to a static website, why would anyone choose to create a static website? The most common answer to this question is that the learning curve for creating a dynamic website is substantially longer than that of a static website, and the program complexity can impede the uninformed designer. While static websites require more time and attention for corrections, they are still an extremely useful method of constructing websites that are small in scale or that do not require frequent updating.

Both HTML and DHTML driven sites are relatively easy to create and make attractive. The layout, theme, and overall appearance of the site can all be controlled with HTML. However, its strength does not lie in stocking content. Typically, the webmaster is the only one that has the ability to add, change, and delete any kind of content. Thus the webmaster becomes the gatekeeper of content, corrections, and structural changes. Because new content and corrections are inputted by a single person, a bottleneck is created. As a result,

the content of the website can only grow as fast as the webmaster can format, test, and upload to the server.

1.7.3 Content Management Systems

In contrast, dynamic systems have the ability to greatly reduce or eliminate bottlenecks. The largest class of programs for creating dynamic websites is a Content Management System (CMS). A CMS program is a collection of program procedures used to manage workflow in a collaborative environment. The CMS controls information and directs it in specific tasks. The origins of the first widely used computer database management program can be traced to “Lotus 1-2-3”, released in 1983 by Lotus Software. It turned the company into the largest independent software vendor in the world almost overnight. The program allowed users to store, load, and access specific pieces of information within a standard structure using easily understood programming and a consistent command structure. This program allowed data that was added or changed to be immediately accessible through queries or searches. The basic operational principles used to create Lotus 1-2-3 have been applied to the Internet in the form of CMS.

One of the goals of this investigation is to create a list of guidelines to help industrial designers design more efficient, effective and user-friendly interfaces for electronic products. The internet was chosen as the most logical test site because it offers an operating environment that is more complex and therefore will provide the most rigorous testing environment for these guidelines.

Handheld devices use older versions of internet technology. Most phones that use programs constructed with flash are using Flash Mobile which is actually Flash 5—a program that is over seven years old. “Hand held” products like phones, GPS devices or MP3 players simply do not have the memory or processing power of a laptop or desktop computer. User interactions with internet sites by personal computers, whether laptop, netbook, or desktop, offer the most complex environment, the most information complexity, and the most divergence in platforms.

Once the internet was chosen as the best place to test the guidelines for designing interactive environments, the next decision was whether to conduct that test with static or dynamic websites. Dynamics websites were chosen because they offer several benefits when examining user interfaces. As mentioned earlier, the benefits of using a CMS are it allows for a large number of people to contribute to and share stored data, and it controls access to data based on user roles. For example a content provider is allowed sufficient access to update and edit content, but is not allowed to make structural or stylistic changes to the website. This makes CMS programs extremely useful for anyone who has content that needs to be controlled for specific purposes. When properly implemented, CMS programs allow a large number of people to contribute to and share stored data. The administrator controls access to data based on what are referred to as user roles. It is important to remember that the term “user roles” encompasses not only end users but contributors to the

website as well. User roles define what information each user can view, post, or edit.

CMS programs have a vast number of features that empower the site architect to collect and control content that can then be made accessible to site users. Unfortunately, many sites constructed with CMS have turned into "content warehouses" because the site has often been constructed only with collection of information in mind and with little thought or attention given to creating an interface that allows users to easily understand and navigate the site. To return to an earlier point, collection does not guarantee effective selection, presentation, or navigation. Typically, a CMS comes preset with a few themes. A CMS's biggest limitation is the complexity involved in altering its appearance and function. As a result, most CMS sites often do not stray far from the basic theme, giving them the same look as other CMS sites, with little or no consideration given to end users, information design, branding, or aesthetics.

There are many powerful CMS sites that have become cornerstones in America's culture. Steve Bailey, the senior advisor on record management issues for infoNet states, "You don't need to be an IT professional to have noticed the rapid rise of a new breed of web applications and services over the past couple of years. Names such as YouTube, Facebook, and Wikipedia have seemingly appeared from nowhere to become part of the cultural mainstream almost overnight. These are all dynamic CMS websites" (Bailey, 2008). It is important to note that while Wikipedia is a content management site, the content is managed

by anonymous users. This almost completely defeats the purpose in having a CMS site because the content is not consistently or reliably controlled by an editorial board or group. Without an editorial board or group responsible for verification and standards, the tremendous power a CMS can be undermined by the presence of questionable or unverified data.

1.7.4 The Getty Example

A great example of a site that has effectively harnessed the power of can be taken from The Getty, in Los Angeles, CA. The Getty contains six separate departments: Museum, Research Institute, Trust Administration, Grant Program, and Leadership Institute. Every program contributed web content to the main campus website ranging from artwork, artist biographies, streaming video, exhibitions, and research to a parking reservation system. Each department's site was different in its layout, colors, and aesthetical appearance. As a result, there was no consistent design that told the viewer that the sites came from the same institution. In an attempt to solve this, The Getty decided to implement a CMS into the site to provide quality control and visual and operational consistency. Each department could continue to contribute content to their department site without worrying about staying within the parameters of the overall website because of the CMS (Honeysett, 2004).

The Getty site has a submission interface that appears "code free" to the content creators; thus they need not understand programming or formatting in order to submit content. Also, the site maintains file versioning, which is the

ability to track individual file changes, what the exact changes were, when they were made, and who made them. These are standard features of any CMS.

This separation of formatting and content is made possible by what CMS site authors call "templating." Templating establishes regions for content placement. These regions are the areas on the page that allow content. The content can be anything from a block of text to an image or a video. This allows the separation of content from design. Templating generates the HTML code and guarantees consistent visual design. It allows Web pages to be generated by contributors that do not know how to program HTML. The Getty museum collection subsites consisted of approximately 18,000 pages. Analysis of the design and layout indicated that they would be able to greatly simplify their website process. Honeysett, the project leader for the Getty site redesign summarized their findings this way: "We could probably serve this [content] with fewer than five templates, possibly even one." (Honeysett, 2004).

1.7.5 Taxonomy

Another important tool in CMS is taxonomy. Taxonomy is the description, identification, naming, and classification of data. Taxonomy terms, also called "vocabulary," are used in CMS to organize content. The vocabulary indentifies attributes that will be tagged as "objects" (anything from images to videos or text) that are submitted to the database. The vocabulary is then used to sort and place objects according to their terms. With only a few vocabulary words attributed to each piece of content, the CMS can make associations to other

content. For example if the words “pop” and “jazz” have a connection with the vocabulary term “music”, they would always be presented anytime a reference to “music” was made. Obviously, care needs to be exercised in selecting the vocabulary so that relevant connections are made.

The CMS Drupal was chosen for this thesis because of its efficiency, speed, and consumer support. Drupal is a highly modular, open source CMS framework with an emphasis on collaboration. Drupal users are continually generating new modules and applications. The new modules and applications are periodically reviewed by an editorial board. As the board identifies innovative and useful code, it is added to subsequent releases of the program. Drupal comes with basic core functionality and additional functionality is gained by enabling built-in or third party modules. Drupal is designed to be customized, but customization is done by overriding the core settings or by adding module(s), not by modifying the code in the core (2008, VanDyk).

1.7.6 ATM Layouts: Attractive Designs Work Better

While Drupal continues to succeed in effectively managing content, its ability to become attractive lies solely in the designer’s hands. Since the early days of the industrial design profession, designers have argued that attractive things work better. Attractive things should certainly be preferred over ugly ones, but would they actually work better? In the early 1990s, two Japanese researchers addressed this question by performing an experiment using ATM machines with Japanese subjects. All versions of the ATMs were identical in

function, the number of buttons, and how they operated, but some had the buttons and screens arranged attractively, while others had buttons and screens that were arranged unattractively. The Japanese researchers found that the attractive ATMs were perceived to be easier to use. This experiment was conducted again with Israeli subjects and produced the same result (Norman, 2004). The researchers concluded that emotions change the way the human mind solves problems, and that the emotional system changes how the cognitive system operates. These conclusions were summarized by Norman, cognitive psychologist in the following way: "Aesthetics change our emotional state and help the mind solve problems" (Norman, 2004). Thus, pleasing aesthetics are crucial to any user interface design. Visually appealing layouts help the user navigate the site more efficiently and effectively. The "cookie cutter" appearance and operation of most CMS sites render the site stale and confusing and severely compromise the usability of the site.

Despite all of the management abilities of a CMS such as Drupal, still does not solve the most basic and fundamental problem: Does the page communicate effectively and can the user find what he or she is looking for? In that sense, designing for the web has much in common with other "industrial designed" objects. The user must have effective and attractive controls and cues to interact and navigate the space. The designer must create an environment for the user, while simultaneously training him or her how to navigate and effectively use the site. Lastly, the designer must meet user expectations through consistent design and effective use of design elements (Fleishman, 1995) Although Fleishman

correctly identified this need fifteen years ago, he did not provide a set of guidelines for acting on this observation. The goal of this thesis is to establish a viable and effective methodology to guide industrial designers in creating attractive, engaging, interactive methods for the design of websites and other interactive screen-based user interfaces.

1.7.7 Hypermedia Navigation

Research into the effectiveness of hypermedia design is still in its youth. As a result, there are no convenient, foolproof rules to guide hypermedia designers. This thesis examines the central issues of hypermedia navigation and offers a methodology for resolving hypermedia navigation issues. In the past, the word *navigation* has always referred to charting a course of travel for ships or planes;when it is applied to hypermedia applications, it takes on an entirely different meaning. In the context of hypermedia, navigation refers to the movement within a potentially complex database of links and nodes rather than physical movement.

In the early 90's, Gygi and McAleese made a distinction between browsing and navigation. They explained that browsing refers to users discovering information by moving through an entire database in an unconstrained, possibly random manner. Navigation refers to users' searching for information in a purposeful way in areas of the database where they can reasonably expect to find what they want to know. Navigation has been broken down into five categories for user navigation (Canter, Rivers, & Storrs, 1985). First, *scanning*

means to cover a large area without much depth. The term *browsing* is used to describe the act of following any path until an area of interest appears. S*earching* is used to describe the act of looking through site to find a specific target. *Exploring* is used to describe the act of finding out the extent and nature of the database. Finally, *wandering* signifies purposeless and erratic travel.

1.7.7.1 Hypermedia Navigation: Lost

Picher, Berk, Devlin, and Pugh (1991) argued that getting lost in hypermedia application is more likely than getting lost in hypertext documents because the rules for navigating through nodes containing video, pictures, and sound are more complicated than navigating through text alone. For this reason Shneiderman and Kearsley (1989) concluded that there are two ways to be lost in hyperspace. The first is not being able to find the desired information and the second is becoming disoriented. Furthermore, Edwards and Hardman (1989) developed three conditions where a user is considered "lost": not knowing where to go next, knowing where to go next but not know how to get there, and not knowing where they are in the overall structure of the document. Shneiderman and Kearsley (1989) claimed that being able to retrace steps and return to previous screens is important to reduce disorientation. There is a method of being able to retrace steps taken in a document through the use of what is known as "breadcrumbs". These breadcrumbs display the location of the page within the hierarchy that it was created in. An example of this could be world/unitedstates/georgia/atlanta. This is a form of way-finding that has

become essential in large sites. Kappe, Maurer, and Sherbakov (1993) stated that since typical solutions that work well on small systems fail completely when applied to large systems, navigation must be extended by adding hierarchical organization of related material.

If someone were to pick up a book, one would be able to flip to the table of contents and understand the hierarchal structure of the book as well as its content. Looking at hypermedia, it is not always apparent what information is available, how it is structured, and where the user is now. For hypermedia applications, Schnediderman and Kearsley (1989) advised that a hierarchal view of structure and content be displayed by means of a dedicated area of the screen. This helps the users get a greater sense of the information landscape.

1.7.7.1 Hypermedia Navigation: Outdated Guidelines

At present, there are very few rules to guide hypermedia designers. As a result, the design of hypermedia applications is an art and likely will remain so until rules have become established. However, there are Federal Aviation Administration guidelines established for data display systems for airplane cockpits. After reviewing these guidelines, there are some strong connections than can be implemented into hypermedia navigation systems.

Woodson,Tillman, and Tillman (1992) present the following "General Guidelines for the Selection and Design of Visual Displays in their *Human Factors Design Handbook.* First, use the simplest display concept available with the information needs of the operator or observer. In short, the more complicated

the display, the more time it takes to read and understand the information provided by the display. A cornerstone in applied ergonomics is the KISS (Keep it Simple, Stupid) principle. Second, use the least precise display format needed to present the information actually required. For example, if man was able to run a mile in 6.75 minutes, the information should be expressed as 6 minutes 45 seconds. Requiring information to be more precise than necessary only decreases a user's ability to understand the information presented. Third, use the most natural or expected display format applicable to the content being shown. The format should be familiar to the user and related to the tasks performed. Unfamiliar formats require additional time to become familiar with and often lead to errors in interpretation.

In *Designing the User Interface*, Shneiderman bases his display guidelines on an earlier work by Smith and Mosier (1984). Consistency of data displays is a principle that is frequently violated by websites, but is essential for navigation. This principle should be incorporated at the very start of the design process. The formatting should be standardized and controlled.

After reviewing Wiley and Sons *Handbook of Human Factors and Ergonomics*, one of the industry's leading sources for human factors data and recommendations it becomes immediately apparent that there is not only a shortage of relevant information with respect to the human factors of displays, but the information that is offered is riddled with jargon and overly complex

words that leave the reader puzzled and confused. The following example is case in point:

> Each relevant process variable should be represented by a distinct element within the display. If precise information about this variable is desirable, a reference scale or supplemental digital information should be provided.
>
> The display elements should be organized so that the emergent properties (symmetries, closure, parallelism) that arise from their interaction correspond to higher-order constraints within the process. Thus, when process constraints are broken (i.e., a fault occurs), the corresponding geometric constraints are also broken.
>
> The symmetries within the display should be nested (from global to local) in a way that reflects the hierarchical structure of the process. High-order process constraints (e.g., at the level of functional purpose or abstract function) should be reflected in global display symmetries; lower-order process constraints (e.g., functional organization) should be reflected in local display symmetries (2006 Wiley).

These recommendations are so abstract and so removed from the task of visual display interface design as to be nearly unusable.

2. Development

2.1 Early Development

Creating a "html based" history website led to the development of this research project. The preliminary site structure, content, layout, navigation, and aesthetical elements were reviewed by an advisory panel, and then a prototype site was created using the web-editing program Adobe Dreamweaver. This first test site became the frame work for identifying design and display problems and solutions. The site consisted of over 250 pages, including biographies, product stories, related articles, firm information, and weekly specials.

2.2 Layout

The original layout of the test website consisted of a header, three middle content columns, and a footer (see Figure A below). The header was used for capturing the viewer's attention using a combination of interesting images and current information. It served as a framework for weekly specials and images that would complement each page. It also provided the navigation system that operated the entire site. The middle columns displayed information relative to the active page. The left column was used to display images and graphics associated with the active content. The middle and largest column was used to display the body of the page through text. The right column was used for related articles, stories, and list information.

2.3 Page Development

Figure A shows the display of the test site. Each page informs the user of his location through text and graphical cues. This became an important principle throughout the site to ensure that the user would not become lost or confused. Informing the user of his location was achieved by colorizing the tabs and text throughout the page that was active by the user.

2.4 Structure

The site structure was divided into three major areas: Stories, Resources and Contribute. Each of these areas had secondary navigation that allowed the user to explore the subheadings. Stories, for example was divided into Biographies, Products, Firms, Publications, Timelines and Links. Each of these submenus maintained the page layout described in section 2.2.

Figure A – Test Site

2.5 The Bottleneck

It quickly became obvious that information input would be single biggest limitation in the site's ability to grow. As various contributors would gather information for the site, they would submit the information to the webmaster for

input into the website. The webmaster would then need to format and process the information constantly to be able to keep up with the new content created by the contributors. The contributor's ability to input information to the site became limited by the webmaster. At the same time, the webmaster's ability to manage the site was undermined by the time spent on the input of contributors' information. A system had to be put in place where the contributors would have the freedom to post content without a middleman. If this became possible, the site would be free to expand at the rate that contributors were able to post content. A content management system was needed in order to accomplish this.

2.6 Separate Content

The separation of content generation from site organization and display is a critical one. Most webmasters are not content experts and even if they are, forcing them to produce content undermines the development and maintenance of the site. By creating a structure in which the production of new content is not limited by the available time of the webmaster, the site becomes more rapidly populated and the quality of the content increases because it is being produced by content experts.

2.7 Aesthetic Translation

This division of labor makes it possible for the webmaster to focus on creating consistency throughout the site, developing effective and efficient navigation.

3. Design Interface Guidelines

In response to the research and development of this study, a set of design guidelines has been created. Each guideline in this chapter has examples and illustrations for clarification. These guidelines have been assembled into a design interface checklist that can be used as a means to evaluate existing display systems or to aid in the design of new display systems. The guidelines will also be used to evaluate new industrial design history website. As a result, this study will demonstrate that the example is valid and credible for this research project. Examples of other websites will also be included from time to time to show the guidelines in practice. The following pages in this chapter display the guideline italicized at the top of the page with an explanation following.

3.1 Inform Location

The display informs user of current location through text, color, graphics, and other appropriate cues.

A page should clearly identify the user's location at all times. Whenever possible, the location should be conveyed in more than one way, a principle known as redundant cuing. An example of redundant cuing is easily seen in the design of an elevator button. Once the elevator button is pushed, it illuminates, sounds a chime, and provides an active display of current location. Figure 1a shows how this principle may be applied to the design of visual interface displays. The page contains multiple tabs. All tabs are colored the same color with the exception of the active tab. The active tab displays the user's current location. Other cues like the use of italics, underlining, or bold type serve as redundant cues to help reinforce the difference between the active tab and the rest.

Figure 1a demonstrates this principle. *Home* tab communicates that it is active through its use of color. In addition, the location of the page is displayed with the *Stories* tab bolded and highlighted.

Figure 1a – Location

3.2 Engaging Interface

The interface uses colors, text, composition, and interactive elements to establish a visually engaging display.

Creating a display that engaged the user requires that one consider all visual elements available. The use of color will play a sizable role in establishing the aesthetic look and mood as well as the readability. Establishing a color pallet and sticking to it will strengthen the site by creating continuity and making the display more engaging to the user. The composition or layout guides the user as to what needs to be looked at and in what order. The layout establishes a visual priority of the display and should effectively convey the message of the text and graphics to the intended audience in the intended order of priority.

Figure 2a illustrates a layout composed of a visual hierarchy. The body of the page should never be dwarfed by any other focal point. The interactive elements have been placed at the top of the page in this example to ensure that they are noticed.

Figure 2a – Visual Hierarchy

Examples in use

- magazine ads
- newspapers

3.3 Icon Clarity

When using navigational icons, text should be combined with icons when applicable for clarity and emphasis.

This is another example of redundant cuing. The power of redundant cuing may easily be seen in a non-web design example: the stop sign. If a red octagon sign was placed anywhere on the road, it would be considered a stop sign. This red octagon has become a road icon in American culture. When it is combined with the word stop, the icon has added emphasis-the shape and the text work together more powerfully than either element alone. Icons have the ability to create a visual connection to the brain and aid in rapid identification and navigation. Having an icon set within a data display builds navigational cues for the user. In addition, the more intuitive the icons are to its actual purpose, the better.

Figure 3a – Stop Sign

Figure 3a demonstrates this principle. Road signs, particularly the stop sign are icons that combine text and shape to add meaning and emphasis. An icon has an amazing ability to communicate information quickly once the user memorizes its function.

3.4 Typeface

Typeface (also known as font) and size are ADA compliant and cross platform.

The ADA stands for American Disabilities Act. While the ADA gives relatively few guidelines for choosing specific fonts, in part due to the vast range of fonts available, it does give recommendations for font proportions. “Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10”(2010, ADA). These proportions keep the typeface from being too thin or too thick. It is interesting to note that the ADA does not address the actual size of the typeface. It does note that “characters and numbers on signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case X. Lower case characters are permitted”(2010, ADA). ADA is vague regarding specific typeface.

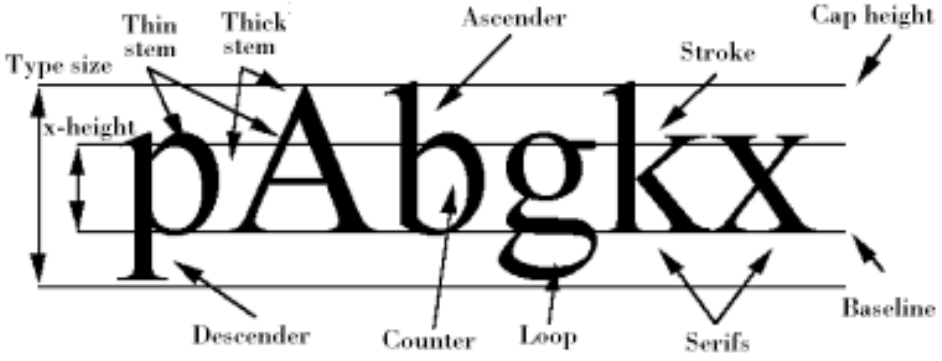

Figure 4a – Font Size (Typography 2004).

For the fonts on a website to display correctly on multiple platforms, the font must be available across platforms. When web designers make use of "non standard" fonts, the computer will make a font substitution. At best, these substitutions change spacing and placement; at worst, they are impossible to read.

The typeface is cross-platform when it can be found on different operating systems such as Mac OS, Windows, and Linux. A study in Figure 4b shows that Arial and Veranda fonts have the highest probability that they will be displayed correctly on various computers' platforms.

Figure 4b is a diagram of fonts found on the Windows, Mac, and Linux platforms. The study reveals that Arial and Veranda would be a good font to use in data display.

Font	Windows	Mac	Linux
Arial Black	97.73%	95.67%	54.44%
Verdana	97.41%	94.02%	55.00%
Arial	96.97%	96.41%	62.78%
Courier New	96.79%	92.08%	61.94%
Comic Sans MS	96.72%	91.63%	51.94%
Lucida Console	96.65%	–	–
Tahoma	96.61%	72.50%	–
Impact	96.33%	88.04%	53.89%
Trebuchet MS	95.79%	92.38%	51.39%
Lucida Sans Unicode	94.09%	–	–
Georgia	92.62%	93.57%	53.33%
Times New Roman	87.32%	90.28%	56.67%
Arial Narrow	87.25%	90.73%	–
Century Gothic	85.73%	39.17%	–
Bookman Oldstyle	84.22%	14.17%	–
Book Antiqua	83.79%	11.67%	–
Calibri	42.78%	6.67%	–
Cambria	42.45%	6.67%	–
Consolas	42.45%	8.33%	–
Candara	42.29%	6.67%	–
Corbel	42.04%	7.50%	–
Constantia	41.55%	6.67%	–
Courier	–	96.26%	74.17%
Helvetica	–	96.26%	57.50%
Geneva	–	92.08%	–
Monaco	–	96.71%	–

Figure 4b – Codestyle Font Survey

Examples in use

- newspapers
- magazines
- cellular texting

3.5 Resolution Range

Pages should be designed for a 1024x768 through 1440x900 screen resolution range.

Determining the proper screen resolution when creating any data display is monumental in interface design. The intended target audience of the display must be considered when choosing the most suitable resolution. Most of us have visited a website where the page is too wide for the Browser's window and as a result end up using the horizontal scroll to view the page. This occurs when the page is designed for a higher resolution display than the one on which it is being viewed. As a result, the information on the site becomes difficult and annoying to view. Resolution also interacts with text size.

A screen resolution is referenced in pixels by width and height. A screen resolution of 1024 x 768 means that the page is 1024 pixels wide by 768 pixels high. Traditionally these resolutions have been proportioned 4:3, which is the same proportion conventional televisions use. Recently, however, a number of computer manufacturers have been adopting proportion based on "letterbox" proportions of 16:9 width to height. As of July 2010, the range of resolution that should be considered standard for personal computers is 1024 x 768 through 1440 x 900(Thompson, 2010).

There are two approaches to screen layouts on the computer. The first is a fixed layout; the web page will not adjust to the visitor's browser window or screen resolution. If your website design is too wide for the visitor's browser

window, a horizontal scroll bar will appear at the bottom of the browser window. The second is a flexible (liquid) layout, which will adjust to the space available on the screen. Either type of layout can be beneficial if done correctly. With a fixed layout, you must determine the lowest resolution reasonably possible for the target audience and base the layout on those dimensions.

The second layout is a flexible (liquid) design. It will adjust to the space available in the browser window and different screen resolutions. If the layout is done correctly, all the elements on the page will rearrange themselves to suit the browsers window and resolution. Unfortunately, a user can distort and make the layout unpleasant by making the viewing window on their screen too small.

Figure 5a – Screen Resolution

Figure 5a is a fixed layout that has a width that is 960 pixels wide. Accounting for scrollbars, window edges, and so forth means the real width of a 1024x768 screen is about 960 pixels. The window height at one time used to also be a key factor because lower powered computers and slow internet connections made scrolling up and down difficult. With the wide access to broadband connections available today, the height is not generally a consideration in 2010 standards because the user is now expected to scroll to display all content available. The height still

needs to be considered in terms of making sure that the main areas of interest and information fall, at least initially, within the available viewer height without the necessity of scrolling. It would be a critical error, for example, to put a log in at the bottom of a long page so that the only way that the user would be aware that a login was necessary was if he or she happened to scroll to the bottom of the page.

Examples in use

- computers
- phones
- GPS systems

3.6 Distinguish Content

The site should distinguish fresh content from older content and all content should be displayed in a timely manner.

Imagine if your local newspaper was filled with articles that had no date. The event written in the article could have occurred weeks or years ago. Most events in time only have relevance when a date is attached. This is why information in general needs to be linked to a date. The newspaper is a great example of a source that many times distinguishes fresh content from older content by how close to the front of the paper the information is. In general it makes the most sense for the newest and most important information to be placed closest to the front of the site. In addition, using visual aids such as posted dates and symbols that indicate new content are ways to help distinguish fresh content from older content.

Information should also be displayed in a timely manner. With the increase in Internet speeds and computer technology, webpages should no longer take minutes to load. Ironically, as load time has decreased, there has been a corresponding decrease in patience for anything that takes longer to load than expected. The standard load time continues to change with the increase in technology and as a result the load time needs to be benchmarked against current user expectations (field tested) for each site.

3.7 Branding

The display should reflect and amplify core principles and brand identity of the company or organization.

What qualities does one want users to associate with one's company? There are many opportunities throughout a site to communicate a company or organization's attributes such as professionalism, excitement, scholarship, trustworthy, or authoritative through the use of layout, organization, and aesthetics. All of the qualities that one would want to impress upon others must be reflected throughout the site.

A brand has attributes, benefits, values, culture, personality, and users. Mercedes Benz is a brand that exemplifies these ideas (see Figure 7a). The company has certain qualities that it communicates to the user, qualities like expensive, well-built, well-engineered, durable, high prestigious high value, fast and so forth. However, customers are not buying qualities; they are buying benefits. These qualities needs to be translated into an emotional and functional benefit, as in "I am safe in case of an accident."("Branding Characteristics" 2010). The values of the brand represent what the company stands for. In this case Mercedes Benz stands for

Figure 7a – Branding

high performance, safety, prestige, and so forth. This brand also has a German culture trait: organized, efficient, and high quality. Lastly, the user is part of the brand. Established, wealthy, and professional people are the proclaimed users of the Mercedes Benz brand.

There are several questions that should be addressed when establishing the brand identity of the visual interface display. Who establishes branding characteristics and enforces them for the company or organization? Are there existing branding guidelines? Are there current branding problems?

The IDHW example created for this thesis establishes a brand of quality, scholarship, trust, professionalism, and respect through the use of colors, credentials, sourcing information, layout, and organization. The site should gain the trust from contributors on the first visit to ensure that they return and ultimately that they become contributing members.

Figure 7b demonstrates an interface that showcases branding throughout the site. The Auburn University logo adds authority and respect to the site, strengthening the brand.

Figure 7b – Branding

3.8 Consistent Controls

The use of navigation should remain consistent throughout the display except when there are areas requiring custom controls.

Because the user must quickly understand the navigation method of the display, the controls of the navigation should remain consistent. Users desire familiarity. The best navigation possible is when the user navigates to the desired information without thinking about how to do it, the same way driving a vehicle becomes a subconscious process. This can only be done if the navigation is organized, controlled, coherent, and consistent. Consistent navigation makes a display easier to use because the user does not need to learn a different navigation method on each new display page. As a result, the user is more likely to retrieve the information if he or she is familiar with the navigation system.

The most important guideline for navigation is to place navigational items that appear on all the pages in the same place on every page with consistent wording and appearance. The usa.gov website provides a few guidelines for maintaining navigation consistency. They are as follows:

> Put navigational items that appear on every page (such as the link back to the homepage) in the same location on each page. Make sure they have the same appearance and wording. Use the same layout, appearance and wording for pages that are logically grouped (for example, by topic, audience, or organization). Make sure your navigation works the same way from page to page. For example, if a set of pages on one topic has subtopic links in the left navigation bar, pages on other topics should also

have subtopic links in the left navigation bar that look and behave the same way. If a particular set of web pages requires specialized navigation, you should apply that navigation to the largest possible logical grouping. (2010 USA.gov).

In Figure 8a, the navigation maintains consistency through its use of color and placement. There are two navigation panes available to choose from. The first pane is the primary navigational pane, which allows for the selection of main categories. A drop down menu is displayed when the mouse hovers over the primary navigational text. The drop down menu presents the "sub navigation" choices. These choices are also presented again in the "sub navigational" bar. This process is repeated for every page that is presented.

Examples in use

- electronic displays

Figure 8a – Navigation

3.9 Levels

The end user should never be more than 4 levels from home when possible because user must memorize navigation after the 4th level (Wang, 2010).

Many times sites fall into the trap of being overly complex, with information that is buried under other information. Most people have had an experience of directing a friend through a site to a specific piece of information. This likely occurred because of the complex and poorly marked route to get there. As a general guideline, a display should consist of three to four levels. According to Auburn University Professor Wei Wang, once a user is past 4 levels from home, the user can become easily lost. For an example, refer to Figure 9a. On the other hand, it is also important to not present too many options at one time. With the resolution of today's computer screens, it is quite possible for a site to display over a hundred options at once if the site only has 1 level, but it would be nearly impossible to find anything amidst 100 choices.

On the other hand, too many levels also creates a problem. A DVD rental kiosk is an example of a type of interface that can frustrate the user because the user has to go through too many levels to get to the desired destination. For example, the user will navigate through the levels rental DVD, new release, action film, and so forth, and then to the specific movie only to decide that is not the right movie. The user must then backtrack to the beginning and start over. In order to keep tabs on how many levels are used throughout an interface, a site map is necessary. A site map is used to display the different levels within a site

along with the connections between levels. The first level, known as the index page, is the display presented to the user at the beginning. Once the user navigates past the initial display, the second level is presented and the user can choose to dive deeper into the interface up to four levels.

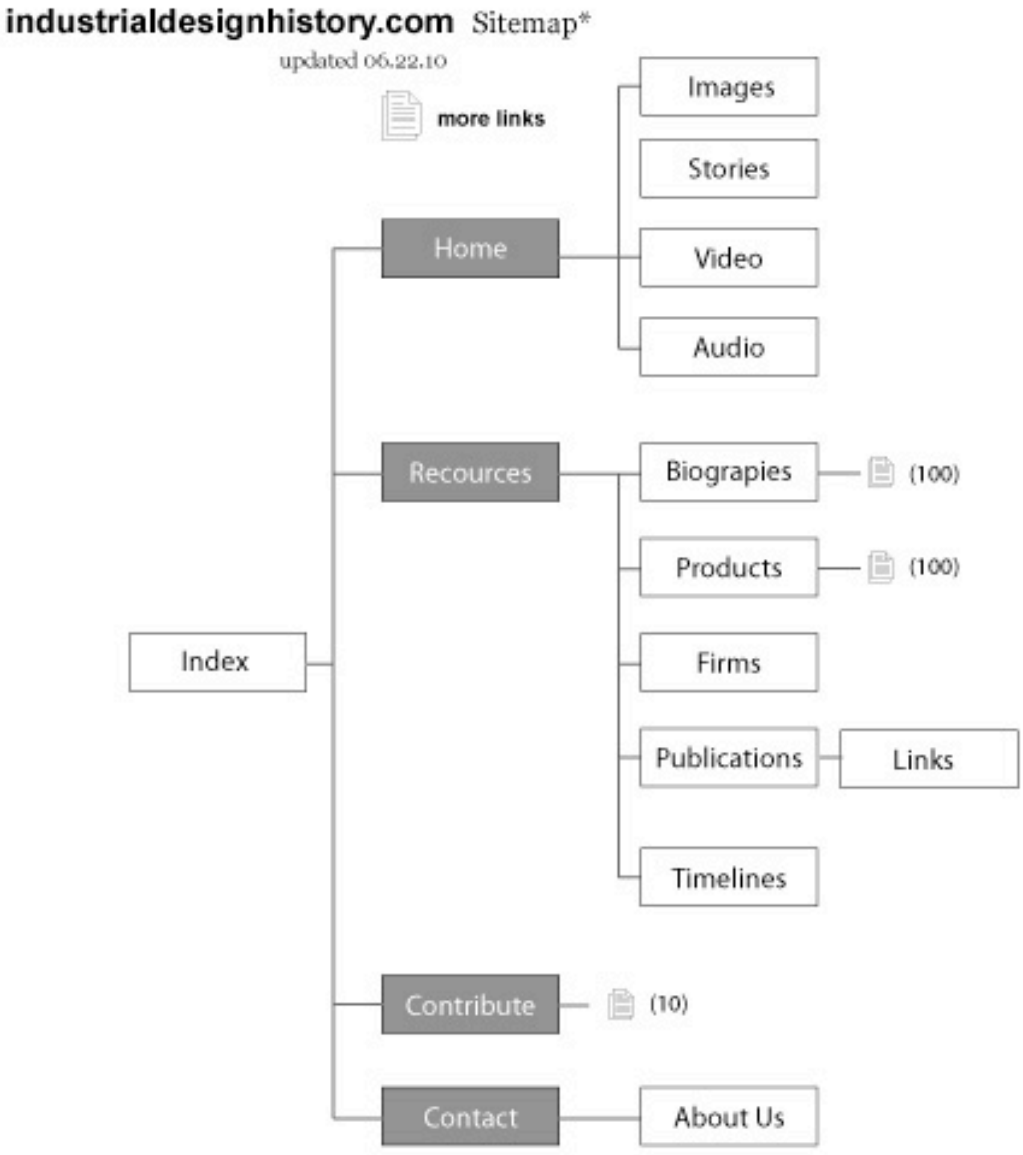

Figure 9a – Site Map

3.10 Expected Display Format

The interface should use the most natural or expected display format.

Users gain a certain sense of confidence when knowing what to expect. If the display format is too different from conventional interface standards, the user will likely become confused no matter how organized the information is. The user should have some familiarity with the interface even though he or she has never used it before. This is done through control stereotyping. Swiss Ergonomicist, Granjean explained control stereotyping as "even when steering an unfamiliar motor car, we expect that turning the steering wheel clockwise will turn the wheels to the right: no one would expect to turn the wheel to the left in order to steer to the right. Such expectations are called stereotyped: experience has engraved the corresponding pattern on the brain (Grandjean, 2005).

Figure 10a – Display format

Figure 10a is an example of a natural or expected display format. Typically the header is located at the top, body is located in the middle, and the footer is located at the bottom of the page. If these three sections of the page were rearranged, it would likely confuse the user because it is not an expected display format.

3.11 Location

Interface should assist the end user in decision making and remembering the location of information.

Hypermedia should be used to help the end user make decisions or choices. Because a user might not know where to go after viewing the piece of information , controlled options should be given to further enhance the user's experience. Associated content, which is hypermedia, is the most applicable form of an interface assisting the end user in the decision making process.

The interface should assist the end user in remembering his or her location throughout the website. One of the methods that is frequently used to keep users from becoming lost is providing an address at all times. Breadcrumbs are site map location addresses. These function in a way similar to street addresses. For example, my address is 324 North Ross Apt 8a, Auburn Al 36830. Certain pieces of that address will determine the scope of the location, but collectively it will pinpoint my exact location. A breadcrumb might display Stories/Products/Household/Kitchen/Mixer. This allows the user to know where he or she is in the overall structure of the system.

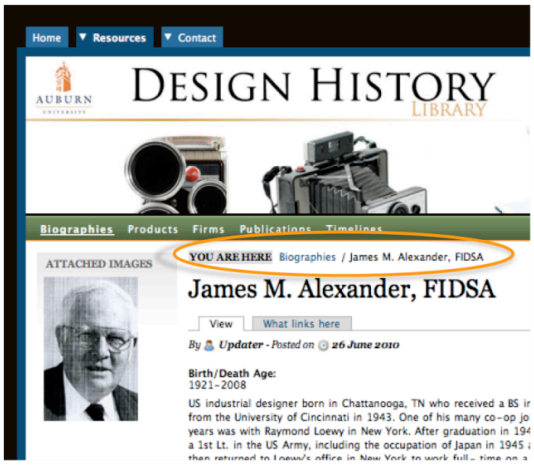

Figure 11a – Breadcrumbs

3.12 Choices

Present a choice only if it assists the user.

As of July 9th, 2010, if one were to go to google.com and type in the word "apple", the user would receive 448,000,000 results. How can this word have that many results? The word apple has many other associations besides the fruit. Logos, music, software, computers, and stocks are all associated with that word. In addition, all of those associations have associations and so forth. The result is that so many associations are presented to the user that the one he or she is looking for is buried amongst all of the other associations. This is hypermedia gone wrong. Having more choices does not make the end user's experience better; in fact, to an extent it makes it worse. Choices should only be presented if they are controlled, logical, and ultimately assist the user. Just because a connection or reference can be made does not mean that it needs to be made.

Figure 12a is a representation of hypermedia gone wrong. Giving countless choices to the end user defeats its purpose. Choices must be purposeful and relevant. Associations must be planned and controlled.

Figure 12a – Apple choices

Examples in use:

- search engine

3.13 Quality Control

End users and content providers should not have the ability to degrade the quality of the interface.

Consistency in the overall appearance, controls, navigation, structure, and information layout is essential in maintaining the quality of the interface. The interface must be structured in a way that will not allow a violation of quality by end users or content providers. This form of quality control is typically established by separating the content from the layout. For example, a contributor can submit information through a form or template to an interface system, while the interface controls the layout, navigation, and aesthetical elements of the display and compiles the page. This process is typically referred to as templating. In addition, the end user should not be allowed to adjust the layout, colors, and aesthetics because these choices have a direct impact on the usability and consistency of the site.

Figure 13a is an example of a form that allows a contributor to input without endangering the look, feel or functionality of the site.

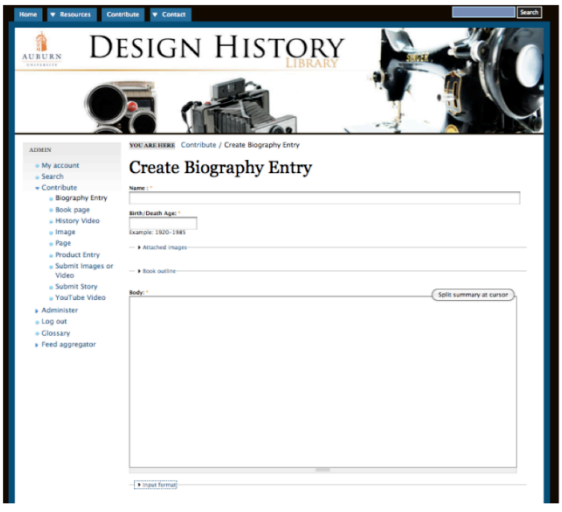

Figure 13a – Quality control

3.14 Least Precise Format

The interface should use and require the least precise display format needed.

When too much information is presented to the end user, he or she will likely become either confused or disregard the information. Requiring information to be more precise than necessary only decreases a user's ability to understand the information presented (Mejdal, 2001). For example, two feet can be expressed as 60.96 centimeters. Although 60.96 centimeters is the exact same length, 2 ft is much more easily understood by the end user. Suppose that a contributor were to create a timeline from an autobiography. In all likelihood, he or she would input the events with the correlating dates into the timeline in the same way that they were listed in the autobiography. Suppose the autobiography source gave only the year of the event, while the input form required the second, day, month, and year to fulfill its requirements. As a result, the contributor would either enter false information to fulfill the requirements or decide not to contribute for not having enough information.

Figure 14a shows the an example of using the least precise display format needed.

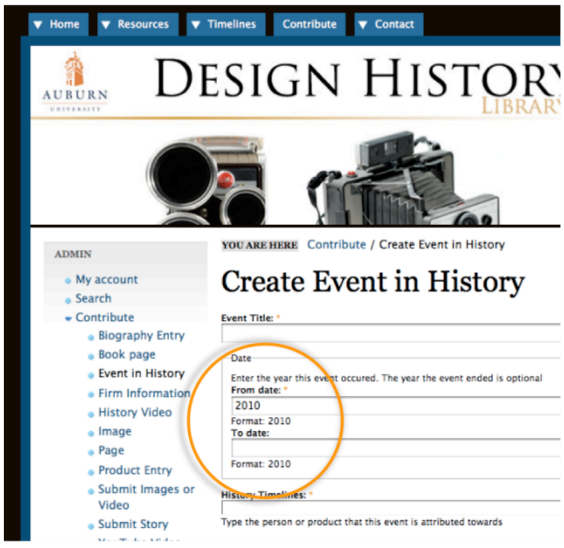

Figure 14a – Display Format

3.15 Control Stereotypes

The interface designer should identify and utilize useful control stereotypes.

As referenced earlier, stereotypes are conditioned reflexes which have become subconscious and automatic. Grandjean points out in his book *Fitting the Task to the Man* that that not all stereotypes are firmly established and occasionally there are considerable individual deviations. For example, there is a 'rule' that clockwise rotation means an increase in whatever is being controlled, but water and gas supplies lines are often controlled by stopcocks which turn off clockwise. This can lead to problems when one person has to control water/gas and electricity at the same (Grandjean, 1997).

This is why the interface designer should identify and utilize relevant control stereotypes in the design of the user interface. Figure 15a demonstrates navigating by making use of a previous button that points to the left and a forward button that points to the right is a useful control stereotype. This keeps the end user from needing to relearn a new system in order to operate the interface.

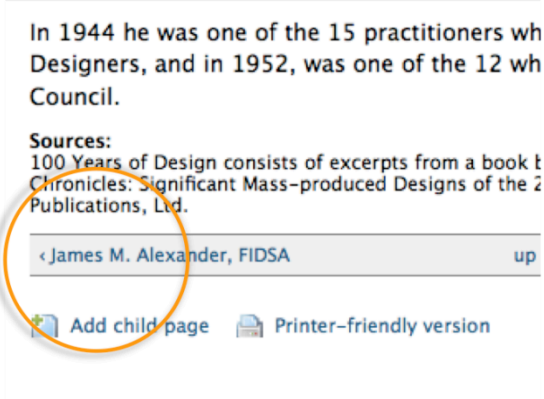

Figure 15a – Control Stereotypes

Examples in use

- thermostats
- television
- cameras

3.16 Communicate Content

Avoid jargon and slang.

Because an interface's sole purpose is to effectively communicate information, it is imperative that the interface does not inhibit this process. This concept might seem too obvious for discussion, but it is one that is easy to overlook. For example, when an interface designer has become knowledgeable in establishing the controls and function of the interface, it is relatively easy for the designer to use jargon and slang vocabulary applicable to the situation when assisting the end user. This principle can be applied to every area of the interface. Information that can help a user accomplish a task should always be provided and communicated without jargon and slang vocabulary.

For example, the display in Figure 16a provides information on recording video. Even though this process can be extremely technical, the information given is written in a way that anyone can understand.

Examples in use:

- airplane safety guidelines
- road signs

Figure 16a – Communication

3.17 Consistency

The interface must maintain consistency in the display of data, labeling, and graphic conventions.

Consistent graphic standards must be established and enforced to maintain a level of professionalism and credibility for any interface. By maintaining a consistent display of graphic elements, the end user will have a more direct connection with the information. For example, if the button sizes, background, font, and layout change for every page throughout an interface, the end user would more likely to be trying to discover the reason for the change of these elements rather than focusing on the information presented. A user who encounters the "Search" at the top left on one page will have problems if that feature is randomly located on other pages of the site.

Consistency can be something that can be used to an organization's advantage. It can help minimize development and maintenance costs, eliminate worry about relatively trivial design issues, and provide an enhanced user experience for customers (Gaffney, 2005).

3.18 Graphic Presentation

Present information graphically, where appropriate.

Graphics add depth, meaning, and power to information, giving the end user a more meaningful experience. Graphics often help explain information more thoroughly than text alone. Also, the end user will be more likely to remember the information presented because graphics give a second dimension to information. For example, if a child were given a series of pictures to illustrate a story, the child would be more likely to remember the story and have an accurate memory if it compared to what would be retained simply from hearing it read.

Figure 18a demonstrates this principle by displaying graphic content to support the information displayed.

Figure 18a – Graphic Display

3.19 Content Provisions

Make provisions for new content.

One of the biggest problems with website creation is providing a mechanism for new content to be contributed to the site. Many sites were never setup to allow for expansion. Using a CMS system for a site can go a long way toward solving the problem. It allows for unlimited contributors without programming knowledge to provide new information to the site. Sites that do not offer this quality typically become stagnant and outdated. The CMS should be set up to cater to the contributors, providing user-friendly input forms that are clear and straightforward. Figure 19a incorporates this principle and allows for new content through the "contribute" page.

With all of the provisions for new content in place, it is also important to track and make records of all contributed and revised information. This allows for proper sourcing and attributed credit for all information provided. By doing so, the qualities of trust, respect, and professionalism are reinforced.

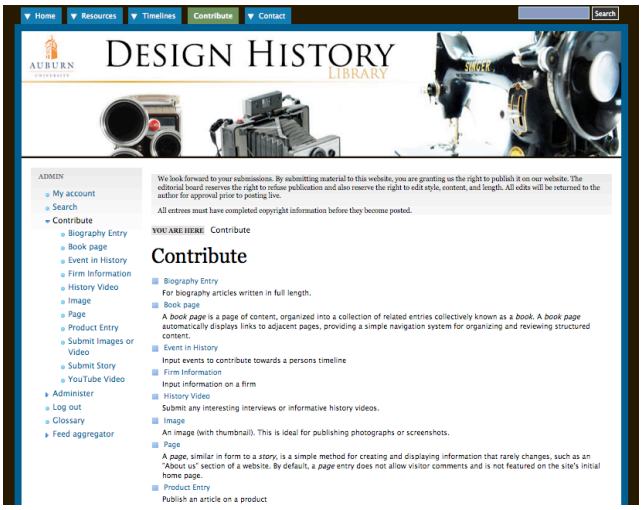

Figure 19a – Provisions for content

3.20 Interface Options

Whenever possible, the interface should limit choices to seven options or less at one time.

Have you ever noticed that eating out can often times be a miserable and frustrating experience? Imagine if you went to a restaurant and looked at a menu that did not break the different choices of food into subsections. On top of that, imagine that there are 40 different options to choose from. More than likely, you have had a similar experience before and it probably took you a lot longer than you would have liked to choose what you wanted to eat. This happens because the brain has a difficult time thinking about more than seven things at any given time (Krulwich, 2010). On the other hand, if the options are categorized, choices can be made much more quickly.

Figure 20a shows the interface drop-down menu. The particular category presents five choices with one choice that can expand further. The category should be split into sub-categories if the number of options exceed seven.

Figure 20a – Limit Choices

3.21 Distinguish Content Type

End user must clearly be able to distinguish between content that is global to the site and content that is specific to the page.

An interface should always differentiate between area-specific and global content. When an end user is directed away from an interface unintentionally, more than likely he or she was unable to clearly identify a difference between global and "page specific" navigation. For example, Figure 21a is a website that has a main navigation menu at the top of the page and a page-specific menu half way down the page. The page-specific menu, more likely to be overlooked and because of its location. The interface will become ineffective when the available controls are misleading.

If a display has multiple navigation systems, it is important that they do not conflict with one another and direct the end user away from the desired information.

Figure 21a – Distinguish Content Type

Design Interface Checklist

- ☐ 1. The interface informs user of current location through text, color, graphics and other appropriate cues.
- ☐ 2. The interface uses colors, text, composition, and interactive elements to establish visually engaging display.
- ☐ 3. When using navigation icons, text should be combined with icons for clarity and emphasis.
- ☐ 4. Typeface (also known as font) and size should be ADA compliant and cross platform.
- ☐ 5. Pages should be designed for a 1024x768 through 1440x900 screen resolution range.
- ☐ 6. The site should distinguish fresh content from older content and all content should be displayed in a timely manner.
- ☐ 7. The display should reflect and amplify core principles and brand identity of the company or organization
  - What qualities do you want users to associate with your company?
  - Who will use the site?
  - Who established branding characteristics and enforces them?
  - Are there existing branding guidelines?
  - Are there current branding problems?
- ☐ 8. The use of navigation should remain consistent throughout the site except when there are areas requiring custom controls.
- ☐ 9. The end user should never be more than 3 levels from home when possible, because user must memorize navigation after the 3rd level.
- ☐ 10. The interface should use the most natural or expected display format.
  Example: Do not put the body text at the very bottom of the page in the footer.
- ☐ 11. Site should assist the end user in remembering the location of information to that user.
- ☐ 12. Present choices only if they assists the user.
- ☐ 13. End users and content providers should not have the ability to degrade the quality of the site.
- ☐ 14. The interface should use the least precise display format needed.
  Example: 2 ft. rather than 24 inches.
- ☐ 15. The site designer should identify and utilize useful control stereotypes.
- ☐ 16. Avoid jargon and slang.
- ☐ 17. The interface must maintain consistency in the display of data, labeling, and graphic conventions.
- ☐ 18. Present information graphically, where appropriate.
- ☐ 19. Make provisions for new content.
- ☐ 20. Whenever possible, the interface should limit choices to seven options or less at one time.
- ☐ 21. End user must clearly be able to distinguish between content that is global to the site and content that is specific to the page.

■ Graphical

■ Operational ■ Navigational

4. Evaluation Of Guidelines

The IDSA History website will be evaluated based on the guidelines detailed in Chapter 3 to determine the effectiveness of the display interface.

✓=Pass ✘=Fail

4.1.1 Evaluation of Guideline 1

The display informs user of current location through text, color, graphics, and other appropriate cues.

Figure B1

The IDSA interface fails to inform the user of the current location by not using multiple cues (refer to Figure B1). While the page title gives the name of the page, the interface design fails to make use of colors, graphics, and other visual elements are not used to aid in informing website users of their location. ✘

4.1.2 Evaluation of Guideline 2

The interface uses colors, text, composition, and interactive elements to establish a visually engaging display.

The display interface does not establish a visually engaging display and fails Guideline 2(refer to Figure B2). The faded gray headline colors clash with the ambiguous, arbitrary, and contrasting background. The global background visible on the entire site becomes abrasive after a few minutes. The result is that rather than complementing the aesthetics, the background begins to compete with elements that should have a much higher visual priority. ✘

Figure B2

4.1.3 Evaluation of Guideline 3

When using navigational icons, text should be combined with icons when applicable for clarity and emphasis.

The icons found on the IDSA site are combined with text, partially passing Guideline 3(refer to Figure B3). Icons included are useful in adding visual stimulus and make the text clear in its purpose. However, nearly fifty percent of the icons are

Figure B3

left blank, having only a white box in place of the needed graphic. For this reason, the IDSA website receives only partial credit. ✓

4.1.4 Evaluation of Guideline 4

Typeface (also known as font) and size should ADA compliant and cross platform.

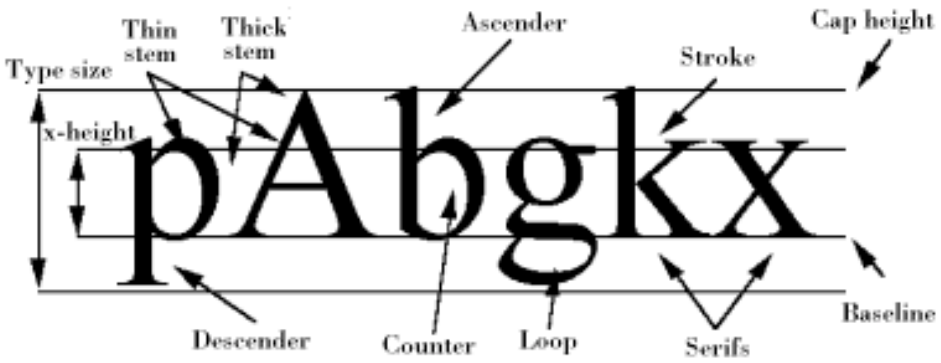

Figure B4 – Font Size

The only way to determine if the typeface and size passed Guideline 4 was to evaluate the CSS code from the site. The code listed the primary typeface as "Cambria". As described in the research guidelines, Cambria is not one of the native fonts found on PC and Mac machines and as a result does not pass Guideline 4. ✗

4.1.5 Evaluation of Guideline 5

Pages should be designed for a 1024x768 pixel through 1440x900 pixel screen resolution range.

The screen resolution that this site is designed for ranges from 640x480 pixels to 800x600 pixels based off of how the layout fills a computer screen. Refer to Figure B5.This range is considered outdated and does not take advantage of the resolution available on current display systems. Because the sight container does not meet the requirements of a 1024x768 resolution, it fails to pass Guideline 5. ✖

Figure B5

4.1.6 Evaluation of Guideline 6

The site should distinguish fresh content from older content, and all content should be displayed in a timely manner.

Content should always inform the user if content is older or newer. Throughout the IDSA website there are no cues given that indicate whether or not the content is newer or older (refer to Figure B6). Typically, new content can be found on the front page of the site, but the navigation system is found there instead. The site fails to acknowledge new content in any beneficial way,

Figure B6

except if the user visits each individual page to observe the posted date. This site fails to distinguish old from new content and does not pass Guideline 6. ✖

4.1.7 Evaluation of Guideline 7

The display should reflect and amplify core principles and brand identity of the company or organization.

At first glance, it appears that the IDSA website has met this criteria. It showcases its logo at the very top of the page, leveraging all of its credibility, popularity, and power through its recognizable logo(refer to Figure B7). Unfortunately, while the logo is effectively displayed all throughout the site, the core principles of professionalism, design, value, and scholarship associated with IDSA are not. The inconsistencies in layout, navigation, and aesthetics cause the site to be perceived as amateur, inconsiderate, and unprofessional. The true branding characteristics are not reinforced, while critical attributes of design, credibility, and loyalty are not conveyed anywhere in the site. The site fails to reflect its core identity and does not pass Guideline 7. ✖

Figure B7

4.1.8 Evaluation of Guideline 8

The use of navigation should remain consistent throughout the display except when there are areas requiring custom controls.

Navigation is the primary downfall of this site. The site navigation is confusing because the navigation system is not consistent on each level of the site. Once the user reaches the 3rd level of information, the applicable navigation for the page is not present anymore. In addition, the custom controls for the pages that still have navigation are confused with the primary navigation bar. (refer to Figure B1). This occurs because there are not proper cues in the navigation to inform the user of the primary and subprimary navigation systems. The main form of navigation throughout the site is using the browser's forward and back buttons. The result of this choice of navigation is to make the third and subsequent layers of the website all but unnavigable because the user is not able to go forward or backward within these levels as a way of paging through information. This site fails to have any consistent and useful navigation system in place and fails Guideline 8. ✖

Figure B8

4.1.9 Evaluation of Guideline 9

The end user should never be more than four levels from home when possible, because user must memorize navigation after the 4th level.

The history section of the IDSA website is composed of 3 levels in the site map structure (refer to Figure B9). The information available in the section is limited making this guideline easily achieved. The site passes Guideline 9. ✓

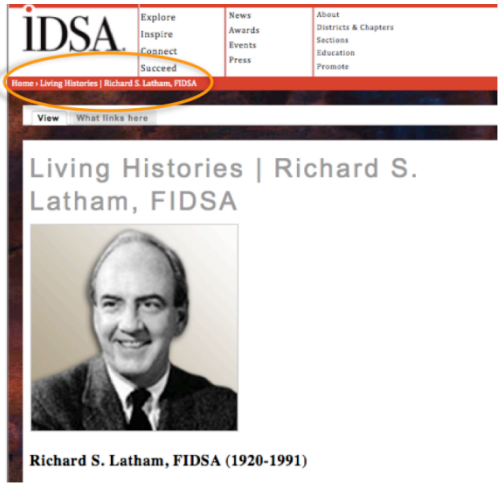

Figure B9

4.1.10 Evaluation of Guideline 10

The interface should use the most natural or expected display format.

Typically, the expected display format for a site contains a header for navigation, a main content section, often referred to as the "body", a footer for redundant navigation, and possible side columns for related content. The

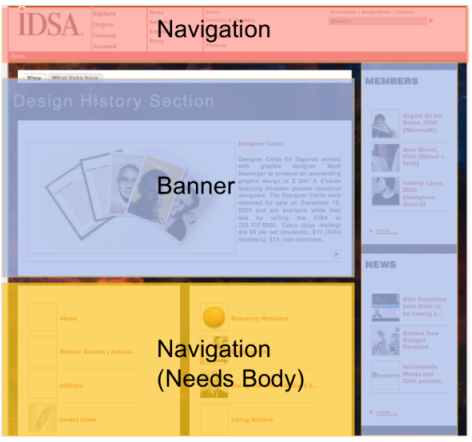

Figure B10

IDSA site does not contain a body section for information (refer to Figure B1). Instead of a body section, the site uses a different set of navigation links in place of the body section for the next level down. This format changes as different pages are selected and viewed because some pages have a second set of navigation links while other pages do not. As a result, the IDSA site does not pass Guideline 10. ✖

4.1.11 Evaluation of Guideline 11

Interface should assist the end user in decision making and remembering the location of information.

The site does use the system referred to as breadcrumbs, which is a site map location system. The site displays the current location of the user, helping the user to avoid becoming lost. The breadcrumb display, however, is difficult to read due to the extremely small font size. Refer to **Figure B9.** The site passes Guideline 11. ✓

4.1.12 Evaluation of Guideline 12

Present a choice only if it assists the user.

A choice should only be presented to the users if it helps them in some way. On every page of

Figure B12

the IDSA site that contains body information, there is a “What links here” tab available. Refer to Figure B12. Upon clicking the tab, the display responds “No Search Results Found”. This choice does not aid the user in any way and should not be presented. Because this tab does not assist the user, the site does not pass Guideline 12. ✖

4.1.13 Evaluation of Guideline 13

End users and content providers should not have the ability to degrade the quality of the interface.

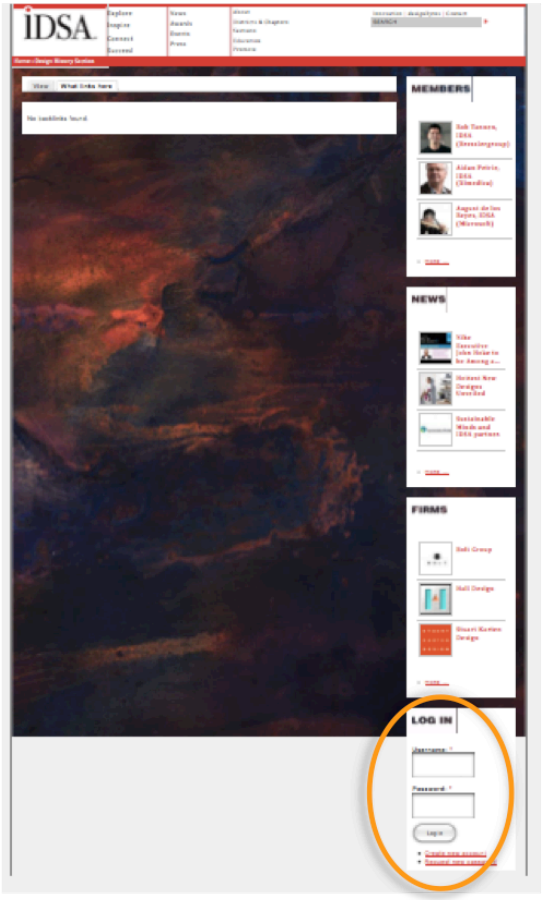

Figure B13

The end user is in no way allowed to control or manipulate any feature or piece of information in the IDSA site, at least as far as it could be tested. As a result the end user cannot degrade the quality of the site. Because access is unavailable to login, unless as a contributor, it is unclear if contributors can degrade the quality of the site (refer to Figure B13). Giving the site the benefit of the doubt reguarding this area, the site passes Guideline 13. ✓

4.1.14 Evaluation of Guideline 14

The interface should use and require the least precise display format needed.

The posted dates throughout the site are displayed in a lengthy format and also written in military time. The post date on the biographies page is displayed as "Thu, 2010-05-06 14:57". (refer to Figure B14). In order to be displayed in the least display format needed, the date would need to be written as 5/6/10 2:57 PM in order to avoid confusion. The site does not pass Guideline 14. ✘

Figure B14

4.1.15 Evaluation of Guideline 15

The interface designer should identify and utilize useful control stereotypes.

One of the biggest problems in the IDSA site is a control stereotype dealing with the user login. The stereotype for a user login is that it is typically found either in the header or directly beneath the header for easy access and to ensure that it is easily located by new users. The site discourages member login by placing the login panel at the very bottom of the page. (refer to Figure B13). Additionally, there is little use of control stereotyping throughout the site and as a result it does not pass Guideline 15. ✘

4.1.16 Evaluation of Guideline 16

Use the most clear way to communicate content.

The site communicates clearly by not using jargon and slang words. The site passes Guideline 16. ✓

4.1.17 Evaluation of Guideline 17

The interface must maintain consistency in the display of data, labeling, and graphic conventions.

Because the site is operated from a CMS, the consistency in the display of data, labeling, and graphic conventions meets the requirements of Guideline 17. (refer to Figure B1)..This is slightly undercut by the web designer's failure to remove unnecessary tabs as noted in 4.12. This site shows the benefit of separating content from aesthetics and layout. ✓

4.1.18 Evaluation of Guideline 18

Present information graphically where appropriate.

Graphics and images are presented that are relevant to the information throughout the site. The images are displayed within close proximity to the content provided (refer to Figure B9). The images are of good quality and strengthen the effectiveness of the content displayed. The site passes Guideline 18 ✓

4.1.19 Evaluation of Guideline 19

Make provisions for new content.

The site does not inform the end user of methods for contributing. The site leads the users to believe that membership is required in order for them to access new information on the site because the unauthenticated user is locked out of many areas in the site (refer to Figure B13). This is detrimental to the site's life expectancy because it does not make adequate provisions for new content. This site does not pass Guideline 19. ✗

4.1.20 Evaluation of Guideline 20

Whenever possible, the interface should limit choices to seven options or fewer at one time.

Menu and list options are limited to fewer than seven options throughout the IDSA site, allowing the user to remember the choices available. Refer to Figure B20**.** This site passes Guideline 20. ✓

Figure B20

4.1.21 Evaluation of Guideline 21

End user must clearly be able to distinguish between content that is global to the site and content that is specific to the page.

Global and "page specific" content throughout IDSA the site are often easily confused with one another. This appears most prominently in the "sub navigation" and main navigation system (refer to Figure B1). The two systems work independently from another and often lead the user astray because there is no cue to the user of its level of control. This site does not pass Guideline 21. ✖

Figure B21

5. Conclusion

5.1 Further Development

Through this present study, a set of design guidelines has been developed for interface display systems. These are an essential first step in developing effective user interfaces for display-based interactive devices and systems. Future studies are needed to refine and expand how these guidelines can be used to improve the display-based interactions with a wide array of consumer electronics. In the course of the present investigation, it also has become clear that content management systems, such as Drupal, are in need of redesign. While the output of CMSs is beneficial, the learning curve required to operate and manage them is extremely high. Moreover, some design choices that enhance usability, like custom theming, specifying certain pieces of information or regions of a page, are unnecessarily difficult or, in some cases, simply not possible with the current generation of CMSs. By making CMSs easier to understand and operate, and making additional visual design choices possible, many more users will have access to this powerful authoring environment.

Additionally, a rating system needs to be developed for CMS. This rating system would be applied to the plugins available for the CMS, identifying and rating a series of critical elements such as flexibility, memory overhead, performance, and other criteria. Currently, the only way to determine useful

modules is by visiting forums and reading blogs of how CMS users solved a problem. Because the site's speed is determined by the number of modules running and how much memory each particular module consumes, it is critical that these elements be rated using a consistent set of criteria.

5.2 Next Step

In the final analysis, the end user is the most important person to design for. In the case of websites there are, in fact, three end users: the webmaster, the content experts, and the final end user who is trying to navigate the system. In the rush to make technological progress, the "user first" principle can easily be forgotten. As a case in point, consider the recent release of Apple's new 4G phone, which contains the newest cell phone technology, live video calls, and a sleek design. Despite all of these positive attributes, it has spiraled down the rankings in *Consumer Reports*, dragging Apple's brand image with it. In fact, *Consumer Reports* has issued a rare "not recommended" verdict for the new iPhone (Hart, 2010). This happened because the phone has been found to drop calls because the antenna is on the left side of the phone so that when the user is holding it in the left hand, the antenna is covered up by the user's hand and reception is compromised. After early criticism from the public, Steve Jobs (CEO of Apple Inc) responded by saying, "Just don't hold it that way". When the user becomes the last person considered, design has failed to do its job. This is why design must be held to a standard. The next big step for the iPhone and for numerous visual display-based products is to improve and standardize

principles of display systems interface design. Industrial Designers, Graphic Designers, Information Technology, and Human Factors Researchers must collaborate to gather additional data and to bring these principles into the various avenues of display systems interface design.

References

Bailey, S., (2008). *Managing the Crowd*. City: Facet Publishing.

Brand Characteristics. (2010, January 20). *Marketing Resource | Brand Building Strategy | Branding | Marketing Management Strategies | Advertising Management | Public Relations |*. Retrieved July 18, 2010, from http://drypen.in/branding/brand-characteristics.html

Chapter 11 Typography. (2004, April 25). *Web Galactic Austin Texas Web Design, Web Hosting, Computer Repair*. Retrieved July 19, 2010, from http://www.webgalactic.com/styleguiDonald, Norman (2004). *Emotional Design*. New York: Basic Books.

Dunn, J. E. (2007) IBM takes fight to Microsoft with Lotus Symphony

Hart, T. (2010, July 12). Consumer Reports won't recommend iPhone 4G after reception tests. *Personal Money Store*. Retrieved July 18, 2010, from http://personalmoneystore.com/moneyblog/2010/07/12/consumer-reports-iphone-4g/

Honeysett, Nik. (2004). *Content Management for a Content-Rich Website*

Fleishman, G. (1995) *Weaving the Perfect Web*

Franklin, M. (1996). *Client Data Caching*. Boston: Kluwer Academic Publishers.

Grandjean, E. (1997). *Fitting the Task to the Human*. Washington: Taylor & Francis.

Pullman, G., & Gu, B. (2008). *Content Management: Bridging the Gap between Theory and Practice*. Amityville: Baywood Publishing Company.

Hernandez, M., (1997). *Database Design for Mere Mortals*. Boston: Addison Wesley Developers Press.

Käfer, K., & Hogbin, E. (2009). *Front End Drupal: Designing, Theming, Scripting*. Upper Saddle River: Prentice Hall PTR.

Krulwich, R. (2010, January 26). Radiolab: Why Is It So Hard To Do The Right Thing? : NPR. *NPR : National Public Radio : News & Analysis, World, US, Music & Arts : NPR*. Retrieved July 18, 2010, from http://www.npr.org/templates/story/story.php?storyId=122781981

Malin, Stuart (1989) Hypermedia and Design: Beyond Timid Steps

Mejdal, Sig. "Design Guidlines for Multifunction Displays." *Office of Aerospace Medicine* Final (2001): 79. Print.

Salvendy, G., (2006). *Handbook of Human Factors and Ergonomics*. New York: Wiley.

Tilley, A., (1993). *The Measure of Man and Woman*. New York: Whitney Library of Design.

Thompson, M. (2010, January 7). Optimal Screen Resolution for Web Design (2010 Update) | StayOnSearch. *Search & Social Media Marketing Tips,*

Resources and Discussions | *StayOnSearch*. Retrieved July 18, 2010, from http://www.stayonsearch.com/optimal-screen-resolution-for-web-design-2010-update

Vandyk, J., & Buytaert, D. (2008). *Pro Drupal Development, Second Edition*. Berkeley: APress.