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## Website Usability: A Re-Examination through the Lenses of ISO Standards

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## Website Usability: A Re-Examination through the Lenses of ISO Standards

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### ABSTRACT

*The original conceptualization of usability was ease of use, this was later expanded into a multi-dimensional construct in ISO standards and usability literature. Such an expansion is seen as an improvement, since cross-study comparison or benchmarking cannot objectively be done without a common set of usability components being defined. The current issue lies in how these components are operationalized, measured and validated. Although ISO standards ties usability to contextual situations, recent research has started to also recognize psychographic and demographic variations within the same context. The purpose of this study is to review web site usability as it relates to ISO standards (more specifically ISO 9126, ISO 9241 and ISO/IEC 25010) and existing usability studies. Implications for researchers and practitioners are provided.*

**Keywords:** Color, ISO Standards, Navigation, Usability, Web Design, Web Usability, Websites

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**OVERVIEW**

This paper specifically addresses web usability from the perspective of how easy a system is to learn, remember and use (Rosen, Purinton, & Lloyd, 2004). The system features should emphasize subjective satisfaction (Cheug & Lee, 2005), low error rate and high task performance (Calongne, 2001). Usability is an important component of a variety of products and services from instruction for lawn mowers to websites. In the case of physical products usability is often measured by does the product do what it claims to do? Does the product work as advertised? Are the instructions clear? Do the instructions make sense?

In the online context usability addresses not only "ease of use" and "efficiency", but it is also concerned with Human Machine Interfaces (known as Graphic User Interfaces – GUIs within modern operating systems or web sites). Although early studies have primarily focused on the ease of use aspect of web site usability (e.g., Nielsen, 1999), later studies have embraced international standards and uniformly recognize a multi-dimensional form of usability. The advent of online retail has forced organizations to consider consumers in a new light. Organizations work hard to ensure a pleasant experience for the user. Shoppers want sites that are valuable and easy to use. Features that aid the users can help retain visitor interest (Socket, Falk, Warren, & Chen; 2007). Socket et al warn organizations to exercise caution and not rely solely on GUI to boost online sales. Interfaces can

be imitated, the long-term competitive edge is less salient compared to factors, such as customer confidence and relationship services (Kotha, Rajgopal, & Venkatachalam, 2004).

**DEFINITIONS OF USABILITY**

The term "usability" has evolved from a simple concept of *ease of use* to a construct with multiple dimensions that was adopted as part of the ISO/IEC Software engineering - Product quality model 9126. The ISO/IEC 9126 is an international standard for the evaluation of software quality. The standard was developed by The ISO (the International Organization for Standardization) and the IEC (International Electrotechnical Commission). The two organizations ISO and IEC were established by "member organizations" for the purposes of providing agreement and a level of uniformity on technical issues (ISO/IEC 9126, 1991). The fundamental objective of this standard is to address some of the well-known human biases that can adversely affect the delivery and perception of a software development project.

The 9126 standard defines six software quality characteristics that minimally overlap (Functionality, Reliability, Usability, Efficiency, Maintainability, and Portability). Together these characteristics provide a baseline for description and further refinement of software quality (ISO/IEC 9126, 1991 p 1).

The construct of Usability is often defined as a set of attributes that bear on the effort needed for use, and on the

individual assessment of such use, by a stated or implied set of users. It is generally accepted to have five sub-classifications: understandability, learnability, operability, attractiveness and usability compliance.

This user interface centric view was later expanded in ISO 9241-11 (1998) which defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." This expansion of usability into a wider system view was later adopted and renamed to "quality in use" in ISO 9126-1 (2001) (Bevan, 1999).

ISO/IEC 25010, a more recent international standard that brings previous standards together, combines the following two models to capture software quality: Quality in Use Model (See Figure 1) and Product Quality Model (See Figure 2). The Quality in Use Model has five

elements (effectiveness, efficiency, satisfaction, freedom from risk and context coverage) relating to the outcome from the actual use. Three of the five elements were adopted from the ISO 9241-11's definition of usability. The Product Quality Model of ISO/IEC 25010 has eight elements that are concerned with the characteristics provided by a product, service or system. Of the eight elements in the product quality model, operability replaces usability of ISO 9126-1 to capture a broader meaning (Lew, Olsina & Zhang, 2010) that includes Appropriateness, Recognizability, Learnability, Operability, User error protection, User interface aesthetics and Accessibility.

Outside of international standards, researchers have been reviewing dimensions of usability. Jakob Nielsen, a renowned figure in the discipline of usability, classified usability to include the following five components (Nielsen, 2012):

Figure 1. ISO/IEC 25010 quality in use model

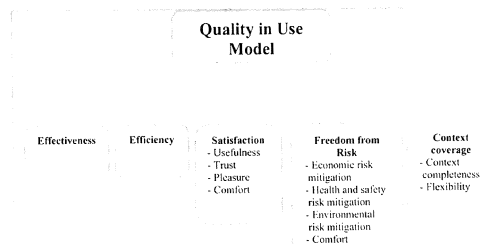


Figure 2. ISO/IEC 25010 product quality model



1. **Learnability:** How easy is it for users to accomplish basic tasks the first time they encounter the design?
2. **Efficiency:** Once users have learned the design, how quickly can they perform tasks?
3. **Memorability:** When users return to the design after a period of not using it, how easily can they reestablish proficiency?
4. **Errors:** How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
5. **Satisfaction:** How pleasant is it to use the design?
6. **Utility:** Does it do what users need?

Consistent with the aforementioned international standards, Nielsen also considers that "usability is a quality attribute that assesses how easy user interfaces are to use". It is interesting to point out that experience based components (such as those in the Quality in Use Model of international standards) and system components (i.e., Product Quality Model in international standards) are both present in Nielsen's classification. Different from these international standards is how the components are identified and what components are included for usability. Abran, Khelifi and Suryn (2003) developed an enhanced usability model with five usability components by con-

solidating ISO 9126 and ISO 9241, and adding the pieces. The model includes the three main pillars (efficiency, effectiveness and satisfaction) from ISO 9241, learnability from ISO 9126, and security as the main key element of usability. Another effort by Seffah, Donyae, Kline and Padda (2006) follows a similar approach by consolidating and expanding international standards into a model called Quality in Use Integrated Measurement (QUIM) that includes ten usability components (efficiency, effectiveness, productivity, satisfaction, learnability, safety, trustfulness, accessibility, universality and usefulness).

The concept of usability has evolved into a multi-dimensional form. With a wider adoption of international standards, consistent measurements may be developed and assessed that eventually may lead to comparable study results.

sors, lack of understanding, fluctuating agreement in end goals, poor project management, turnover of key personnel, cost overruns ... Additionally, the user community and technology development group utilized language and terms they were not well understood by the others. It was a devastating process whose ill-will often doomed future projects.

This confusion was often the direct result of many things going a skew. Developers overstating their capabilities, and users over demanding on what they like, when they like it, and what they were willing to pay for it. In the end, many projects failed because both sides were too ambitious and neither wanted to compromise. In addition technology was changing faster than it could be assimilated by organizations and the general public.

**WHY IT MATTERS**

**EVOLUTION**

Originally, "online systems" were not developed for a "generic user" but for the specialist, someone that had understanding of the system being developed. They were expensive applications to build, and labor intensive to design and implement. Initial development projects were designed to replace existing "paper-based" manual systems and in the end provided only limited system enhancements. The systems were often considered a success under the most dubious factors; often it boiled down to "we got some usable result" and "it did NOT outright fail. Early problems included limited "Buy-in" by key spon-

sors, there is no need to compound them by confusing users on what is happening or what to do next. According to the U.S. Nuclear Regulatory Commission (NRC) the most serious accident in U.S. commercial nuclear power plant operating history occurred at Three Mile Island (TMI), Dauphin County, Pennsylvania, on March 28, 1979. Even though "the small radioactive releases had no detectable health effects on plant workers or the public, its aftermath brought about sweeping changes involving emergency response planning, reactor operator training, human factors engineering, radiation protection, and many other



areas of nuclear power plant operations" (emphasis added, NRC Factsheets: <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html>).

In the end, it was confusion over valve status that caused TMI. Critical human factors and poor user interface engineering led operators to misinterpret the meaning of a "warning light." They thought a critical valve was closed when it was actually open. It turned out the light they were concerned about did *not* indicate the position of the valve, only the status of the solenoid that controlled the valve. This confusion was a key contributor to the initial failure to recognize the mishap as a loss-of-coolant accident, and led operators to turn off the emergency core cooling pumps due to fears the system was being overfilled (Wikipedia, 2013).

The TMI incident permanently changed the nuclear industry and the NRC itself. Besides requiring upgrades, strengthening of plant designs and equipment requirements they also addressed "the critical role of human performance in plant safety - which led to revamping operator training and staffing requirements, followed by improved instrumentation and controls for operating the plant, and the establishment of fitness-for-duty programs for plant workers to guard against alcohol or drug abuse" (see NRC Factsheets). Further, TMI "inspired Charles Perrow's Normal Accident Theory; which contends that accidents result from an unanticipated interaction of multiple failures in a complex system. TMI is an example of a usability type accident - it was "un-

expected, incomprehensible, uncontrollable and unavoidable" (Walker, 2004).

### USABILITY GOALS

Once upon a time, usability was an afterthought in the computer and information systems industry. Developers were rewarded for the features of an application, and not its usability (Pagani, 2009). Usability was a suppressed and barely tolerated oddity (Nielsen, 2000). Typically, web usability was interpreted to mean how effective the website is at permitting access to its information. Site design should take into account the users characteristics, experience and context (Badre, 2002; Rau, Liang & Max, 2003; Chen, & Sockel, 2001). People rely on their experience and use semantic models in an attempt to make sense out of the environment. What might seem an easy application for a design team can be awkward and difficult to the end user (Marinilli, 2002). Therefore, it warrants setting usability goals and measuring them before a site goes into production. If the goal is set to be high task performance, a sensible measure might refer to the speed in which the web pages load given a particular hardware and software combination (Calongne, 2001). However, if the low error rate is the point of interest, then click stream data and server logs might need to be analyzed to isolate patterns.

The usability components reviewed in the previous sections should give practitioners a starting point for areas to tackle. Not all usability components are created equal or are areas of focus.

ISO/IEC 25010 outlines five characteristics for the "quality in use model" and three (efficiency, effectiveness and satisfaction) out of these five directly relate to the usability construct defined in ISO/IEC 25010's predecessors (e.g., ISO 9241 and ISO 9126). A web site may be very efficient in rendering its pages with decent computer hardware and software, but that does not necessarily automatically translate into user effectiveness. This is especially true when the developer becomes too creative by adding features or components (such as non-rectangular buttons) that require visitors to "learn" to use the web site. This is exactly the reason that usability gurus like Jacob Nielsen have been advocating against being too creative in user interface design.

Additionally, ISO/IEC 25010 has re-grouped the traditional usability components (e.g., learnability, ease of use and helpfulness) into the operability component of the "product quality model", which implies that usability is not just an experienced based construct like those components identified in the quality in use model. In summary, practitioners are advised to review usability components in both ISO/IEC 25010 quality models.

### USABILITY ISSUES

Every web page has an address on the Internet. The more recognizable the address the easier it is for the user to become brand aware and the more often they might return to the site. The Web can be used as a marketing tool that

allows millions of potential customers to visit a site each day (Hart, Doherty & Ellis-Chadwick, 2000). However, before that can happen, a person needs to be able to find the appropriate web page. In that regard, many individuals use and depend upon search engines to locate sites of interests. A serious problem is that a website's reference may be buried so deep in a search result, that it will very likely go unnoticed, and hence not visited. The consequence is not only a usability issue, it is also a visibility/profitability problem. To circumvent this issue, an organization should consider using the search engine optimization (SEO) guidelines which were developed by the major search engines.

While search engines use web-bots to find the pages on their own, it makes sense to register the site with the search engines so that search criteria can be tailored to the website. Studies show that a majority of all website's traffic is generated through search engines and directories. The website's domain name becomes more meaningful to the user if it contains cognitive cues.

### Design Issues

Nielsen (2003) lists the top ten web usability design violations. While the study is a little old, many of these basic guidelines are still applicable in today's web environment:

1. Emphasize what your site offers that's of value to users and how your services differ from those of key competitors;

2. Use a liquid layout that lets users adjust the homepage size;
3. Use color to distinguish visited and unvisited links;
4. Use graphics to show real content, not just to decorate your homepage;
5. Include a tag line that explicitly summarizes what the site or company does;
6. Make it easy to access anything recently featured on your homepage;
7. Include a short site description in the window title;
8. Don't use a heading to label the search area; instead use a "Search" button to the right of the box;
9. With stock quotes, give the percentage of change, not just the points gained or lost;
10. Don't include an active link to the homepage on the homepage.

For the most part it seems as if the focus of usability has gravitated from traditional webpage development to emphasize mobile computing, especially considering the popularity of computer cell phone hybrids. There is a difference between mobile or nomadic computing and the use of hybrid devices. Mobile computing is the use of portable devices to access the Internet and data from work or home from anywhere in the world (Rouse, 2007). Hybrid devices are primarily designed to be used for entertainment, communications, shopping, and incidental work utilizing a cellular and other wireless networks (Hargreaves, 2007).

Designing sites toward hybrid computing products such as cell phones and

tablets brings up a host of new usability issues. A lot of these devices are used while multi-tasking. If a mobile device is to be truly usable, new elements need to be included. These elements / components have to be designed with the goal of minimizing attention so that other tasks can be performed at the same time - such as driving. As these hybrids try to incorporate the many functions other devices are specifically designed for such as, talking (telephone), texting, GPS, and Internet browsing, usability now transitions from a secondary afterthought - to the major design concern. As Teotia, Shashi and Teotia (2012) pointed out, challenges (such as context, connectivity, screen size, resolution, limited processing capabilities and limited data entry methods) could cause issues in conducting usability tests on mobile devices.

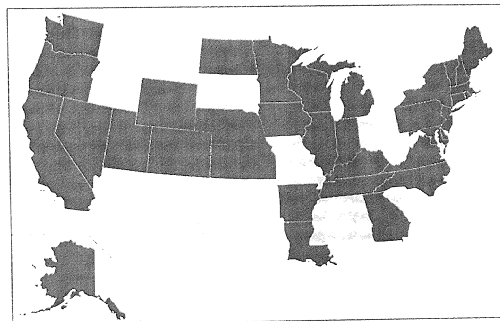
#### INPUT AND QUERIES

For products to work well in the hybrid environment certain design features need to be incorporated and enhanced. Traditionally a keyboard, mouse or touch pad were utilized to input data or conduct queries. In a truly mobile environment those input devices may not be effective. Within the ever growing evolution of the input and query function voice operation is at the top of the list. While the technology is not completely sound there are working elements that are in place. At this point Global Positioning Satellite (GPS) commands such as "find a location" and / or store are somewhat precise. Conducting voice searches and

reading back messages (email or text) are also pretty accurate. Sending text messages also works fairly well. Problems with this technology include user accent, accurate data bases, and that a user still has to activate these features by touch. The fact that a user needs to touch a screen in a certain spot can also become an issue or even a danger because the user has to look at the device. This is the reason that many states have passed the laws that prohibit using of mobile devices in certain ways. As of this writing, 12 states prohibit all drivers from using hand-held cellphones while driving, 37 states ban all cell phone use by novice drivers, and 41 states ban all drivers from texting while driving (GHSA, 2013).

See Figure 3 for a graphical illustration from Wikipedia. Users may suffer when the context of usability within a specific category of a device is not defined and they are not aware of the correct context, as in texting and driving. Usability is defined based on the context of use in most international standards. Even if a product is usable in a certain context, it does not mean that it is appropriate. Additionally, it is very rare that the usability of a product is universal. In his work titled "Universal Usability", Shneiderman (2000) defines universal usability as "... having more than 90% of all households as successful users of information and communications services at least once a week (p. 85)."

Figure 3. States with texting while driving laws (Darkest or Red: banned for all drivers; Lightest or Yellow: banned for new drivers; Grey: no statute yet)



*(Note: the above image was retrieved from [https://en.wikipedia.org/wiki/Texting\\_while\\_driving](https://en.wikipedia.org/wiki/Texting_while_driving) under Wikipedia's Creative Commons license. The image is solely Wikipedia's work, not that of the authors of the present article. Please visit the above web site for a color version of the map.)*

Based on this definition, universal usability is not something that applies to all and works in every situation.

### LOAD TIME

The overall goal of a web page should be to quickly deliver quality content in a fashion that does not cause the person to become hopelessly irritated. In this regard, "Time is a very big factor." Time becomes more of an issue when mobile computing on a hybrid device is considered. In the past a general rule of thumb is that a web page should load in less than eight seconds. More recent research suggests that business performance begins to decrease after a response time delay of 5.1 seconds. NetForecast's APDEX uses 4.0 seconds as the dividing line as to where users become frustrated (Godskind, 2009). Some users include too many images which can cause three problems: cognitive disorientation, slow downloads and excessive bandwidth use. Graphics should be used sparingly - only when they add value and have a point (Nygaard, 2003).

The primary element in making a website usable is its design. Unfortunately, many people are anxious to skip steps and just go for a "product", without considering the "basics". As in the engineering field, the design has to be "defined" up front, along with the goals and objectives of the site. One cannot test quality into a product; it has to be designed in it. However, designing interfaces is a complex problem, quite different from typical engineering challenges, because it deals with users' behavioral

aspects. Inadequate forethought, tight schedules, misconceptions, inappropriate attitudes and priorities: such as "Usability is a plus that we cannot afford now", and lack of professionalism are responsible for many of the poor sites (Marinilli, 2002).

### SCREEN SIZE

Like in any other medium the design should be aesthetically pleasing and balanced. To avoid optical confusion, the background needs to be just that, background. The site should use ample white spaces so that the site does not appear cluttered. A problem that developers face is that they do not know the size screen the user is viewing. The usability issue includes the fact that each version of each browser type may interpret web pages slightly different, with some browsers not supporting specific features (Apple and Flash). This is further complicated, in that there is a large mix of disparate technologies: different browsers, different versions of software, and different machine based applications. Further, there is a variety of different devices that are web enabled besides the standard desktop PC: TV's, cellular phones, watches, and PDAs. Each technology is associated with a different set of characteristics that limit its ability to be usable. Most websites were originally developed for viewing on "standard" monitors; the trend now skews toward mobile devices such as cell phones and tablets. A great deal of developmental effort is needed to successfully transition traditional web-

sites to smaller screen portable devices (Huang, 2003). This is especially true when certain usability aspects are taken into considerations. For example, the attractiveness aspect of the operability component in ISO 25010 is difficult to achieve when the mobile devices have only limited graphic capabilities. The ease of use aspect of operability component can also be quite restricted if the limitation is caused by the device itself (e.g., small screen space for data entry), rather than the web site.

### HARDWARE AND SOFTWARE ISSUES

Over time the size and density of the viewing screen has changed. Initially the standard screen size was 480 x 600, followed by 800 x 600, then 1024 x 768, and larger. The standard screen sizes allowed web developers target smaller sizes and to be confident that most users would be happy. This is no longer true; the devices that connect to the network can accept data faster - allowing for higher resolution images. They can process these images faster, and crisper with lower energy costs. In addition, the number of devices set to higher resolutions are on the rise. Just as important as the change in the popularity of resolution size is the introduction of new devices; mobility has caught on and is a tremendous force. It is not uncommon to see laptop computers, cell telephones, and tablets using WIFI and cell networks just about everywhere.

The newer equipment presents new concerns for the website developers;

different screen sizes and modes present information differently. The smaller the screen mode, the larger items appear on the screen, leaving less room (real estate) for information to be displayed. Differing mode sizes change the layout on the screen and can account for line shifts, sentences to be broken in midline, moved links, and many other irritating manifestations.

Another dilemma that can have an effect on the design is the browser that the consumer chooses to use. The most popular browsers are Internet Explorer, Firefox, and Safari. Various browsers and versions (even within the same vendor) may display items on a website differently. In some cases, certain elements and features such as videos, marquee, and colors can be viewed on some browsers and not on others. This dilemma is also related to the bigger issue of compliance, which is a key element of ISO 9126-1 for all six quality components (including usability). The compliance component is also recognized in the Product Quality Model of ISO 25010. A web site may be developed in compliance to the existing web standards, but it may still not be usable across all browsers. Not all browsers implement a complete set of features defined in web standards. Added to the complexity is that some browser manufacturers may decide to be compliant only to a certain degree on certain features. Therefore, a large part of web usability testing is to check not just whether a web site is compliant to existing web standards, but whether it is also consistent or compatible across browsers. This is the reason Compatibil-

ity becomes one of the key components of the Product Quality Model in ISO 25010.

### DISABLED USERS

A relative recent phenomenon in the realm of communication is the vast number of disabled sub groups and the computer usability functions that should be tweaked to accommodate those groups. The Federal Government has led the way with the Americans with Disabilities Act (ADA). Section 508 of the Rehabilitation Act now requires, among other things, that all web sites used by federal employees and members of the public seeking information and services from the federal government be accessible (Gerber, 2002). Entities under the ADA constrains are required to provide effective communication, regardless of whether they generally communicate through print media, audio media, or computerized media such as the Internet. While the ADA requirement does not apply to everyone, is it good practice to incorporate the necessary accommodations for those with disabilities. With the growth of computing technology many special needs groups are using the web to make things easier and with a population of approximately "57 million people classified as having a disability" (U.S. Census 2010), it makes sense for an organization to incorporate ADA requirements now.

### NAVIGATION

There are many issues that need to be taken into account when creating an easy

to use website. The layout of the screen is central to the user's ability to recognize information. Information must be placed in a logical order and its physical location should be taken into account. Web page content can be longer and wider than the visible portion on a screen, causing the user to have to scroll down or across to see the rest of the content. Generally speaking scrolling should be minimized, and avoided on navigation pages because hyperlinks below the fold (browser bottom border) are less likely to be seen and chosen (Nielsen, 1999). The screen is typically considered to be divided into nine asymmetrical regions (similar to a tic-tac-toe board) with each region associated with its own prominent use characteristics. Typical "European" style languages read from left to right; therefore, it is generally considered appropriate to put the more important information on the left side of the screen; so that the viewer reads it first before interest withers.

The three click rule should be taken into account. The rule indicates that users should be able to obtain data from all content on the website within three clicks from the home page. The content of the information should also be fresh and up to date (Langer, 2000). Hyperlinks need to be accurate and clearly marked. They should also be placed at the bottom of long pages. Once accessed these links should change color. Each level in the site should allow the viewer to go back to the previous level and forward to the next. As a viewer gets deeper into the site, a link should be present that allows the user to return to the opening page so

that the navigation can begin anew if so desired. Nothing is worse than having a user become frustrated because a means to either exit or restart is not present or apparent.

It is very important, in any discussion of hyperlinks, to note that there should be no dead links. It is annoying to go to a site and click on a link and have nothing happen, or to come back with a "404 error," page not found. It is like reading a newspaper or magazine article and the continuation is not there. Some feel that a link that leads to a page that states "under construction" is equally annoying - if a page is not ready, do not post it.

The web page itself needs to cater to the needs of the user. Many developers feel that it is extremely important that each web page contain contact information or at least link to a page that has the contact information. From a user's perspective, it is extremely frustrating to want to place an order and run into problems and not be able contact anyone for assistance. Further, the responses generated by the site needs to be monitored and responded to in a reasonable amount of time. The "standard" being adopted by many organizations is to respond within 48 hours. Failure to respond to contact information can acerbate the situation.

A "site map" can also be helpful in making a site user friendly. In its simplest form a site map lists everything that is located on the website and provides navigational links to get to the information. This is important because it lets the viewer know what is and is not on the website (Krug, 2000).

### COLOR

Color schemes play an important role in usability, they help tie pages together and assist with navigation. Color impacts the website in many ways, it can add to the value by helping to organize the site, or detract by making it harder to read the web pages. To aid in eliminating confusion page colors and design should be consistent throughout the site. Radically changing a site's "look and feel" may cause the user to question whether they are on the same site. Within a web page, color can be used as an effective tool to help categorize products.

A website that would otherwise be "perfect" can be totally unusable if the colors are inappropriately chosen. Color contrast is also important; as an example, some sites are not readable (usable) because the background color or the design is as dark as the font color. Contrasting colors need to be used so that viewer can read the information on the site easily. Dark fonts with any light background works well. Another issue concerning color is viewers with visual disabilities; some developers give users the ability to select a theme (foreground and background) colors that are easy on their eyes. This is important because not all colors are displayed the same across different browsers or machines. There are a few simple color rules that can aid in the construction of a successful site (Cannon, 2012).

Developers should be aware that The World Wide Web Consortium (W3C) has identified 216 browser safe colors. Developers should stay away from red and

green backgrounds, ensure high contrast between background and foreground colors, and avoid busy background patterns that interfere with reading. To avoid confusion, the default hyperlink colors (such as blue for unvisited links and red for links already visited) should not be altered. Standard hyperlink colors should be avoided for text.

### USABILITY MODELS

Many developers' subscribe to the idea that the first step in making a site usable is to think about usability and the information architecture of the site before it is actually developed. Because the success of a site is based on the metaphor of how a site will be used, by whom, and in what environment; it is essential to define the purpose of the website and the expected audience (Rosen, Purinton, & Lloyd 2004). This is an important issue because it determines the type of information, the breadth, as well as depth. Three basic website models (Falk, 2000) are: the Presence Model (often refer to as the "me too model"), Informational Model, and the E-Commerce Model.

#### Presence Model

These websites are designed to establish a presence on the web but not really to accomplish anything more than "I am on the web too". They do not usually contain a lot of information, but they often point to other sites that may. They are often used by individuals to share pictures and such with their friends. Organizations have used this model in the

past as a promotional tool to show that their organization is progressive. This type of site is used mostly by smaller organizations that either do not have the expertise to design a more in-depth site or the manpower to maintain it.

#### Informational Model

The web pages in this model are usually heavy with information. These web pages are set up so the user can get to specific information. A lot of software or computer companies use this model to provide access to Frequently Asked Questions (FAQ), so that they can limit the amount of traditional support that they might otherwise have to provide. Organizations that use this model often refer telephone callers to their website, and consequently miss the opportunity for one-to-one sales.

#### E-Commerce Model

This model typically employs dynamic web pages and is designed to: create, support, and establish sales. There usually is enough information on these sites so that the viewers feel sufficiently comfortable to make a purchase. These sites are run by companies with the expertise to quickly update and maintain online inventories.

### FUTURE TECHNOLOGY TREND

The future of website usability is changing, not just because of our understandings of how people actually use websites;

but also because organizations and consumers are demanding more from the web presence. New Internet accessible devices are being introduced, so the earlier semantic metaphor of a "desktop" is no longer viable. Many users of a network do not use desks. Examples include delivery personnel who use automated Internet accessible clipboards to report deliveries, or Inventory control agents that remotely report sales activity and volume. Among the cutting edge Internet devices are a new breed of portable equipment that enhance the issues associated with mobile commerce. Presentation platforms have grown to include things such as: Smartphone's, Televisions, Wrist Watches, Tablets, Radio and Video Receivers and Recorders, and Portable Marquees. Additionally, software tool vendors are continuously introducing new features and techniques; unfortunately, this often detracts from the organizations' message rather than adding to it.

### RESEARCH AND ASSESSMENT

#### Item Measurement

The several international standards reviewed in the first few sections of this article have laid out a foundation as to what constitutes usability. Even though we still see disagreements between ISO standards and research publications (and to some extent inconsistencies between older and more recent ISO standards), the trend seems to converge the many

thoughts into a common set of usability components. While it is beyond the goal of international standards to mandate how each usability component is to be assessed, the actual instrument for assessment perhaps is better conceived through an active and critical study of the intended context. For example, the usability requirements (or to a larger extent the weight for each usability component) for entertainment web sites are not necessarily the same as compared to corporate web sites.

Some researchers have started to look at how and whether a common set of questions may be possible to measure each usability component. Dix et al. (1993) shows a model with 3 measurement items for the Effectiveness component of usability, 7 items for Efficiency, 3 items for Satisfaction and 1 item for Learnability. Nielsen (1994) has 1 item for Effectiveness, 5 items for Efficiency, 2 for Satisfaction and 1 for Learnability. It is important to caution that some of the usability components (such as Productivity, Quality, Satisfaction, and Efficiency) are measured quite differently outside of the usability discipline. In looking at the Satisfaction component, the literature shows that the construct may be approached from behavioral, affective and cognitive angles. It can also be measured with surrogate items, such as return purchase or continued use. It may be helpful in the continuing development of usability to try to recognize key constructs relating to its measurement and validation by looking at other more established fields.

### Targeted Usability

Identifying key usability components is typically a start for any usability study, but a key question is "to whom" the usability of a product or service is designed for. A broader question posed by Massey, Khatri and Montoya-Weiss (2007) is how requirements and perceptions of usability might vary across different web sites, users or access methods. Research in this area has been quite limited. Massey's research marks one of the early works that looks into contextual differences (hedonic versus utilitarian web sites), access methods (desktop versus wireless web) and one of the psychographic characteristics - technology readiness. The results suggest that usability is perceived differently across different types of technology readiness, access methods and contextual situations. As the international standards and prior research stress the importance of context difference in usability studies, it is also useful to note that psychometric, experience and other demographic differences may contribute to the variations of perceived usability even within the same context.

### CONCLUSION

This paper explored concepts of usability as it refers both physical and online issues. The paper was not intended to be the definitive statement on what is and is not important in the construct of usability. It is anticipated that usability will continue to mutate as new service and technologies are developed and de-

ployed. It seems inevitable as individuals taste in computing devices change so will the need for flexible, easy to use, and understandable devices.

Already the unthinkable, the mighty PC role is being usurped by tablets and smart phones. A new breed of computing devices is on the verge of making its entrance. Wearable computing technology, Google eyeglasses, Samsung wrist watches, "Heads-Up Display" (HUD) technology - adopted from the military (any transparent display that presents data without requiring users to look away from their usual viewpoints) and other nerve based interfaces are giving a whole new meaning to HCI - Human Computer Interfaces. It is evident from the research cited in this article that contextual differences (new services, technologies, mobile, etc.) as well as demographic and behavioral differences may lead to variations of intended usability.

Further, the construct of usability is not the "end all", silver bullet that cures all. In the early days in an effort to make life easy for the operator, security was not considered. In some locations where password mechanisms were installed, all users simply used the same login credentials. Such an approach was easy and efficient from the users point of view. However, this approach was one of the catalysts for security to quickly become an issue. From an online point of view, early electronic commerce research documented that security is a major concern for those who shop online (Soekel et al., 2007). Chen (1999) indicates that buyers are likely to lose faith

in sites where security or seller's trust is questionable (Elliott & Speck, 2005).

Usability for cyberspace concerns not only the usefulness of certain offerings (i.e., Web site content), but also the user interface that delivers these offerings. Shoppers want sites that are valuable and easy to use. Features that aid the users can help retain visitors' interests. Although interface usability is crucial for an e-tailing site to foster a pleasant online experience, caution should be exercised when relying on usability as the sole factor to boost online sales.

The ISO international standards and current usability research reviewed in this article seem to point to a convergent set of usability components. The history of usability studies suggests that the composition of the usability construct expands as technology becomes enhanced. Key elements, such as accessibility and compliance were not apparent in early international standards, but are included in recent research and standards. Some long time usability components (such as learnability, efficiency, effectiveness and satisfaction) are subject to variations of measurement since these key concepts are also heavily researched by outside disciplines. Practitioners should strategically position their usability goals keeping in mind that variations may still come from contextual, demographic and behavioral differences. This is the main reason why many usability experts recommend against forcing users to "learn to navigate" your site or software.

### REFERENCES

- Abnan, A., Khelifi, A., Suryan, W., & Sef-fah, A. (2003). Usability meaning and interpretations in ISO standards. *Software Quality Journal*, 11(4), 325-338. doi:10.1023/A:1025869312943
- Badre, A. (2002). *Shaping web usability: Interaction design in context*. Addison-Wesley.
- Bevan, N. (1999). Quality in use: Meeting user needs for quality. *Journal of Systems and Software*, 49(1), 89-96. doi:10.1016/S0164-1212(99)00070-9
- Briggs, R., & Hollis, N. (1997). Advertising on the web: Is there response before click through? *Journal of Advertising Research*, 37(2), 33-45.
- Calongne, C. M. (2001). Designing for website usability. *JCS*, 16(3), 39-45.
- Cannon, T. (2012). *An introduction to color theory for web designers*. Webdesing Tuts+. Retrieved from <http://webdesign.tutsplus.com/articles/design-theory/an-introduction-to-color-theory-for-web-designers/>
- Chen, K. (1999). *Factors that motivate internet users to use business-to-customer electronic commerce*. Ph.D. dissertation, Cleveland State University.
- Chen, K., & Soekel, H. (2001, August 3-5). Enhancing visibility of business websites: A study of cyber interactivity. In *Proceedings of Americas Conference on Information Systems (AMCIS)* (pp. 547-552).

- Cheung, C., & Lee, M. (2005). The asymmetric effect of web site attribute performance on web satisfaction: An empirical study. *e-Service Journal*, 3(3), 65-86.
- Cunliffe, D. (2000). Developing usable websites - A review and model. *Library Computing*, 19(3/4), 222-234.
- Dix, A., Finlay, J., Abowd, G., & Beale, R. (1993). *Human-computer interaction*. Englewood Cliffs, NJ: Prentice-Hall.
- Dominick, J. (1999). Who do you think you are? Personal home pages and self-presentation on the world wide web. *Journalism & Mass Communication Quarterly*, 76(4), 647-658. doi:10.1177/107769909907600403
- Elliott, M. T., & Speck, P. S. (2005). Factors that affect attitude toward a retail Web site. *Journal of Marketing Theory and Practice*, 13(1), 40-51.
- Falk, L. (2000). Creating a winning website. *The Public Relations Strategist*, 5(4), 37-40.
- Fitcher, D. (2005). Web development over the past 10 years. *Online*, 29(6), 48-50.
- Galletta, D., Henry, R., McCoy, S., & Polak, P. (2004). Web site delays: How tolerant are users? *Journal of the Association for Information Systems*, 5(1), 1-28.
- Gerber, E. (2002). Conducting usability research with computer users who are blind or visually impaired. In *Presented International Conference of California State University*.
- GHSA. (2013). *Distractions driving laws: governors highway safety association*. Retrieved from [http://www.ghsa.org/html/stateinfo/laws/cellphone\\_laws.html](http://www.ghsa.org/html/stateinfo/laws/cellphone_laws.html)
- Godskind, K. (2009). *5, 10, 15 seconds? How long will you wait for a web page to load?* Retrieved from <http://blog.smartbear.com/software-quality/5-10-15-seconds-how-long-will-you-wait-for-a-web-page-to-load/>
- Hart, C., Doherty, N., & Ellis-Chadwick, F. (2000). Retailer adoption of the internet: Implications for retail marketing. *European Journal of Marketing*, 34(8), 954-974. doi:10.1108/03090560010331441
- Huang, A. (2003). An empirical study of corporate website usability. *Human Systems Management*, 22, 23-36.
- ISO/IEC 9126-1. (2001). *Software engineering - Product quality - Part 1: Quality model*. ISO.
- ISO 9241-11. (1998). *Ergonomic requirements for office work with visual display terminals (VDTs) Part 11: Guidance on usability*. ISO.
- ISO/IEC 9126. (1991). *International standard (1st ed.)*. (dated February 20, 1998). Retrieved from <http://www.dis.uniroma1.it/~monsca/Didattica/progsw08/slide08/S.1.4%20-%20Lo%20standard%20ISO%209126%20sulle%20qualita%27%20del%20software.%201991%20-%20ProSW.pdf>
- Kotha, S., Rajgopal, S., & Venkatasalam, M. (2004). The role of online buying experience as a competitive advantage: Evidence from third-party ratings for e-commerce firms. *The Journal of Business*, 77(2), S109-S133. doi:10.1086/381639
- Krug, S. (2000). *Don't make me think: A common sense approach to web usability*. New Riders Publishing.
- Langer, M. (2000). *Putting your small business on the web*. Peachpit Press.
- Lew, P., Olsina, L., & Zhang, L. (2010). In B. Benatallah et al. (Eds.), *Quality, quality in use, actual usability and user experience as key drivers for web application evaluation, in web engineering* (pp. 218-232).
- Lu, M. T., & Yeung, W. L. (1998). A framework for effective commercial web application development. *Internet Research: Electronic Networking Applications and Policy*, 8(2), 166-173. doi:10.1108/10662249810211638
- Marinilli, M. (2002). *The theory behind user interface design*. Retrieved from [http://www.developer.com/design/article.php/10925\\_1545991\\_1](http://www.developer.com/design/article.php/10925_1545991_1)
- Massey, A. P., Khatri, V., & Montoya-Weiss, M. M. (2007). Usability of online services: The role of technology readiness and context. *Decision Sciences*, 38(2), 277-307. doi:10.1111/j.1540-5915.2007.00159.x
- Nielsen, J. (1994). *Usability engineering*. Boston, MA: Academic Press.
- Nielsen, J. (1999). User interface directions for the web. *Communications of the ACM*, 42(1), 65-72. doi:10.1145/291469.291470
- Nielsen, J. (2000). *Designing web usability*. New Riders Publishing.
- Nielsen, J. (2003). *The ten most violated homepage design guidelines*. Retrieved from <http://www.nngroup.com/articles/most-violated-homepage-guidelines/>
- Nielsen, J. (2012). Usability 101: Introduction to usability. *NNGroup*. Retrieved from <http://www.nngroup.com/articles/usability-101-introduction-to-usability/>
- NRC factsheets. (2013). Retrieved from <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html>
- Nygaard, V. (Sept., 18 2003). *Top ten features of a good website* (pp. 1-2). Retrieved from [www.webdesignbits.com](http://www.webdesignbits.com)
- Pagani, M. (2009). *Encyclopedia of multimedia technology and networking* (2nd ed., Vol. II, pp. 533-538). Information Science Reference.
- Perrow, C. (1982). The president's commission and the normal accident. In D. Sils, C. Wolf, & V. Shelanski (Eds.), *Accident at Three Mile Island: The human dimensions* (pp. 173-184). Boulder, CO: Westview.
- Rau, P., Liang, P., & Max, S. (2003). Internationalization and localization: Evaluating and testing a website for Asian users. *Ergonomics*, 46(1-3), 255-271. doi:10.1080/00140130303527 PMID:12554410



- Rogovin, M. (1980). *Three Mile Island: A report to the commissioners and to the public* (Vol. 1). Nuclear Regulatory Commission, Special Inquiry Group.
- Rosen, D., Purinton, E., & Lloyd, S. (2004). Website design: Building a cognitive framework. *Journal of Electronic Commerce in Organizations*, 2(1), 15-28. doi:10.4018/jeco.2004010102
- Rouse, M. (2007). *Nomadic computing (Mobile computing)*. Retrieved from <http://searchmobilecomputing.techtarget.com/definition/nomadic-computing>
- Seffah, A., Donyaee, M., Kline, R. B., & Padda, H. (2006). Usability measurement and metrics: A consolidated model. *Software Quality Journal*, 14(2), 159-178. doi:10.1007/s11219-006-7600-8
- Shneiderman, B. (2000). Universal usability. *Communications of the ACM*, 43(5), 84-91. doi:10.1145/332833.332843
- Socket, H., Falk, L., Warren, H., & Chen, K. (2007). A mental model to capture eCommerce atmospherics. *Journal of International Business Disciplines*, 1(2).
- Swaminathan, V., Lepkowska-White, E., & Rao, B. P. (2003). The Internet and consumer buying behavior: A research framework and analysis. In C. Steinfield (Ed.), *Current topics in e-commerce* (pp. 64-84). West Lafayette, IN: Purdue University Press.
- Teotia, S., & Shashi, T. R. (2012). Challenges, methodologies, and management issues in the usability testing of mobile applications. *International Journal of Marketing and Technology*, 2(2), 282-292.
- U.S. Census Bureau News. (2012). *Profile America facts for features*. CB12-FF.16.
- Walker, J. Samuel (2004). *Three Mile Island: A nuclear crisis in historical perspective*. Berkeley, CA: University of California Press. ISBN 0-520-23940-7.
- Walker, J. S. (2004). *Three Mile Island: A nuclear crisis in historical perspective*. Berkeley, CA: University of California Press.

## The Impact of Standards in Web Services Security

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### ABSTRACT

The Internet has provided an avenue for businesses to adopt web services. Web services promises scalability, agility, cost reduction, profitability and availability thereby meeting instant gratification needs of web users'. It refers to modular Internet-based business functions that perform specific business tasks to facilitate business interactions within and beyond the organization. While addressing web services benefits there have been discussions on the importance of its security. The security of web services has deeply influenced its development and is also one of the main reasons why web services have not been adopted widely. Therefore, this study aims to examine the impact of web services standards and how it facilitates web services security. We analyze security models in web based technologies from previous studies such as; in cloud computing and security as a service technologies to develop a framework of web services standards and its impact on web services security. We then discuss the theoretical and practical implications of web services security and directions for future research.

**Keywords:** Security, SOAP, Standards, UDDI, Web Services, WSCI, WSDL, WSFL, XML

### 1. INTRODUCTION

Web services are rapidly becoming the enabling technology of today's e-business systems. Web services are

interoperable and loosely coupled components used for simplifying business processes over the Internet (Tewari, Thakar & Dagdee, 2013). Businesses use existing software components specified

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