



School of Computing
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Web Site Usability

Technical and Social Perspectives

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ABSTRACT

World Wide Web (www) has achieved an important role in communication, information sharing and service delivery now-a-days. World Wide Web consists of millions of web sites and web based applications which are deployed and can be visited all over the world without the limitation of time and geographical boundaries. Web site usability, security and reliability consider some of the core aspects in designing of web sites. In this thesis, we explore possible tensions and tradeoffs between usability and security issues in web site design. We discuss web site usability issues in terms of technical and social aspects. We discuss web site security in terms of usability and offer some recommendations for secure website design without compromising the web site performance. We also highlight the importance of ease of navigation and other aspects of user interface design.

In order to explore these issues, we have chosen to review the related literature. We have also conducted interviews with professionals who are mainly concerned with web site usability. Two sample interviews are available at the end of this thesis report.

Keywords: Usability, web site usability, interfaces design.

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CHAPTER 1

Usability and its Technical Aspects

Human factors and usability issues have traditionally played a limited role in security research and secure systems development. System designers have disregarded usability concerns for the reason that they are not acquainted with them or sometimes they do not take into account the importance of the human factors.

Addressing issues of usability and human factors could be an important part of way out for today's security tribulations. Well-publicized security problems are often attributed to human errors that can be tackled with the use of secure and usable software. Also there exists a need for deployment of security technology that allows non-technical users to use the system as well. Still, many people believe there is an inherent tradeoff between computer security and usability. It is understandable that people need to use computers in everyday life today, but what happens if the system is not secure? The result of using non-secure systems may be a hacked, compromised system or otherwise non-trustworthy or useless system.

There is increasing agreement that we need to design secure systems that people can actually use, but less agreement about how to reach this goal (Cranor and Garfinkel, 2005). According to Nielsen (2000) there exists a conflict between web site usability and security that he defines as:

Usability advocates **favor making it easier to use a system**, ideally requiring no special access procedures at all, whereas

Security people **favor making it hard to access a system**, at least for unauthorized users. There exists a need to resolve this conflict (security tradeoffs). The optimal goal for security can be said to be when the system allows for the minimized amount of unauthorized access. The following section provides an overview of the main characteristics of usability and related recommendations to deal with issues of security of web sites.

Characteristics of Usability

According to Abran and Suryn (2003) there are a number of central characteristics of usability which are listed and further described below:

- Effectiveness
- Efficiency
- Satisfaction
- Security
- Learnability

Here we will elaborate the selected features of usability which have problems and what are the causes of such problems and what can be suitable guidelines. These recommendations provide an idea how to deal with web site usability without compromising the web site security. The selected set of features of those standards is: effectiveness, efficiency, satisfaction and learnability and we can graphically represent it as follows in figure 1.1.

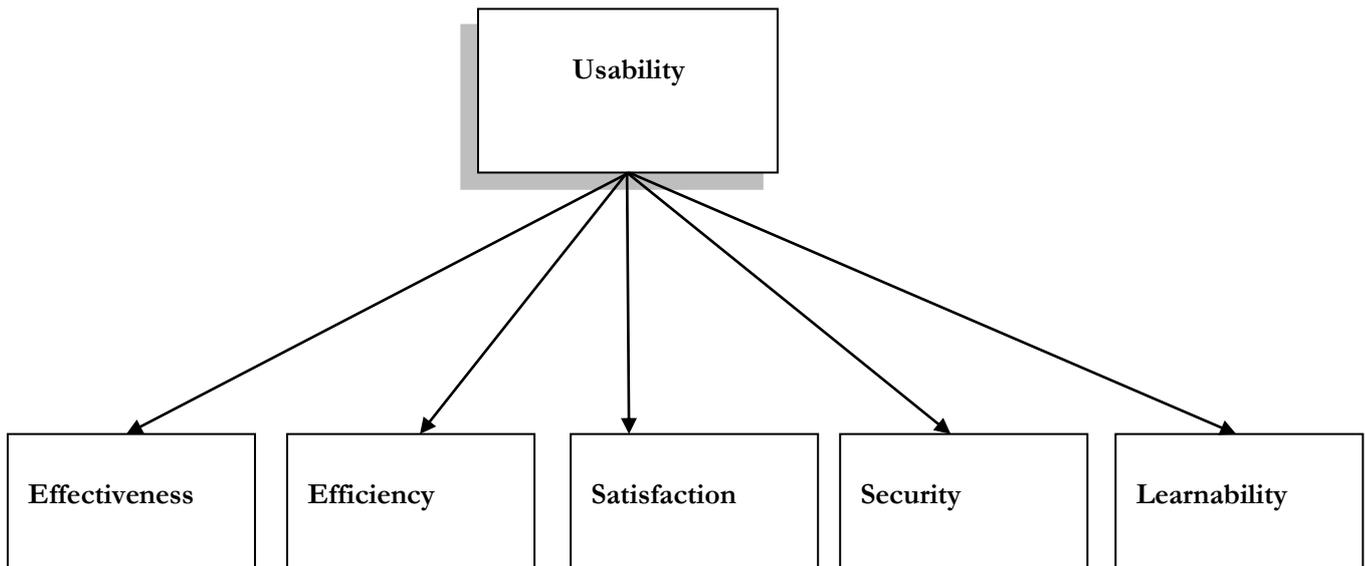


Figure 1.1; A graphical representation of usability characteristics.
 Source: Abran, Khelefi and Suryan, 2010

Effectiveness and Security

Effectiveness and Security describe “the accuracy and completeness with which users achieve specified goals” along with providing good security (Bevan, 2001). In case of password’s protection, the password protection mechanisms are very inconvenient to the users to enhance their security. So these users possibly face new security threats (Braz et al, 2007). As a result due to lack of effective usability the strong security policies turn into weak security. Moreover, Whitten and J.D (1999) say that “User errors cause or contribute to most computer security failures, yet user interfaces for security still tend to be clumsy, confusing, or near-nonexistent.”(p.169)

.For effective security, different software requires different standards. So these are different acceptable levels of usability and security effectiveness.

Recommendations and Guidelines: Designers should provide an easy to use and easy to understand interface, less complex, because the average web user probably has limited or no understanding of the technical material and hence the designer needs to provide support for better understanding of warning messages, wizards (if any) and other interacting tools etc.(Yee, 2004). It is highly recommended that designers should take into account security measures in the early stages of software development to get an optimized, usable and secure design.

Efficiency and Security

This is considered as quite sensitive aspect of usability since designers have to compromise on security in order to have achieved efficiency especially when dealing with content distribution like a small amount of video that is selected for watermarking and encryption. The combination of security with efficiency sometimes calls for carefully considered compromise because there is a need to implement security efficiently with all respect in concern of speed and accuracy in the use situation (Duma et al, 2003)

Recommendations and Guidelines: Since efficiency is a very sensitive issue in any web site design, special care has to be taken related to the efficiency attributes like speed and accuracy while keeping in mind security attributes, for example user authentication etc. Designers should

be aware about the less-secure states because there are scenarios when security implementation is difficult to apply due to speed and accuracy concerns. So a good compromise between efficiency and security issues is achieved when the security attributes are not compromised and yet do not seriously reduce the speed and accuracy of the web site in use situations.

Satisfaction and Security

Why do companies make web sites? Why are more and more businesses shifting from legacy business to e-business? Why are most government departments adopting e-government directorate? Why is it becoming important to have a web site for almost every area of life? The very simple answer is to “satisfy” the customer / visitor. Now consider the situation where the user is visiting your web site and this visitor was not satisfied with the security on the web site and hence lost “trust” in it, with the result that the visitor left the web site and will probably not return to use it again. So designers should focus on the satisfaction of the user and what the user expects of the working environment without compromising the security issues. Dealing with payments, transactions, digital products are common examples of when user satisfaction and security interact. The main issue in the online services is the user’s satisfaction with the services, with security policies building customer trust and ensuring privacy of the customer.

Recommendations and Guidelines: This is a very important area in terms of financial institutes like banks and others which are concerned with financial transactions. For example, banks should provide a satisfactory working environment so the user feels secure while working with financial data and the user should feel secure and comfortable during the processing of the tasks. To explain the concept with a very simple example, Nordea Bank (famous commercial bank in Sweden) has been selected and below figure with marks shows how they meet up with the demands and needs concerning security and user satisfaction.

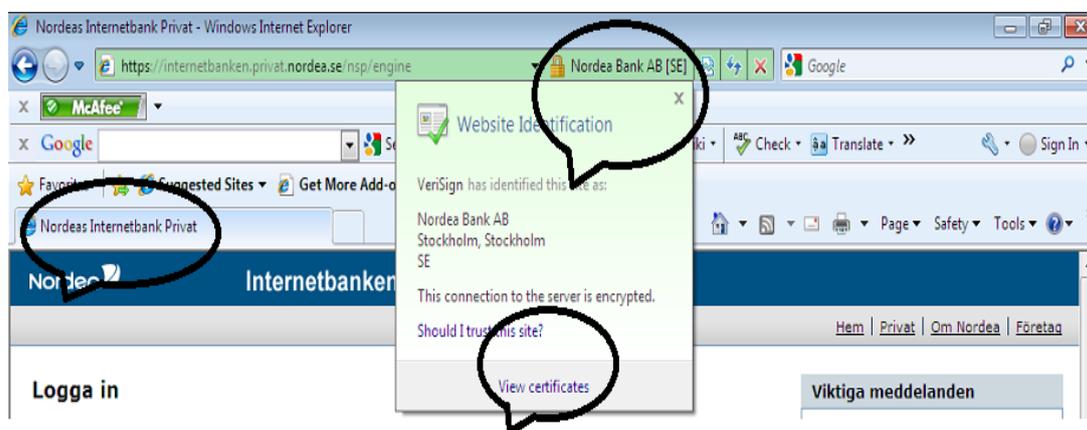


Figure 1.2; Identification of a secure web site.

Image Source: <https://internetbanken.privat.nordea.se/nsp/engine>

In figure 1.2; when user clicks on the INTERNET BANKING, the web site shows the SECURE link with the symbol of LOCK showing user that you are in the secure area. Now, since by means of Internet Banking you can make financial transactions, you can shop online, pay bills, transfer funds to other accounts etc. And you can get the details of the security of the web site by clicking on the lock icon and you will see WEBSITE IDENTIFICATION that provides you with more information about the web site etc. So here you can see that the provided information is intended to ensure that the user feels secure while utilizing this online service.

Further, the user should be satisfied with the „safety and privacy of personal data“. For instance, the web site should state in the privacy statement that the user’s crucial data (passwords, PIN codes, credit card numbers etc.) will not be saved, not shared and not revealed to anyone.

Learnability and Security

This relates to the web site literature and concerns if the system is easy to learn and use. The learnability is important to consider because there exist some secure systems that are not used unfortunately just due to the difficulty implicated in the system and the extreme security constraints for the task completion (Yee, 2004).

Recommendations and Guidelines: Perhaps the most common problem concerning web site usability is the issue of learnability or lack of it. The design is considered to be an optimized design if there is a balance between security and learnability. Unfortunately in some circumstances learnability prevails over security. The web user in most cases is not concerned with the technology used to develop the web site (for example ASP /ASP.NET / JSP / PHP / XML / CGI etc). And the user also is not concerned with how the security polices and checks are constructed. But they are concerned with the information that they are supposed to find on the web site. So the right tradeoff between security and learnability is to have a more learnable system that does not compromises security, that is, learnability issues should not prevent designers from incorporating proper security into the system.

CHAPTER 2

Research Questions and Methods

Research Question Addressed:

In chapter 1, an overview of the main characteristics of usability was presented. General guidelines and recommendations concerning how to combine security with usability in web site design were listed. In this chapter our research questions and methods are presented and discussed. Already in the guidelines and recommendations presented in the previous chapter, it is clear that there are tradeoffs between security and usability. The research questions are intended to support further exploration of these issues. In our study, we have thus focused on the following research questions:

- Are there any tradeoffs between security and usability?

- What are the main the usability issues according to related literature?

- What relationship can be identified as being sandwiched between usability and user experience?

Methods

In this study we have combined a literature review with a minor field study. In the literature review, we explored research papers mainly selected from the IEEE community publications (IEEE stands for Institute of Electrical and Electronics Engineers, and is the world's largest professional organization dedicated to advancing technological innovation and excellence for the benefit of humanity) and master's theses available at the BTH web related to our topic and research questions. Observations and feedback from the customers which we have experienced in our own work environment are also analyzed and merged in this thesis report. For instance, Naveed Anwar has worked as "Network Support Engineer" for a Web Hosting Company and Adam Kwoka is an MBA and working in a business and IT environment. During the field study, data was collected by interviewing web designers and developers at his workplace who are involved in the design of the user interface. Chapter 4 is mainly based on the data analysis based on the interviews. The results of our study are thus based on interviews, literature review and personal experiences and feedback from web users about a particular website.

A sample interview is available at the end of this thesis that mainly focuses on the technical aspects of the user interface design (UID) (see Appendix 1)

One more interview is also available which highlights that usability is essential for the success of online business (see Appendix 2)

Are there any tradeoffs between security and usability?

According to interviews that we have conducted with Network Support Engineers at a Web Hosting Company, they speak about the user experiences and questions related to website security and usability issues due to security (Please see the Appendix section for the sample interviews). In other words, they are talking about the logical balance between the web site being perceived as secure and being perceived as usable by the users. Human factors must not be forgotten while designing secure

systems and security policies. For example, consider a security policy of user authentication that requires the change of password after every week and the password must contain a random combination of letters, symbols and digits, making it difficult to memorize.. Of course users can't cope with that kind of security policy. Conversely, if users are allowed to use any password they like and the password does not require changing after a certain time, then in this case the system risks rapidly becoming a highly non-secure system. There exist security policies that are user friendly but technically insecure, as well as ones that are very difficult to use but technically secure. One usability study shows that users do not like to configure things, particularly multifarious security technology that they don't understand (Balfanz et al , 2004). Authentication methods are compulsory for access control in a secure system. Still design of usable yet secure user authentication methods raises significant questions concerning how to determine conflicts linking security and usability goals (Braz and Robert, 2006).

Identification of usability issues according to related literature

In today's world no one can negate the importance of web applications and the advantages obtained through and with web applications. But still there are some issues that the web user encounters while surfing web applications. According to Bruno (2005), the following categories are relevant to apply and explore in this context:

- User Category
- Task
- Technology

According to the scope of this thesis we will focus on the web issues, but these issues are also applicable in traditional software as well.

User Category

This section highlights the usability issues related to the user category. Some authors argue that older people take a bit of much time as compared to young users before they can click on the submit button on web applications. Normally they have to read the text to get an understanding of the behavior of the system by clicking or pressing the button. This happens due to the reason that the normally a long text is mentioned that may be confusing especially when a user input is required. Text reading can also be difficult due to other stuff available on the web page for example images, forms and banners etc.; that may be a reason to delay in searching the related information on the page. The success rate of user task depends on locating the desire information In the context of mobile devices, due to narrow display available and widespread scrolling causes intricacy in locating and reading the contents (Shrestha, 2007).

One more problem for older persons is the knowledge of the information flow. Uniform resource locator (URL) is mostly confused by old peoples as they cannot understand the location where they are (Chadwick-Dias et al., 2003). For this kind of persons, the generations of the popup windows also detract the attention of user and they might be able to forget where they were and what was done.

(Becker, 2004) also pinpointed the issues encountered by the old people while surfing the web applications due to age factor and these issue are: vision, cognition and literacy.

The vision factor is the diminution of elasticity in the lens that causes the object to view accordingly. Of course these kinds of visualization factors affect the use of web site. For many old peoples background images and properties of fonts also cause the disturbance in completing tasks. Further, bad navigation schemes and complexity involved to search something also affects the use of web site by old people (Umar A. and Tatari K.2008)

Task Category

According to (Bruno, 2005) the issues related to the type of task category are concerned with the type of web site and the items placed in the web site. Let's start our discussion on this by looking the search and search engine first. The its quite common and obvious functionality of web site to have a search service that facilities a web user to search the desired information on the web site. Although modern search engines are quite optimized but still the web users complain about the problems when they use search functionality. The users of the web can be of any category, they may have understanding of the computer and technology or other category that has a limited understanding of the technology and computers. Difficulty occurs when the web sites uses the multiple search engines. An example is search on-site or internet search. Disappointment and irritation occur when the user query does not display the desired results. The plural, hyphens, special characters, wrong phrases influences the effectiveness of a search query (Tom et al., 2002).

Navigation is also an important task while surfing the web applications. The amount of text on the web site, the size of the text, placement of the text and the web links affects the usability of web page. The importance of navigation can be analyses in such a way that, most of the user uses the "back" button instead of the navigation link. It's of most important in the online shopping when user buy something online and add to his basket, then instead of using navigation or links the most of user press the Back Button of the browser, and as a result the preceding page with vacant basket will be present in front of user. This can be frustrating to the user to see the empty basket and they might feel they have to place the order again or do same function twice (Lee, 1999).

Issues related to technology

Here we will discuss issues related to the technology. Technology encompasses all the types of hardware, software and other services that are used by the users for example computers, networks, information systems, internet services, mobile phones and telecommunications, PDAs etc. The web is a service that is available on the internet and the internet is an arrangement of the network of the associated organized networks. Prior to the web application can be accessed the interconnected networks also take part. Different category of network may influence in the traffic between two sides. As a result the web site with a lot of multimedia stuff like flash animations, images may lessen the downloading speed of the page and causes the webs site accessibility problem. Since the web services are being accessed with heterogeneous devices for example desktop computer, notebook computer, mobiles, PDAs etc. Each device has its limitation towards the internet. Some deceives are perfect in the display of large web pages but in case of mobile devices, the display screen is small and frequent scrolling is required that may cause the frustration to the completion of user tasks (Shah,2009).

Identification of the association sandwiched between usability and user experience.

Why web sites are being created? Why some web sites has great number of visitors as compared to others? Why more and more businesses are having web sites and converting from the traditional approach of business to electronic business (e-business)?

All the above questions are typically when we relate the web site usability to the user experience. We cannot limit the scope of usability to only the interaction between a product / service and its user but it contains more that can't be underestimated i.e.; satisfaction of user and the functionality of product.

$$\text{Usability} = \text{Interaction between user and product} + \text{User Satisfaction \& Product Functionality}$$

There exist some features that persuade the mindset of web users. These factors may include the user's expectations from the product, environment where the product is used and the ability of system (Roto and Kaasinen, 2008). From the different literature and interviews it can be concluded that usability affects the user experience. For example one interview conducted with the Network Support Engineer in a Web Hosting Company reveals that their indirect users (users or their resellers) complaints about the usability problems. So the company makes a norm called "your satisfaction is our priority" to listen the user experiences and do modifications in the design accordingly.

A more detailed discussion is available in the section titled "Usability and its Social Aspects". In this section user experience and expectations are listed as well as some practical guidelines to improve the design that leads towards the maximum user satisfaction and of course a useable web site.

CHAPTER 3

Usability and its Social Aspects

This section provides details about the social aspects of the web site usability. We draw some recommendations based on our experience and personal usage of the web sites. Also it shows how end user interacts with web site if there is any change in the look and feel of the web site. It's not the product or service that a user interacts first; it's the design of the web site. The product or services available on the web site user evaluates later but the first thing the user get interacts is the web site. If the web site is easy and user friendly user will stay on the web site otherwise will leave within a while.



Figure 3.1; Usability Problem.

Source: http://www.masternewmedia.org/images/usability_testing_vs_expert.jpg

In figure 3.1 a boss is showing poor web site design to the employee and discussing how customers can interact with this poor web site design. Picture depicts that boss has visited the web site from a customer's point of view and failed to find what he is looking for.

According to market research from Gartner Group, 50% plus online sales are lost because visitors cannot find what they are looking for. Usability directly affects the company capital. Web users will get panic if the design is difficult and they can't find what they are looking for.

Social aspects related to design of web site and layout with respect to end user thinking:

This section includes the following:

- Ease of Navigation
- Selection and consistency of color palette

- Maintaining confidentiality of personal data
- Change Management and Feedback

Ease of Navigation

According to Hudson (2004), the web is navigational environment and travelers (web site visitors) walk around in this virtual world by activating hyperlinks. To fulfill the information needs of the web users and the success of the web site, web site must have a systematic, planned and logical navigation system that meets the expectations of the real world navigation.



Figure 3.2; Web Site Navigation

Source: <http://www.cs.txstate.edu/~ok11/images/usability.jpg>

In figure 3.2 the importance of web site navigation is illustrated by artifacts giving an idea of how a user perceives and responds to a particular navigation scheme. Either they find the information they required or else they have to dig into the system to find what they are looking for. In short, the idea behind this image is to highlight the fact that a user can respond to a web site in a different way if the navigation scheme is good.

Positioning of Navigation Elements

Position / placement of the navigational elements is an import choice to facilitate the web user to find what they want at the same time not presenting user with too many options that become surplus. Common practices used for navigation can be broad sites in which very few interactions are required to access all the items on the web site but all the choices have to be displayed all the time. This in contrast with the deep sites, where a limited set of items are displayed to the user and for the rest of the items the user has to navigate the site to get the information they want. There is no fixed rule for the placement of the navigational elements; it can be top, bottom, right, left or any combination of these that has been tested by designers. However, consistency within a web site is to be recommended.

Global and local navigation

A recent fashion shows the global (primary) navigation to the main area of the web site and local navigation within each area of site. Again there is no fixed rule for the placement of the global and local navigation bar. Some sites have primary navigational bar at the top of the page and the local navigation at the right or left side of the web page. In some site, local and global navigation items have been observed in the left hand column. The presentation of global and local navigation choices within the same column allows them to be easily associated with the user, which may benefit some people with cognitive or learning difficulties. A long left-hand navigation column however, can cause difficulties for some assistive technology users. Without an adequate way of bypassing the navigation, a physically impaired user who is dependent on a single switching device, may be forced to click through many links before getting to the page content they are seeking. At this stage, it appears that many assistive technology users are more comfortable with the presentation of global navigation at the top of the page and local navigation in a left-hand column (Hudson, 2004). According to our personal experience of web browsing and listening to different views and complaints from the customer, the user does not feel good if the web site follows the deep navigation approach i.e.; click on the link, and dig to another link and continue the navigation process until you have reached what you are looking for. As compared to the other approach in which if the user clicks on a particular link then all the related information is visible to the visitor (local navigation approach) so that s/he can dig further according to their needs.

Selection and consistency of color palette

In this section we will discuss some issues related to the colors used in web designing. Let's start the discussion with some questions as following:

Some Questions regarding color selection and usage

Do specific colors convey specific meaning? Which color is eligible for your web site? Is it necessary to be consistent with the color selection throughout the web site? Is it important to think about the users who have problems to distinguish between different colors?

In the context of usability the above questions should be considered when dealing with colors. Not for all web sites but most of the web sites there exist specific color pallets that should be used. For example "blue" color is commonly used for the communication web sites like telecom and similar areas. For the web sites that promote online dating and romance "red" color is the best candidate to use since it represents the feelings of love and emotions. It has also been noticed that some religious web sites (specifically Muslims web sites) have "green" color and some has "black" as well. Once you have knowledge about the meaning of color you are going to use and selected a color scheme to use for your website it is important that you are consistent with the color palette you have selected (until or unless there is need to use a different color). If the color scheme is not consistence then while navigating the web site, the visitor may experience it as if they have been directed to a different web site. As a result a web visitor may lose interest in the web site. But sometimes it's OK to have a different color scheme, such as when you have a number of product lines and each product line has its own distinction profile, then you can manage your web site areas according to each specific product line. Further there exist users who have difficulties to distinguish the different colors and care should be taken so that these users still can use the web sites effectively. This means that care should be taken that information which is conveyed with color is also available without color, for example for context or markup.

The Vischeck Web site (<http://www.vischeck.com/>) can be used to simulate various color vision problems. Vischeck is a free online service that can be used to check the accessibility of Web page colors for people who experience color vision difficulties (Hudson, 2004)

Difference between Windows and Macintosh Appearance

Normally designers only rely on the color brightness, saturation only, but tend to be short sighted about the fact that a web site can be visited on Windows computers as well as on Macintosh systems. Generally it has been noticed that a web site looks brighter if it's displayed on the Macintosh system as compared to Windows. If the designer has tested the site only on the Macintosh system and concluded that it is fine and there are no issues related to colors and color properties, then it is highly recommended that same site should be tested on the Windows systems before finalizing the color scheme (Color Schemes and Usability, 2001).

Individual Monitor Settings

Unfortunately we cannot control this setting (but still it's important to discuss under the context of the web site colors and usability) since each user has different monitor settings and site brightness varies according to the monitor settings itself. A site's appearance will always vary according to monitor settings on the individual user's computer or other device. Although artistic beauty is an important factor in choosing a color scheme, consideration for readability is even more important when it comes to designing a site where users can have a stress-free browsing experience (Color Schemes and Usability, 2001).

Maintain confidentiality of personal data

The user interacts with the web site directly not with the actors behind it. It's not the user's area of concern how a company is running the business and who has designed the web sites. Customer trust is vital for any kind of online activates especially financial transactions. This means every user must be able to find information about how confidential and private data are treated when such information is expected to be communicated through the web site. Confidentiality of the private data is much more important if the nature of the web site is financial and transactions are made on the web site. In this case user crucial data must be secured and confidential and user should also be aware if s/he is now interacting with the secure area. There should be a clear privacy policy available on the web site so users can view it and be aware of what kind of information is being saved (if any) and what are the other discourse related to the safety of the personal data. For example, on the web site [uigarden.net](http://www.uigarden.net) (<http://www.uigarden.net/english/privacy/>) the service providers have clearly mentioned what kind of data they are saving and what is the purpose behind it, as is clear from the following, which is directly quoted from the web site privacy policy page.

“Automatic Collection of Information: we automatically log personal data by means such as programming or we link information automatically logged by such means with personal data about specific individuals. We do so for the following purposes:

- Technical administration of the Web site
- Research and development

We use cookies to store personal data or we link information stored in cookies with personal data about specific individuals. We do so for the following purposes:

- Technical administration of the Web site
- Research and development

Data Collection and Purpose Specification

You can access our web site home page and browse our site without disclosing your personal data. We collect the personal data that you may volunteer while using our services. Our Web site enables you to communicate with other visitors or to post information to be accessed by others. When you do so, other visitors may collect your data. We do not disclose your personal data to our subsidiaries or other organizations without your permission. Confidentiality / Security All our staffs and data processors, who have access to, and are associated with the processing of personal data, are obliged to respect the confidentiality of our visitors' personal data.

We ensure that your personal data will not be disclosed to State institutions and authorities except if required by law or other regulation” (Privacy Policy, 2009).

Here it's clear that if you are collecting some information that is personal in nature and crucial, especially related to financial data, it is highly recommended that users must be made aware of this and must be given the choice to customize if they want to provide this information, given the conditions under which it is collected and managed via the specific web site, or not. According to experience of some e-business related persons they reported that it is a common query from the new customer or customer-to-be (a visitor that is near to become a customer) if the service provider is storing the credit card information. For example, working in the Web Hosting Company we studied, a common query from customers was “will you automatically charge at the time of renewal?” They were worried about if the company is keeping the confidential data and can charge customer automatically. Then the company web site was updated with a suitable descriptive text and separate section under the privacy section with the aim to be sure that the user is aware that the company will send them a reminder email notification regarding the renewal of their web site charges. In short, sometimes some well-known brands like Amazon keep credit card information so that at the next purchase the user just has to confirm the transaction, and there is no need to provide the details. Some users may like this option, especially those who are shopping with Amazon on a regular basis can add their card and on subsequent purchases just have to confirm the transaction, no need to provide the card data. Here Amazon provides full control to user to manage their credit cards (of course they use a secure section that requires user authentication). This option also gives the choice to add more than one card, or delete the card that is already added with Amazon, while at the same time user is aware how their personal and financial data is being treated.

Change Management and Feedback

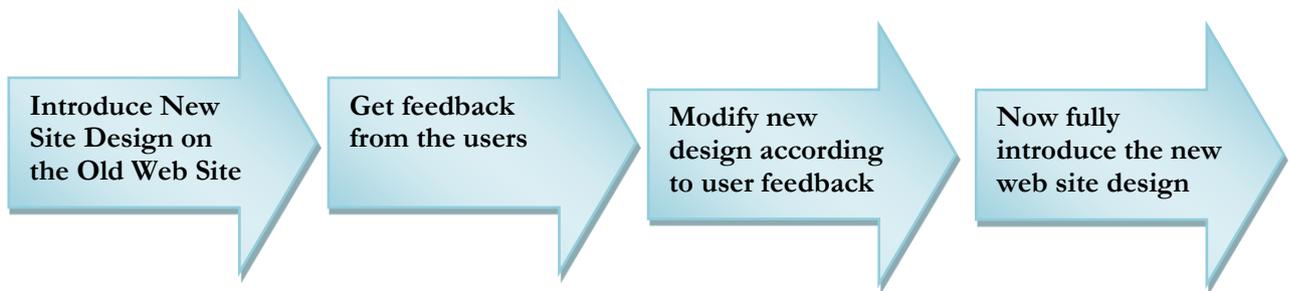
It is normal to have change in the design and layout of the web site with the passage of time because both information content and visual effects need to be updated and the responsible web designers may be inspired by new innovative ideas, possibilities and trends.. Sometimes users like changes but sometimes users do not like changes, since they are now use to the site and know how to use it according to their needs. Before continue with the change, the designer should have adequate knowledge about what their users are expecting from the change One way to do this is to provide a feedback form that users can fill in . Designers collect samples and check if it is feasible to introduce the planned change. Sometimes it is worth checking the web sites of your competitors in order to learn what they are doing and how they get customer feedback about their web sites. Feedback is really important because it helps you to improve and learn what users want. Now you have information about the changes you are supposed to do, now the question arises how to manage these changes. A better approach is to apply changes in stages. For example if you have changed the web site layout and design; do not apply it as soon as the design is ready. Rather, keep running your old design and add a link or interactive button on the web site with a descriptive text like “Link to new web site”.

Here is just an example:



Here users can view the new design while they are interacting with the old design. Feedback is of great importance, and users who have visited the new web site can provide you with feedback about improvements and comments. Once designers and developers have modified the layout or design according to the customer feedback (if required), then it's time to apply the new web site design.

Following is the graphical representation of the change management process:



In this way users are made aware of that the web site design is going to be changed, and they are offered the opportunity to mention what they need in the form of user feedback, and designers get valuable input concerning how they can provide a successful design solution.

Our final recommendation concerning Change Management is to think about the user's "Favorite Links". If you are going to change the web site layout and other types of changes, always keep in mind that your existing users have bookmarked the web addresses and web designers should not compromise the uniform resource locators (URLs) of the web site. If you have changed the web addresses, then the users who have bookmarked web pages will be dissatisfied if they are not served with the web page they are looking for when they expect to get access to it through their bookmarks.

CHAPTER 4

Usability Evaluation Methods

Brief History and Contribution of Jacob Nielsen

The age of usability evaluation methods is the same as that of the concept of usability itself. Usability evaluation was considered a quite expensive and complex process from the beginning. But in 1989 Jacob Nielsen presented his research paper titled “Discount Usability Methods”, later known as Guerilla HCI (Nielsen, 1994). This usability paper of Jacob Nielsen’s revealed the fact that usability can be achieved with minimal resources.

Interface Design and Usability Evaluation Methods

According to Villiers and Ssemugabi (2007), there is a need for usability evaluation methods to evaluate usability in order to achieve a professional interface design. The relationship between usable design, usability evaluation and usability evaluation methods is shown in figure 4.1

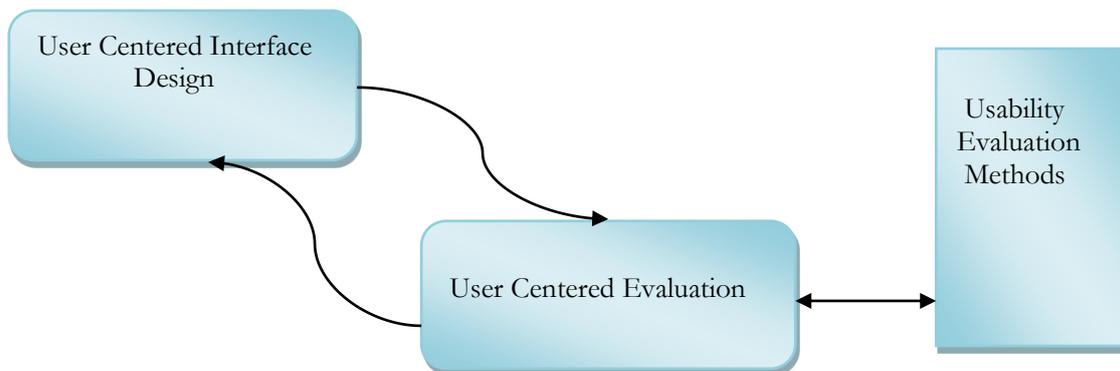


Figure 4.1; Relationship between interface design, evaluation and usability evaluation methods.
Source: Villiers and Ssemugabi, 2007

A number of usability evaluation methods exist. Each has its own advantages and disadvantages. Selection of the evaluation methods depends on many factors, since each web site is not of the same category. The selection of usability evaluation methods (UEMs) to determine usability problems is influenced by time, cost, efficiency, effectiveness, and ease of application (Villiers , Ssemugabi, 2007).

Usability Evaluation Methods and Classification

The main goals of evaluation are to assess the application functionality, to verify the effect of its interface as experienced by the user. The evaluation aims to identify any specific problems with the application. For example some characteristics which may result in unexpected effects when used in their intended context (Abowd and Beale, 1998). Although there do not exist any universally accepted classifications of Usability Evaluation Methods (UEMs), in the following section we will briefly mention some classifications based on researchers’ and practitioners work and experience.

Nielsen and Molich Classification

In 1990, Nielsen and Molich divided usability evaluation into four categories:

- Automatic
- Formal
- Empirical
- Inspections

Formal methods are not much used in real software development projects, because the methods are tedious to apply (Riihiahho, 2000). Automatic evaluations, on the other hand, are feasible only for very primitive checks. Therefore, empirical testing and usability inspections provide the main part of usability evaluation in product development.

Adelman and Riedel Classification

Adelman and Riedel (1997) have done a lot of work in the field of product development, product prototyping, requirement engineering etc. They have proposed three types of usability evaluation methods mentioned in the “Handbook for Evaluating Knowledge Based Systems” which are listed below:

- Heuristic
Based on Expert Opinion
- Subjective
Based on User Opinion
- Empirical
Based on User Action

As far as the question of usable applications is concerned, we cannot assure just applying principles of usable application. We need to apply accurate design techniques and test the application at the intermediate stage. Both design techniques and testing will help to check if the application meets the user’s expectations.

The main goals of evaluation are to assess the application functionality, and verify the effect of its interface to the user. Also to identify any specific problems with the application, for example some aspects which show unexpected effects when used in their intended context (Dix et al, 1998).

Usability evaluation methods

In the following section we will discuss effective web usability evaluation methods.

User Testing

User testing deals with real behaviors observed from some representatives of real users (Nielsen, 1994). It requires that users perform a set of tasks through physical artifacts, either prototypes or fully functioning systems, while the experimenter observes the user’s behavior and collects empirical data about the way users execute the assigned tasks (Preece et al, 1994).

In user testing the most important items of information to collect are:

- Execution time
- Number of errors

□ User satisfaction

On the basis of the outcomes of the collected data, the results can be analyzed and checked for an evaluation of the application usability. Here one additional recommendation should also be mentioned, that most web designers neglect to test. This is web site testing from a different geographical location. Sometimes application are designed well and work fine in some countries but they do not function sufficiently well in some other countries (where high speed internet connections are not available). Your user may be in any part of the world so if the home page is taking a long time to load then the user might panic and close that web page. At the same time, user testing should also be done with commonly used web browsers. Users may be using Internet Explorer, Mozilla Firefox, Google Chrome, Safari etc., so user satisfaction elements may vary due to shift of web browser as well. This kind of usability testing is dedicated to evaluate in depth the user interaction with the application for the execution of well-defined tasks. This user testing also isolates the concept of beta testing in which the product is released and available to users and any errors and omissions are expected that are supposed to fix in the future / upcoming versions / models. But user testing is conducted with mock-up users intermingled with the application and execute tasks. The problems found in the application are recorded and addressed together with recommended redesign suggestions (Whiteside et al, 1988).

Inspection Methods

A set of methods used by an evaluator to inspect the user interface is called usability inspection. Usability evaluation and usability testing are often confusing and sometimes referred to as the same thing. But usability evaluation is different than usability testing because in usability testing the interface is tested by the real users. Usability inspections can generally be used early in the development process by evaluating prototypes or specifications for the system that can't be tested on users. Also usability inspection is considered as a cheap alternative to the usability testing (Nielsen, 1994). The cost of user studies and experiments became a central issue. Therefore, many proposals were made for usability evaluation techniques based on the involvement of specialists to supplement or even replace direct user testing (Nielsen and Molich, 1990). In inspection methods usability related aspects of an application are examined, efforts are made to detect violations of established usability principles, and then feedback is provided to designers about possible design improvements. Usability inspectors can be professional usability specialists who are offering services only for the usability inspection or they can be designers as well with specific expertise. Among many usability inspection methods, Cognitive walkthrough and Heuristic evaluation methods are the most commonly used and these are described in the below section.

1.1.1.1 Heuristic Evaluation

This is the most informal form of usability inspection method in which groups of usability testers dexterously scrutinize the application against a list of pre-defined usability principles called heuristic. Some researchers consider the heuristic evaluation method very efficient as a usability evaluation method and at the same time quite cost effective, so that's why this evaluation technique is also called discount usability method (Jeffries and Desurvire, 1992). These evaluation methods are now widely taught and practiced in the New Media sector, where UIs are often designed in a short space of time on a budget that may restrict the amount of money available to provide for other types of interface testing (Wikipedia, 2009).

It is required by each evaluator to go through the system interface at least twice during the evaluation session. The first step is performed in order to get a feel of the flow of the interaction and the general scope of the application; the second is to focus on specific objects and functionality, evaluating their design and implementation against a list of heuristics. In this

method we get usability problems as output of the heuristic evaluation in relation to the violated heuristics. The usability problems that the evaluator gets in relation to heuristics enable easy generation of redesign under the light of the prescribed guidelines of the violated principles. When the evaluation process has been completed, the results of different evaluators are compared. Generally speaking, heuristic evaluation can be conducted by a single evaluator but according to an analysis of six studies it has been noticed that one evaluator is capable of finding only 35 % of the total number of existent usability problems and different evaluators may come up with different problems, which is why it is recommended to involve more experts to increase the possibility to find more of the potential usability problems (Molich and Nielsen, 1990).

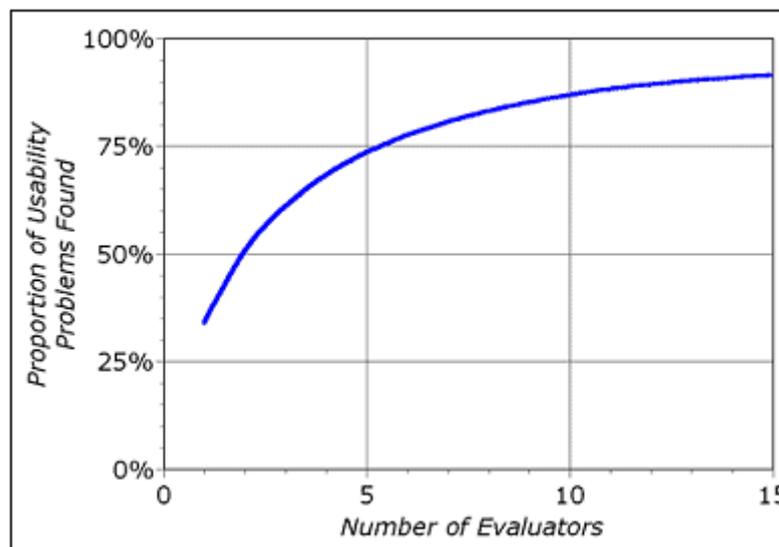


Figure 4.2; The percentage of usability problems found by heuristic evaluation in relation to number of evaluators involved in the evaluation process
Source: Molich and Nielsen, 1990

Figure 4.2 shows the percentage of usability problems found in relation to the number of evaluators involved in the process, as reflected by a mathematical model defined in (Landauer and Nielsen, 1993).

From the curve it is evident that reasonable results can be obtained by having only five evaluators, and certainly not less than three.

Cognitive walkthrough

Cognitive walkthrough is also a usability evaluation method that focuses on the ease of use and how easily users of an application can accomplish tasks using the application. In this method the evaluators create a task scenario and go through the interface step by step and discuss the usability issues. This method guides evaluators in the analysis of the actions that the users would perform trying to reach the objectives defined in the scenario, by means of the identification of the relations occurring among user goals, user actions, and the visible states of the application interface.

Typically in cognitive walkthrough a collection of tasks is selected to be performed by evaluator based on a specific scenario. After execution of those specific tasks the evaluator interprets the application and evaluates the steps for the accomplishment of the achievement of the user goals. This is accomplished by answering the following standard questions (Matera et al., 2006)

Are the feasible and correct actions sufficiently evident to the user, and do the actions match with her/ his intention?

- Will the user associate the correct action's description with what s/he is trying to do?

- Will the user receives feedback in the same place where s/he has performed her/his action and in the same modality?

- Does the user interpret the system's response correctly: do they know if they have made a right or wrong choice?

- Does the user properly evaluate the results: if user can access if they are close to their goals?
- Does the user understand if the intentions/he is trying to fulfill cannot be accomplished with the current state of the world: does s/he finds out alternative goals?

For each step in the task case the evaluator will try to establish a success story. "Common features of success" is the condition where a success story can be told and given next. Common features of success are:

"Users may know **"what effect to achieve"**:

- Because it is part of their original task, or
- Because they have experience using a system, or
- Because the system tells them to do it

Users may know **"an action is available"**:

- By experience, or
- By seeing some device (like a button) or
- By seeing a representation of an action (line a menu entry)

Users may know **"an action is appropriate"** for the effect they are trying to achieve:

- By experience, or
- Because the interface provides a prompt or label that connects the action to what they are trying to do, or
- Because all other actions look wrong

Users may know **"things are going OK"** after an action:

- By experience, or
- By recognizing a connection between a system response and what they were trying to do."

CONCLUDING REMARKS

Security issues in interactive systems are playing a vital role in user interface design. A successful system is one that fulfills the security requirements without sacrificing the usability constraints. A system is called an ideal system when it is secure and the user is facilitated by using the system because it is “usable enough”. When using effective web site usability methods (such as inspection methods), systems can be designed in a professional way without violating the financial limitations and exceeding the capital budget. Organizations should be aware of the importance of usability and give enough attention to producing high quality systems. They should adopt suitable usability evaluation methods to inspect the system before the end user uses it.

The purpose of this thesis was to identify experienced usability problems in web sites and provide recommendations according to literature and experience and also based on the ideas and experiences of the professionals that were generated and discussed during the interviews conducted with web hosting professionals. A separate section is dedicated to the research questions, which further explore the balance and tradeoffs between security and usability issues in web site design. This discussion is further expanded in the subsequent sections where we have mentioned the findings from the literature and related these to our experiences (for example change management in the Section of Usability and Its Social aspects) and interviews with web hosting engineers at a web hosting company. Also one of the authors (Naveed Anwar) has been working in the same job role to provide support to web users and he also integrated reflections based on his experiences while relating usability problems and recommendations to the literature and interviews. The other author (Adam Kwok) also conducted interviews at his former workplace with the web site designers in USA. The research questions have been addressed and explored through the interviews and mainly through the literature review.

APPENDIX 1:

Sample Interview 1

Background:

Why do web sites monitor the user traffic? Why do web site owners/managers change the design and layout of web sites? Why do web site designers and developers need input from the data collected through user experiences and customers' feedback? Are there usability issues that really matter and should be considered while designing the user interface etc.? To find the answers, we decided to conduct interviews with the web site developer at Web Hosting Company. The following dialog is conducted between "WD" (web developer, a colleague of Naveed Anwar) and "Std" (Naveed Anwar, a student at BTH, one of the authors of this thesis.).

Std: Hello Mr. Web Developer, I am here to ask you some questions related to web site usability and collect some data that I can integrate while writing my thesis.

WD: Sure, you are welcome to ask as many questions as you like.

Std: Thanks, let's start with the first question, is web site usability something that you often speak about when designing the user interface?

WD: Yes, of course usability is essential for any web site.

Std: OK, so how do you come to know that you need to change the existing design to a new one?

WD: Well there are so many factors that we consider before we proceed with the new design.

Std: Could you please elaborate, as we are interested to know more about it.

WD: First of all it's the web site traffic or web visitors that we monitor on regular basis and record that data, compare it with the previously collected data. Of course web sites exist due to the visitors who use the web services.

Std: When you guys analyze the data after making changes to user interface, which factors do you consider worthy of special attention towards achieving an optimized web site design?

WD: Positive change is always good to adopt. Our support engineers reported that they receive a considerable number of questions that are purely related to web site design and design layout.

Std: You mean that layout also matters while designing and managing web interface?

WD: Yes I exactly meant it. We received input from our staff that sometimes user raises a question not due to problem or issue in the services that they are using rather they found it difficult to access the required information under their customized area.

Std: "Customized user area" what does that mean?

WD: You probably know it as "Members' Area", here users can find all his information related to his account and the details about the services he/she is using. And sometimes they felt that navigation is complex that leads to difficulty to find what they are looking for. As a result they just contact the support officers and ask for help. Here important thing to consider is that this kind of query is related to web site design not apparently related to the product or the services that customers are using.

Std: Interesting, but don't you guys check / test the design before launching the web?

WD: We do! But of course we continuously work to improve it and sometimes all the things are not happening in the testing phase rather we encounter some issues after a while.

Std: Ok may we know how you plan those improvements? What is the source of those improvements?

WD: We always use standard usability evaluation methods to improve the user interface design. The information comes from the management and input from our staff is also significant that we always receive new ideas and suggestions.

Std: How is management really involved, I mean they have less technical understanding?

WD: We always listen to our users and keep track of what they want... this kind of information is handled by the management. Also the best source of the management information is based on the user's feedback.

Std: You said the management has collected data from user's feedback and that means you guys received enough data for sampling?

WD: Yes we do, on our web site; we conduct online surveys and record the user feedback etc. Another feedback is designed for the existing members and they are asked to participate in the survey when they are using the web sites their members are. To give motivation to our existing clients we have set some kind of offer for our members that say something like "Participate in the user experience program by filling this form and get opportunity to free renewal of your web site". Our management took care of the feedback and analyzes the data, discusses with staff the information they received etc and selects an existing member for the free renewal by lucky draw!

Std: Anything else that you think is worthy to for us sknow about?

WD: Yes maybe you are interested to know about the mobile/touch devices?

Std: Sure, that will be great if you can let us know about it.

WD: While designing a user interface, we also keep in mind the application behavior on different devices.

Std: are you speaking in terms of iPads, Tablets, Smart phones etc?

WD: Exactly, we need to optimize our design in such a way that our users can use it without any issues on touch technology like iOS or Android etc.

Std: Ok, thank you for your time and sharing the information. We hope this interview will help us to add strong arguments in our report with the integration of related literature.

WD: You are welcome.

Sample Interview 2

Background:

This interview was conducted by Mr. Adam (one of the authors of this thesis) with the CEO of his company. This interview focuses on the business aspects and usability; try to find if there exists any relationship between usability and business success etc.

Here we can use the following conventions for this interview. Std(Adam Kwoka, student at BTH and co-author of this thesis) and CEO(the CEO of the company explains about the usability)

Std: Hello Mr. CEO, I am here to conduct an academic interview as I requested when I sent you the email invitation.

CEO: Yes I remember, you are welcome.

Std: Thanks.

CEO: You may proceed with the questions you have, I am ready.

Std: Great! Please let us know how you reason and think about your company web site portal.

CEO: Our portal is one of the vital parts of our organization and it's not wrong to say we are here because our business is running that means our web portal is optimized.

Std: Ok, you mentioned that your web site portal is optimized, could you please elaborate what you exactly meant by optimized design?

CEO: Since we are running online business, and we are not alone in this type of business. To simplify for you I can describe it like this ... there exists user "need" and we are here to capture that user "need" and fulfilling its need by providing the services they want. Why does a customer come to your web site and place an order? Why does a customer come to a site and leave that site within a few seconds? These are the questions that we are always concerned with when we are finalizing the web site design with our developers.

Std: Quite interesting, so what is the most important area that is crucial and helps web users to stay on your web site?

CEO: Truly it's the usability.

Std: How you measure it? I mean how do you conclude that this design is more useable as compared to some other one (or the old one)?

CEO: There are always new ideas to make things better and even better ... but our web site developer has implemented a system into our portal that tracks the "web site visitor foot prints". That means you can get the information about which web page the visitor has visited before coming to your web site. Which item he/she was reviving? From which link /search engine has this visitor come to your web site and which specific product or service is he/she looking for... etc. We examine these logs and filter the potential logs and then compare our design with other portals (normally our competitors). We have purchased license of a web based application called Live Person that generates these kinds of logs, or formally called "foot prints" in terms of Live Person.

Std: So you mean learning from your competitor to make a useable design?

CEO: Not exactly, but to some extent, we observe the visitor's behavior and see at which point he /she jumped to some other link, and we try to determine if it was something related to design that the user finds difficult and therefore leaves left the site or it's something else. That generates an idea and future tip to how to implement changes.

Std: What kind of data do you think that you normally compiled.

CEO: It's different, mainly user's switch from the payments sections, they feel insecure to make the transactions etc.

Std: You mean there exist security risks on web sites?

CEO: Yes there exist security risks on some web sites but not always.

Std: That would be great if you can explain it?

CEO: Sure, what we concluded is that web sites are not really full of risks, but the design has failed to convince the web user about the security, for example with a meaningful text or descriptive image that gives the user the necessary information about the financial transaction and safety issues.

Std: yes I have seen some examples as well that make me feel uncomfortable while making a transaction online.

CEO: Normally web site designers and developers use the correct technology to make the site secure but the end user has no computer knowledge. Web site user is not concerned whether you are using ASP,ASP.NET, Java, PHP etc. but they are concerned about the functionality of the web site, so there is a need to give user related information.

Std: OK sir thank you very much for your time and I will analyze your interview and use the text in my report.

CEO: welcome and good luck!

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