

Usability Evaluation Methods and Principles for the Web

Joel Mvungi¹ and Titus Tossy²

^{1,2} Computer Science Studies Department, Mzumbe University, Morogoro, Tanzania

¹jlmathew7@gmail.com, ²tossytm@gmail.com

ABSTRACT

In order to determine the quality of any web application in the world, Usability is the one of the most important tool that one can use. Web analysis perform several inspections on the websites and software and use usability criteria to determine some faults on the systems. Usability engineering has being important tool for the companies as well, this is due to the fact that through usability engineering companies can improve their market level by making their products and services more accessible. Know days there some web application and software products which are complex and very sophisticated, hence usability can be able to determine their success or failure. However currently usability has been among the important goal for the Web engineering research and much attention is given to usability by the industry due to recognition of the importance of adopting usability evolution methods before and after deployment. Moreover several literature has proposed several techniques and methods for evaluating web usability. And however there is no agreement yet in the software on which usability evolution method is better than the other. Extensive usability evaluation is usually not feasible for the case of web development process. In other words unusable website increases the total cost of ownership, and therefore this paper introduces principles and evaluation methods to be used during the whole application lifecycle, so as to enhance usability of web applications.

Keywords: Evolution Methods, Web Usability, Web Usability Principles, Development Process.

1. INTRODUCTION

Web development is a complex and challenging process that has to deal with number of heterogeneous interacting components(Murugesan,2008).However the construction of Web applications has changed in some discipline, but there still lack of proper engineering approach for developing web systems, and the whole development process is still unengineered(Ahmad et al.,2005).Due to the challenges emerge in developing of more usable Web applications, this has led to the rise of several techniques, methods, and tools of which address usability issues. However much knowledge exist on how to develop usable

web applications, but many of the applications still don't meet most of customer usability expectation (Offutt [29]).On top of that many company know days have decline as result of not taking to account web usability issues (Becker and Mottay [5]).Hence therefore there is need of identifying those usability evaluation methods (UEMs) which have been successfully applied to the Web development.

However web-based applications have influenced several domains, which provide access to information and services by variety of users showing different characteristics and backgrounds. Most user visits websites, and also return back to the previously accessed sites, if they some easily useful information, organized in a way that facilitates access and navigation and presented according to a well-structured layout. Therefore we can say the acceptability of Web applications by users strictly rely on their usability.

Most of literature has reported that most work on web applications has been done, on making them more powerful but relatively little has been done to ensure the quality of those applications. Some of important factors for quality of web application are reliability, availability, usability and security. It's estimated that 90% of web sites provide inadequate usability. The ISO/ISEC 9126-1 standards mentions six principle categories of quality characteristics. Which are functionality, reliability, usability, efficiency, maintainability and portability. Therefore we can say Web usability is a core component of web quality. Without a good usability features, the web quality will always be a question mark.

2. RELATED WORK ON UIMS FOR WEB APPLICATIONS

Bray introduced an attempt trying to measure the web in 1996, he tried to answer the question such as the size of the web, its connectivity and visibility of its sites. Moreover Stolz et al. (2005) came with new technique to access the success of information driven websites that

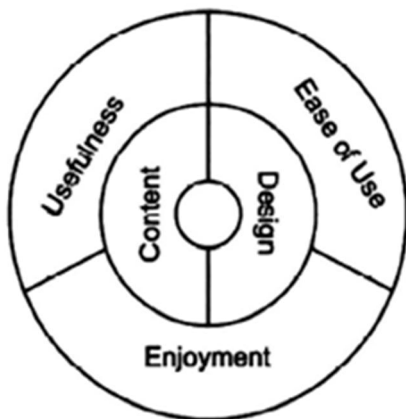


merged user behavior, content of site and structure while utilizing user feedback.

Dominic and Jati(2010) evaluated the usability and quality of Malaysian University websites based on factors like load time, frequency of updates, accessibility errors, and broken links using the following tools: Website optimization, Check link validator,HTML validator and accessibility testing software. Moreover from Treiblmaier and Pinterest's (2010) point of view, you can describe a website based on two main criteria: "What is presented?" and "How is it presented".

All academic efforts for developing UIMs for Web applications there is still room for improvement. (Rivero and Conte, 2012a) identified that emerging of UIMs for Web applications should be able to: Find usability problems in initial stage of its development, Aid in both identification and solution of usability problems. There is an important shortage of standard criteria for comparison, therefore UEMs cannot be evaluated. Several studies have been done to see which measure has been so common and majority of the study used thoroughness measure (ratio between the number of real usability problems found and the total real usability problems).

However Palmer (2002) emphasized on the importance of metrics in helping organization generate more effective and successful websites. Another survey by Hong (2007) on Korea organizations also found that a key enabler of website success measurement is website metrics. These metrics play two important roles: Determining if website perform to the expectation of the users and the business running the site, and also identify website design problems.



Source: Treiblmaier and Pinterest, 2010

3. DEFINING THE TERM USABILITY

Usability is the term that is generally described as factor of system quality, it defines the quality of systems and products from human point of view who use the systems (Andrian and Emilio, 2003). However the term usability was derived from the term 'user friendly'. However the concept of usability is somehow complex to define this is due to the fact that it is used in many different context such as performance, execution time, and user satisfaction as well as easy of learning. The concept is also applied in areas like consumer electronic products and communication. Also may refer to efficient design of mechanical object such as door locks. In other words usability means those people whom use products such as software application, can learn it quickly and use it easily to accomplish their tasks(Azeem and Kamran,2008.Usability enables employee to concentrate more on their work rather than on the tool the use to perform the tasks.

A usable product may refer to a product which:

- Is efficient to use
- Is easy to learn
- Provide quick recovery from errors
- Is easy to remember
- Is visually pleasing
- Is enjoyable to use

Moreover there several definition of usability which vary according to the model they are based on ISO standards defined usability as "the extent to which a product can be used by specified users to achieve specified goals within effectiveness, efficiency and satisfaction in specify context of use". Where effectiveness means accuracy and completeness with which user archive specified goals, efficiency means the resource expended in relation to the accuracy and completeness with which user achieve goals and satisfaction is described as the comfort and acceptability of use. Where by usability problem refer to the aspect that make application ineffective, inefficient and difficult to learn and use.

Nielsen's defined usability as Learnability: the ease of learning the functionality and behavior of the system,Efficiency:the level of attainable productivity once the user has learne.Memmoability:the ease of remembering the system functionality so that the casual user can return to the system after a period of non-use without needing to learn again to use it.Few errors: the capability of the system to feature a low error rate, to support users making few errors during the use of the system and in case they make errors to help them to easy recover. User's satisfaction: the measure in which the user finds system pleasant to use.

4. WEB USABILITY CRITERIA

General usability principles are achieved through usability criteria (Tayana and Jobson, 2010), the criteria provide guidelines to designers in restricting the space for design alternatives hence prevent designers from developing products that are not usable.

There are three important dimensions that any web developer has to focus on i.e. hypertext, data and presentation design each dimension consists of number of criteria this part there will be explanations on the mentioned dimensions which represent great impact on usability of any Web application.

The criteria could be discussed as follows:

A. Content Visibility

Refer to the understanding of information structure offered by the application, and get oriented with the hypertext, user must be able to identify main conceptual classes of the contents of the application.

Concepts of identification of Core Information

The content visibility can be supported by content design, where by main classes of content are identified and hence structured (Azeem and Kamran, 2000). The identification of information entity modeling concept could provide a way in full filling the requirement.

The content will help in centering Data design, and gradually evolve by detailing their structure in terms of

elementary components, and adding further auxiliary contents for accessing and browsing them.

Hypertext Modularity

The design of hypertext must be able to support users to perceive where core concepts are located, therefore:

- The hypertext can be organized on areas i.e. modularization constructs, where you group pages with homogeneous contents.
- However areas must be defined as global landmarks accessible through links grouped in global navigation bars that are displayed in any page of the application interface.
- For each area, the most representative pages can be defined as local landmarks, reachable through local navigation bars displayed in any page within an area.

However learnability and memorability could be enhanced by the use of hierarchical landmarks within pages. Landmarks indeed provide intuitive mechanisms for highlighting the available contents and the location within the hypertext where are placed.

B. Ease Of Content Access

After users have identified main classes of content the application deals with, they have to be provided with facilities for accessing the specific content items they are interested in.



Fig. 2. User login to the system



Fig. 3. User home page

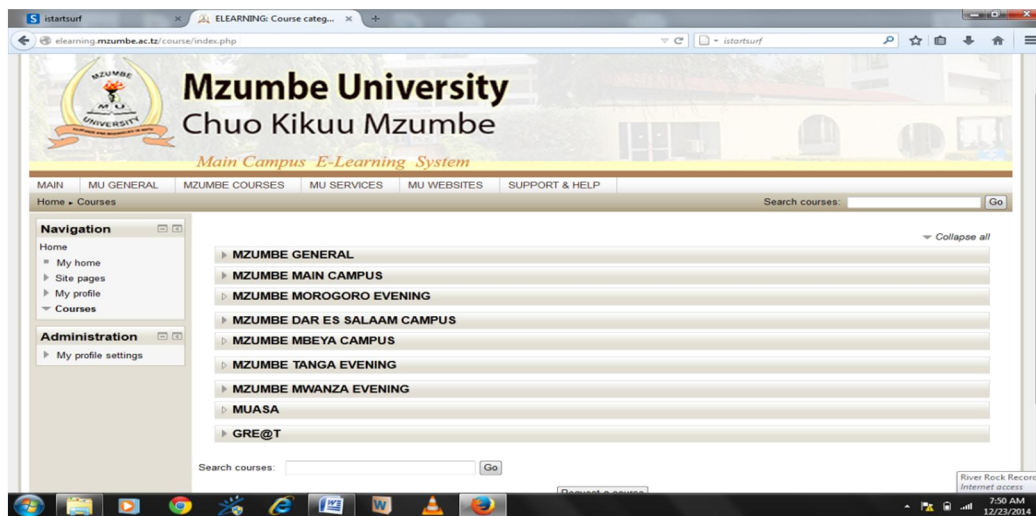


Fig. 4. User specifics page

Source: www.elearning.mzumbe.ac.tz

Identification of Access Information Concepts

As discussed the design of access paths for retrieving core content items can be facilitated if designers augment the application contents with access concepts corresponding to classification criteria or contexts over core concepts, enabling users to progressively move from broader to narrower categories, until they locate the specific core concept of interest.

Navigation Access and Search-Based Access

In order to facilitate the access to specific instance of core concepts, access concepts defined at data level should be used to construct navigational access mechanism that

typically consist of multi-level indexes (Alan and Gregory, 2004), which possibly distributed on several pages, bridging of pages with high visibility, such as the Home Page or the entry page of each area, to pages devoted to the publication of core concepts.

Moreover navigational access is very often complemented with direct access, especially in large Web applications i.e. keyword-based search mechanisms, which enable bypass navigation and rapidly reach the desired information object. Also direct access mechanism are essential in interfaces (such as those of mobile devices) that are unable to support multiple navigation steps. In traditional hypertext interfaces they enhance orientation when users get lost by moving along navigational access mechanisms.

C. Ease of Content Browsing

Usually the auxiliary contents related to each single core concept must be easily identified by users, as well as the available interconnections among different core concepts.

Core Concepts Structuring and Interconnection

The user understanding of content structuring and of the semantic interconnection defined among different content classes, enhance the ease of use and learnability of the web application (Luis and Tavana, 2013). And therefore when the identified core concepts represent a structured and complex concept, it is recommended to expand them via top-down design into a composite data structure.

Moreover the semantic interconnection among core concepts must be established for reproducing a knowledge network through which users can easily move for exploring the information contents.

5. EVALUATION METHODS

Evaluation methods are mainly aimed on assess the application functionality, to verify the effect of its interface on user, also to identify any specific problem with the application such as aspects which show unexpected effects when used in their intended context(Azeem and Kamran,2008). Also evaluating Web applications in particular consists of verifying if the application design allows users to easily retrieve and browse content, and invoke available service and application they need. This therefore implies not only having appropriate contents and service available into the application but also making them easily reachable by users through appropriate hypertexts.

However the development of a Web system is a continuous process with an interactive life cycle of analysis. Design, implementation and testing(Murugesan 2008).However what we need really is a different focus on evaluation methods and a new categorization system according to the purpose and platforms as Web and Website evaluation methods according to Stolz et al. & Hasans work.

- Website evaluation methods(WSEMs) could be:
 - i. User-based usability evaluation methods
 - ii. Evaluator-based usability evaluation methods
 - iii. Automatic website evaluation tools ie Bobby,Lift

- Web evaluation methods(WEMs) could be:

- i) Web analytics tools ie Google analytics
- ii) Link analysis methods ie Page Rank

A. Website Evaluation (WSEMs)

Limited number of website can be measured manually or automatically by the WEMs measure, based on some criteria so as to achieve quality website. However the manual testing can be done as well but output of such evaluation consists of list of usability problems and recommendation to improve the tested website. Some of other evaluation methods are:

1) User-based Usability Evaluation Methods

Process of design for usability, user testing and redesign is called User centered Design (Former and Bosch, 2004; Nielsen, 1993).The term “usability evaluation” refers to the entire test, planning and conducting the evaluation and presenting the results. However the main goal of usability evaluation is to measure the usability of the system and identify usability problems that can lead to user confusion, errors or dissatisfaction (Larusdottir, 2009).The user evaluation approach consists of set of methods that employs representative user to execute some tasks on specific system. The user performance and satisfaction with the interface are then recorded. And the most useful method in this category is user testing.

User Testing, when users use the system they normally work towards accomplishing specific goals in their minds (Stone et al., 2005).A goal is an abstract end result indicating what is to be achieved, and can be attained in numerous ways. Also each goal breaks into a task specifying what a person has to do, and then each task decomposes into an individual step that needs to be undertaken. User should be able to do basic tasks correctly and quickly. In order to select tasks the examiner begins by exploring all the tasks within the website then narrowing them down to those that are the most important to users. Moreover a good task is the one that discovers a usability problem or one that reveals and error that is difficult to recover from. Next step is how to present selected task to the participants and one way to do this is by using a “scenario” in which the task is embedded in a realistic story.

However it is important to test users individually and let them solve the problems on their own. Actually the purpose of usability study is to test the system and not the users, and this aspect must be explicitly explained to tested



users (Nielsen, 1993; Stone et al., 2005). Metrics can be collected from user testing; time for users to learn a specific function speed of task performance, type and rate of users' errors, user retention of commands over time and user satisfaction.

2) Evaluator-based Usability Evaluation Methods

Evaluator or Experts inspects the interface and assess system usability using interface guidelines, design standards, users' tasks, or their own knowledge, depending on the method to find possible user problems (Larusdottir, 2009). Moreover the inspectors can be usability specialists or designers and engineers with special expertise (Matera et al., 2006). In this category, there many inspection methods such as cognitive walkthrough, guideline reviews, standard inspection and heuristic evaluation (Hasan, 2009). However heuristic Evaluation is the most efficient usability method, because is a special variable when time and resource are scarce. There number of evaluators assesses the application and judge whether it confirm to a list of usability principles, namely 'heuristics' (Hasan, 2009). During heuristic evaluation process each evaluator goes individual into a system interface at least twice, and the output obtained from such evaluation is a list of usability problems with reference to the list of violated heuristics. However by principle heuristic evaluation can be conducted by only one evaluator, whom can find about 35% of total usability problems (Nielsen, 1993). But Matera et al. (2009) believed that better results are obtained by having five evaluators and certainly not fewer than three for reasonable results.

3) Automatic Website Evaluation Tools

Automatic tools are software that automates the collection of interface usage data and identify potential Web problems. First study was conducted by Ivory and Chevalier (2002), who concluded that more research was needed to validate the embedded guidelines and to make the tool usable. And therefore Web professional cannot rely on them alone to improve websites. Brajnik (2004b) mentioned several kinds of We-testing tools that can be used: accessibility tools such as Bobby, usability tools such as LIFT, performance tools such as TOPAZ, Security tools such as Web CPO, and classifying website tools such as Web Tango. He also stated that the adoption of tools is still limited due to the absence of established methods for comparing them and also suggested that the effectiveness of automatic tools to be itself evaluated.

B. Web Evaluation Methods (WEMs)

The method studies the web as whole by calculating statistics about the detail use of the site and providing Web- traffic data, visibility, connectivity, ranking and overall impact of a site on the Web.

1) Web Analytics tools

Web analytics have been defined by the Web Analytics Association as "the measurement, collection, analysis and reporting of Internet data for the purpose of understanding and reporting Web usage" (Fang, 2007). However these tools automatically calculate statistics about the detail use of site helping. By origin, Web analytics is a business tool that started with some webmasters inserting counters on their home pages to monitor Web traffic. However most Web analytics studies target e-commerce, the method can be applied to any website (Prom, 2007). The two well-known Web analytics tools are Google Analytics and Alexa.

Google Analytics, google purchased a Web analytics company called Urchin software in 2005 and released Google Analytics to the public in 2006 (Fang, 2007; Hasan et al., 2009). However the service is free for up to five million page views per month per account. Once signed for google Analytics, Google offers users code that must be inserted into each web page to be tracked. Visual data results are displayed with a wealth of information as to where visitors come from, what pages they visited, how long they stayed on each page, how deep into a site they navigated, etc. (Fang, 2007). Alexa, refer to a website metrics system owned by the Amazon Company that provide a downloadable toolbar for internet explorer users. Calculates traffic rank by analyzing the Web usage of Alexa toolbar users for three months or more as a combined measure of page views and reach (the number of visitors to the site). Although this information is useful, Alexa ranking is biased towards MS Windows and Internet Explorer users (Scowen, 2007).

6. SELECTION OF APPROPRIATE EVALUATION METHOD(S)

The evaluation of Indian Banking website navigability performed by Kaur and Dani found that Alexa and Google PageRank do not have significant correlations with navigability metrics, indicating that popularity and importance are not good indicators of website navigability; therefore the traffic data the back-links of websites are not

meaningful measures of site navigation assessment. Moreover Cho and Adams (2005) added that PageRank is not a metric of page quality; Further, Hong (2007) stated that most organizations use Web metrics to determine site traffic or popular content but seldom used them to improve navigation Jalal et al. (2010) and Noruzi (2006) concluded that the Webometric method is an imperfect tool to measure the quality of website and that it reflects unreliable results in most cases.

The findings of these five studies hence support the argument that WEMs, such as the Web analytics tools and the link analysis methods, do not discover navigation problems accurately nor do not measure website quality. Further, it seems that WEMs are complementary approaches since they do not definitely discover usability problems of a site, rather they just indicate their probability. However Link analysis method do not discover navigation problems accurately nor do not they measure website quality. It seems that WEMs are complementary approaches since they do not definitely discover usability problems of a site, rather they indicate their probability.

In other words even though usability testing demonstrate how real user interacts with a website and the exact problem they face, it's not enough to measure the success of the site or describe the interaction of large number of users with it (Hasan, 2009). Therefore this highlight the weakness that WEMs such a user evaluator or automatic evaluation methods cannot provide traffic data, Web ranking of site or its online visibility among others.

Therefore, the choice of appropriate evaluation method depend greatly on the purpose of the evaluation itself. If the intention is to redesign the website and wanted to discover most of its potential usability problems, then the best evaluation methods are user testing and expert evaluation, while an automatic tool or Google analytics is useful complement in this situation. If the goal of evaluation is to redesign a website then WEM is the best approach, while WEMs are not useful enough in this circumstance.

7. CONCLUSION

In conclusion, in order to address the challenges of developing complex Web systems, "Web engineering" is an emerging discipline for the implementation of engineering principles to promote high quality websites that attract visitors (Andrina and Viado, 2000). Web measuring has become a valuable area of ongoing research, but unfortunately the field is not yet mature; Web evaluation method are so many on literatures but they lack studies that classify, compare and determine the appropriate evaluation methods. However some previous studies confused the term "Web evaluation method" with "Website evaluation methods" since they did not distinguish between diverse platforms of assessment methods and also did not address the purposes

behind such evaluation. For example some of the study evaluate the web in terms of the ranking and connectivity of the sites, others assess specific websites to discover there usability problems.

Lastly the purpose of Web evaluation is to determine the appropriate methods to be used. If the purpose is to redesign the website, then the scope of evaluation is WSEM, and therefore as stated by the literature the best evaluation methods are user testing and expert evaluation, while automatic and Web analytics tools (complementary) could provide a first insight into the status of the website. Similarly, if Web ranking and traffic statistics are of interest, then the scope of evaluation is WEMs; thus the best way is to use a Web analytics tool such as Alexa.

REFERENCES

- [1] Luis Rivero* and Tavana Conte (2013): Using an empirical study to evaluate the feasibility of a new usability inspection technique for paper based prototypes of web applications: Journal of Software Engineering research and development.
- [2] Adrian Fernandez*, Emilio Insfrana, Silvia Abrahao: Usability Evaluation Methods for the Web: ISSI Research Group, Department of Information System and Computation, Universidad Politecnica de Valencia, Camino de Vera, s/n, 4022, Valencia, and Spain.
- [3] Dalal Ibrahim Zahran, Hana Abdullah Al-Nuaim, and Malcom John Rutter: A comparative approach to web evaluation and website evaluation methods: International Journal of Public Information Systems, vol 2014:1.
- [4] Azeem Umar, Kamran Khan Tatari: Appropriate Web Usability Evaluation Method during Product Development: Master Thesis Software Engineering Thesis no: MSE-2008-03 Feb 2008.
- [5] Alan Dix Janet Finlay, Gregory D Abowd Russel Beale (2004): Human-computer-Interaction Third
- [6] Tayana Contel, Jobson Massollar1, Emilia Mendes2, Guilherme H. Travassosl (2010): Usability Evaluation Based on Web Design Perspectives, First International Symposium on Empirical Software Engineering and Measurement.
- [7] Andrina Grank, Viado Glavink and Slavomir stankov: Usability Evaluation Methodology for web-based Educational Systems. Faculty of natural science. mathematics and Education, University Split.

