UTILISING *IGV* APPROACH TO IDENTIFY FACTORS AFFECTING WEB USABILITY

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ABSTRACT

Due to the changing nature of Internet technology and user needs, continuous web evaluation has become very important in determining the usability of web sites. However, web designers often face problems in identifying the right criteria for evaluation. Despite the growing number of guidelines and other literature on web design and evaluation, each of them varies in terms of quality, coverage, relevancy, and suitability. With this in mind, a study using *IGV* approach was carried out to identify key generic criteria that need to be taken into consideration by designers or others when assessing the overall usability of web sites. The results of the study include a comprehensive list of the identified usability criteria that were grouped into 7 major factors - screen appearance, content, accessibility, navigation, media use, interactivity, and consistency.

Key words: web design, web usability, usability criteria, web evaluation.

1.0 INTRODUCTION

*W*eb usability has emerged as one of the important factors that determine the success of a web site. Usability is related mostly to the design aspects of web pages that make sense to people who use them. It not only allows surfers to navigate easily and conveniently, but also helps them find the relevant information. Various studies (Rowland, 2000; Seminerio, 1998; Nielsen, 2002) show that web usability problems will cause firms a lot of money and they may even lose potential customers. This

realization underscores the need for designers and web developers to put some effort and money into improving the usability of their web sites. This involves, among other things, evaluating key aspects of web design that affect usability.

Assessing web usability is not as easy as one would expect. In order to perform the evaluation, designers should consider many issues, including the criteria to be used for the evaluation. This is where the problem might arise. Although there are abundance of web design guides and usability literature where designers and evaluators can refer to, each varies in terms of coverage, clarity, context, suitability, quality, and comprehensiveness. With this in mind, the present research seeks to answer the following questions:

- What are the generic factors affecting web usability?
- What are the criteria for each factor that should be taken into consideration when evaluating web sites?

This paper will first define the concept of web usability, followed by a description of the *IGV* approach, including the methodology used. Then, the research findings which focus on factors affecting web usability are presented. Finally, this paper ends with a discussion on the findings and suggestions for future studies.

2.0   WEB USABILITY: CONCEPT AND DEFINITION

Usability is a very broad concept in systems design. However, the word 'usability' suggests that it is related to how convenient, usable, practicable, and useful a system is for a user. According to the Webster dictionary (1999), usability originates from the word 'usable' which means 'capable of being used' or 'convenient and practicable for use'. The Institute of Electrical and Electronics Engineers (IEEE, 1990) defines usability as the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or components. In agreement with that definition, Marcus (1999) states that usability can be defined in terms of how easy or efficient a product is for a user to recognise, learn, remember, use, and enjoy. Web usability however, is a concept that relates to not only web sites' ease-of-use, but also deals with the question of whether web site users can accomplish what they are looking for (Nielsen, 2000).

In light of the broad range of interpretations of the concept and subsequent variations in definitions, approaches to measuring usability as proposed by scholars also differ from each other. Some scholars define usability as an attribute to a product or system acceptance (Shakel, 1991; Nielsen, 1993). Therefore, their model of usability is explained in terms of its relationship with the concept of 'acceptability of a system'. Most usability models (Nielsen, 1993;

Lu and Yeung, 1998; ISO 9241-11, 1998) emphasize the importance of usability because it relates to the following four main aspects:

- *Effectiveness* – relates to accuracy and completeness of users' tasks while using a particular web site;
- *Efficiency* – relates to users' level of performance while using a particular web site;
- *Learnability* – relates to users' ability to learn a particular system, and;
- *User Satisfaction* - refers to users' subjective assessment of a particular web site concerning how useful and easy it is to use it.

An important issue with regards to usability definition is the question of whether the content coverage of a system should be included as one of the elements of usability. However, most models of usability (Shakel, 1991; Nielsen, 1993; Lu and Yeung, 1998) include 'user satisfaction' as one of the usability criteria. This element has an indirect relationship with the need for content quality of a particular system. User satisfaction is related to users' subjective assessment on a particular system in terms of its ease of use as well as its usefulness. This is to say that users will be satisfied if a system is not only easy to use, but also useful in terms of its contents. From this, it is possible to justify that both user interface and content together determine users' level of satisfaction.

3.0   *IGV* APPROACH

The Identification, Grouping, and Verification (IGV) approach was developed and utilised specifically for identifying factors affecting Web usability. The approach involves three main phases. First, the identification of the criteria that affect web usability. Second, the grouping of the criteria, and finally the verification on the criteria by usability experts. Content analysis was used in phase one to analyse the various literature on web usability, including web design guides currently available. The main objective was to gather the key web usability criteria proposed in the selected literature. Several guides, articles and textbooks were selected based on the recommendation of Human-Computer Interaction (HCI) scholars such as Jakob Nielsen (Nielsen, n.d.), Keith Instone (Instone, n.d.), and Gary Perlman (Perlman, n.d.). Information provided by the British HCI Special Interest Group (BCS-HCI, n.d) was also referred to. At least 30 guides were selected, some of which were as follows:

- IBM Web Design Guide (IBM, 2000)
- Interface Design for WWW Web Style Guide, Yale Style Manual (Lynch & Horton, 1999)
- Usability Matters: What's Usability, Webreview.com (Rowland, 2000)
- Improving Web Site Usability and appeal, Microsoft Web Workshop (Web Workshop, 1999)

- Designing Information-abundant Web sites : issues and recommendations (Shneiderman, 1997)
- Writing For the Web Guide (Sun Microsystems, 1999)
- Web Content Accessibility Guidelines (WCA) 1.0, WC3 (MIT et al., 1999)
- Web Graphics – elements of web design, CNETBuilder.com (Benjamin, 1996)
- Web Design, the Complete Reference (Powell, 2000)

The content analysis in phase one was conducted based on the method proposed by Miles and Huberman (1994), which consists of two steps, namely, Data Reduction and Data Display (which includes conclusion verification):

3.1   Data Reduction

All selected guides were analysed to extract generic criteria of web usability. Each criterion identified was recorded in a standard form. During the analysis, all criteria and elements of usability that were considered too technical were rephrased or in some cases, excluded to cater for both technical and non-technical people. Both concept existence and frequency were used for coding the data (i.e., any usability criteria identified from the selected literature was not only coded for its existence, but also for the frequency of its mention - see example in Table 1).

Table 1: An example of data analysis summary for web criteria elicitation

No.	Criteria	Guide 1 (Benjamin, 1996)	Guide 2 (IBM, 2000)	Guide 3 (Web workshop, 1999)	Guide 4 (MIT et al., 1999)	Total
1	Clear title for each pages	X	X	X	X	4
2	Compatible content for all main browsers	X	X	-	-	2
3	Labelling of all static media	-	X	X	-	2

Note: 'X' means that the criterion was mentioned in the guide.

3.2   Data Display and Conclusion Verification

The coding process was performed manually. Manual coding was more practical because the computerised analysis tools could not identify different phrases or sets of words that had similar meanings. Once the data was properly coded, it was analysed for any redundancy or duplication. Finally, a list of web usability criteria was finalised to be used in phase two of the IGV approach.

In phase two, all criteria were analysed and classified into groups. A two-hour brainstorming session involving three evaluators was carried out for this purpose. Since web design environments are closely related to multimedia, information retrieval, and networking areas (Powell, 2000), the three selected evaluators were those who have strong knowledge in each of these disciplines. The main objective of the brainstorming session was to isolate each criteria into a suitable category. A card-sorting method was used to achieve this. Each criteria was written on a small card for the grouping process. All evaluators would decide the grouping for each criteria by placing it in one of the boxes provided. The placement was based on suitability, contexts, and relevancy. Finally, the evaluators decided on the appropriate name that should be given to each group. In phase three, an expert review method was used. The list of web usability criteria derived from content analysis and brainstorming was sent to 36 experts for review and verification. These experts have more than five years experience in web usability areas. The selection of experts involved two processes :

- Identification of the experts from the proceedings of past conferences on Human Factors in Computing Systems (CHI) ; and,
- Invitation to participate in the CHIWeB email list.

The main objective of the review was to get verifications and suggestions from the experts with regard to generic web usability criteria. Additionally, they were also requested to comment on the suitability of the criteria groupings. The experts were allowed to edit (add, delete, rephrase) all the criteria derived from the literature. Fifteen responses were analysed and the outcome recorded. The activity chart of the IGV approach is presented in Figure 1.

4.0   WEB USABILITY CRITERIA

By applying the IGV approach, a total of 68 key criteria of web usability were identified initially. These criteria were clustered into seven main groups based on their suitability, context, and relevancy. Following the refinement process, a refined list of 52 criteria that were divided into the seven main categories named as *SCANMIC* was derived (see Table 2).

4.1   Screen Appearance

One of the main aspects of design is screen appearance. Screen appearance or layout can be divided into 4 categories - space provision, choice of colour, readability, and scannability (Lynch and Horton, 1999; Seminerio, 1998). All experts agree that these are four very important areas of usability. The proposed list of web usability criteria for Screen Appearance is presented in Table 3.
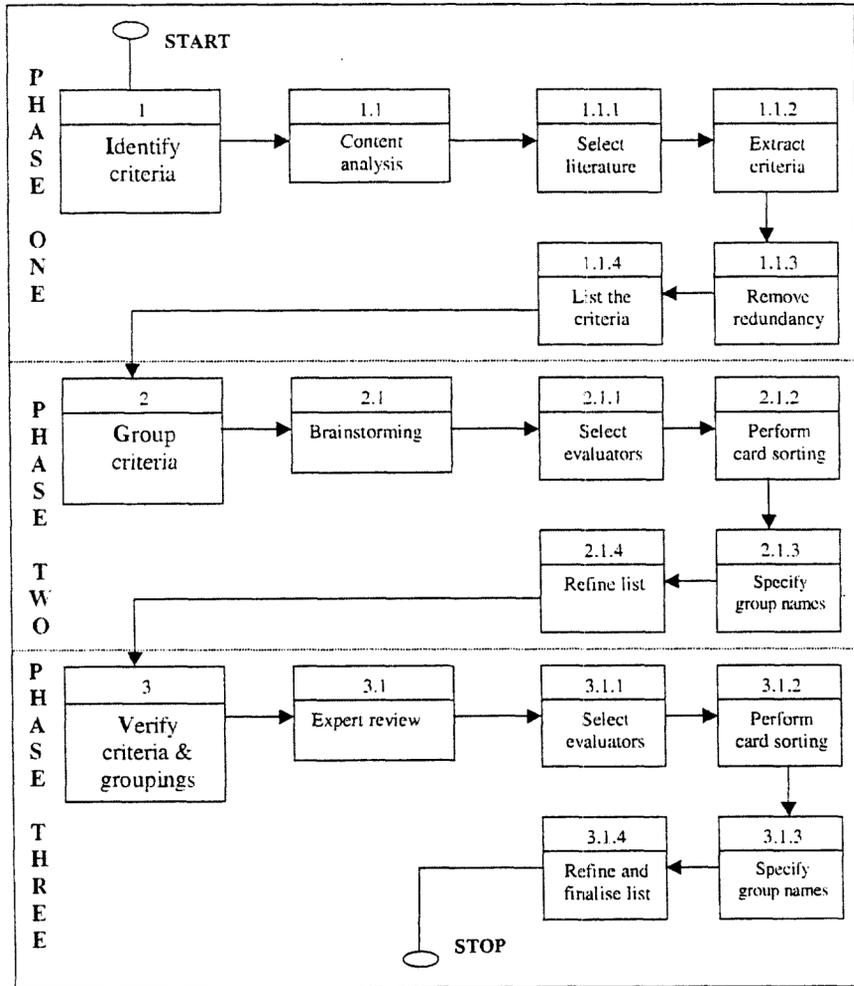
Fig. 1: Activity chart of the *IGV* approach

Table 2: Seven categories of web usability criteria

Category	Total
Screen Appearance	10
Content	15
Accessibility	5
Navigation	8
Media use	8
Interactivity	3
Consistency	3
Total	52

Table 3: List of web usability criteria for screen appearance

Screen Appearance	
Space allocation	• More space for contents than to other display elements (e.g. menu bar, list of contents, and advertisement banners)
Choice of colour	• Sharp colour contrast between text and its background • Use of colour to differentiate between functional area (e.g. tool bar, menu bar and list of contents) with content display area • Non excessive use of colour for text except for photos and graphics
Readability	• Different text sizes to differentiate between titles, headings and texts • Avoidance of background images in the content display area • Use of fonts that are easy to read (e.g. Verdana and Times)
Scannability	• Clear titles for each pages (i.e., should reflect the content) • Clear headings, sub headings for text/ document • Use of typography and skimming layout (e.g. bold fonts and highlighted words)

4.2   Content

Apart from user interface, content is undoubtedly another very important element of web sites. It is the content that makes people want to visit a particular web site. The question of what should be on a web page depends largely on the goals of the web site. Some intend to sell products and services, some offer free entertainment, and some provide government information. However, one should bear in mind that providing content in a web page is not as easy as providing a printed page in a book. Yet, a designer should not run away from the basic elements of a document to ensure a web site's usefulness (IBM, 2000). The generic criteria of content usefulness are shown in Table 4.

4.3   Accessibility

One of the goals of having a web site is to attract as many visitors as possible from various locations. The basic way to achieve this is to ensure that the site is accessible to target users. By the word 'accessible', it means that users will not only be able to get connection to a web site but will also be able to browse all available contents. Theoretically, the higher the degree of accessibility, the higher would be the level of usability. In our study, we found that there are at least, three elements of accessibility: *loading time, browser compatibility,* and *search facility*. The proposed accessibility elements of the web are shown in Table 5.

4.4   Navigation

Good navigation in a web site is comparable to a good road map. Our findings show that with good navigation such as logical tree-like structure, proper grouping of contents and use of navigational tools in all pages, users know where they are, where they have been, and where they can go from their current position. In short, navigation is the key to making the experience enjoyable and efficient. The usability criteria proposed by the experts are listed in Table 6.

Table 4: List of generic criteria for content usefulness

Content	
Scope	• Suitable language for audience • Up-to-date publication (e.g., news, articles, working papers, etc) • Archive of previously published materials • Contents provided meet the expectation of target users
Accuracy	• High quality writing (e.g., good grammar and no typographical error)
Authority	• Information on authors and other documents (e.g., names and affiliation) • References or sources of text and other documents • Background information of institution/ organisation/ owner of the site (i.e. logo, name, address, phone number and email address)
Currency	• Up-to-date contents (i.e., provide resource date and page revision date).
Uniqueness	• Options for output/ print format when appropriate • Choices of language for multi-ethnic audience • Choices of media type for a particular information (e.g., text only, audio or video) • Information or warnings on file type and size for downloading
Linkages	• Clear distinctions between internal and external links • Links to other relevant sites (e.g., state, local branches, and sponsors)

Table 5: List of web usability criteria for accessibility

Accessibility	
Loading speed	• Acceptable loading time (about 10 seconds depending on the content)
Browser compatibility	• Compatible contents for all main browsers (Netscape and Microsoft Explorer) • Compatible contents between different versions of the same browser • Compatible display for different screen types (e.g., black & white, palm top and digital TV)
Search facility	• The use of local search facility especially for medium and large web sites

Table 6: List of web usability criteria for navigation

Navigation
• Menu/ list of key categories of contents in the main page • Menu/ list of key categories of contents in all sub-pages • Links to the main page from all sub pages • Accurate/ unbroken links • Use of sitemap • The wording for each category of content is meaningful to users • Contents should be grouped into a small number of key categories (about 7) • Small number of steps/ links to arrive at a particular information (rule of thumb is 3)

4.5 Media Use

Information presentation in web pages is different from presentation on paper due to the ability of web designers to manipulate multimedia elements such as graphics, images, animation, and audio. Studies on on-line electronic materials have shown that the integration of these media keeps users attention, and when

used effectively, can enhance usability. However, designers should take extra care when introducing all these elements as improper use of them may distract users and affect usability. Additionally, heavy utilisation of media elements consumes the web site server's hard disk space, and lengthens the downloading time. Table 7 presents the list of the proposed usability criteria for the proper use of media.

Table 7: List of web usability criteria for media use

Media Use	
	Objective
Continuous/ time-based media (audio, animation and video)	• Control features for continuous media where appropriate (e.g., replay, control volume and turn off) • Alternative access (e.g., text version) to any information presented through continuous media • Avoidance of looping animation to prevent users' distraction • Use of continuous media to suit content (e.g., demonstration, instruction, and speeches)
Static media (graphics, images, pictures)	• Labelling of all static media especially those used for menus and icons • Use of thumbnails to display photos • Use of static media to enhance the information being presented • Non excessive use of static media in all pages

4.6 Interactivity

Interactivity is a broad term and can be misleading. However, in this study, it refers to *features in a web site that facilitate a two-way communication between users and site owners or other pre-assigned personnel*. Additionally, the features allow users to give feedback and comments on any issues raised by the web site. The introduction of interactivity features such as email, guess book, online forms, and net forum might enhance a web site's worthiness. While agreeing that these elements are important, some of the experts say that making them available is insufficient. Designers should take into consideration whether the elements are effective and easy to use, especially when dealing with multiple forms. Three criteria are proposed as shown in Table 8.

Table 8: List of web usability criteria for interactivity

Consistency
• Consistent page layout (e.g., screen size for content display, banners, and menu bar). • Consistent use of text in terms of its type, font size, and colour. • Consistent use of navigational aids (e.g., menu bar, buttons, and links in terms of graphics metaphor, size, and colour).

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4.7   Consistency

There is an element of 'fear of the unknown' when users visit a web site for the first time. Although they might be familiar with the browser and hypertext application environment, the design of a web site differs from others. Some web sites might put the menu bar at the top of the screen, while others might use a horizontal hypertext button at the bottom of the screen. Some web sites prefer using frames to divide functional areas while others merely use coloured boxes. Therefore, there will always be some elements of unfamiliarity on the part of users when they visit a web site for the first time. Considering this, design consistency is important to speed up users' learning. All experts agree with the fact that designers need to provide a consistent layout for title, subtitle, page footers, and background. In addition, the layout for navigation links and icons should also be consistent in terms of colour, size, space, and fonts used. However, one of the experts suggests that minor changes be made to the structure of the screen appearance every now and then so that users will not get bored and banner blind. The proposed usability criteria for consistency are shown is Table 9.

Table 9: List of web usability criteria for consistency

Interactivity
• Availability of features for users' feedback about the site (e.g., web master's email address and on-line form
• Availability of features for sharing views and discussions (e.g., e-forum, net conference and net chatting)
• Availability of entertainment features (e.g., online games and puzzles)

5.0   DISCUSSION

The outcome of this study shows that usability covers at least seven main categories - screen appearance, consistency, accessibility, navigation, media use, interactivity, and content. Screen appearance refers to the visual layout and structure of a web site. It relates to how a web site is designed and how the information is presented on the screen. The use of colour, scannability, and readability are examples of areas that affect screen appearance. Apart from appearance, consistency is also an important aspect of usability. It is vital in determining users' familiarity with a web site in terms of for example, navigation icons, colouring scheme, and page structure. Having a good design and useful content are inadequate without considering accessibility factors. This means that one needs to take into consideration whether one's web site is easily accessible to all target users who use different technology to access the internet.

Usability also relates to how easy users can move around a web site. Good navigation will help users find information easily and quickly, especially for large web sites that have hundreds of web page linkages. Site map, table of

contents, menu, and page linking are examples of web elements that affect navigation. Media use relates to the use of multimedia elements, both of static media (text and graphics) and continuous media (audio, animation, and video) to present information within web sites. Effective and proper use of media can enhance the way information is presented on screen. Another factor to consider is interactivity. This factor refers to the interactivity elements of web sites such as facilities for users to contact web masters, communicate with other users, and perform online enquiries. Content is undoubtedly another important factor of web usability. Content is normally the main reason why internet users visit web sites. Hence, constant evaluation is needed to ensure that the content provided in web sites is useful to users, reliable, relevant, and up to date.

All these categories have been identified by experts as the factors that affect the usability of web sites. Figure 2 depict these factors.
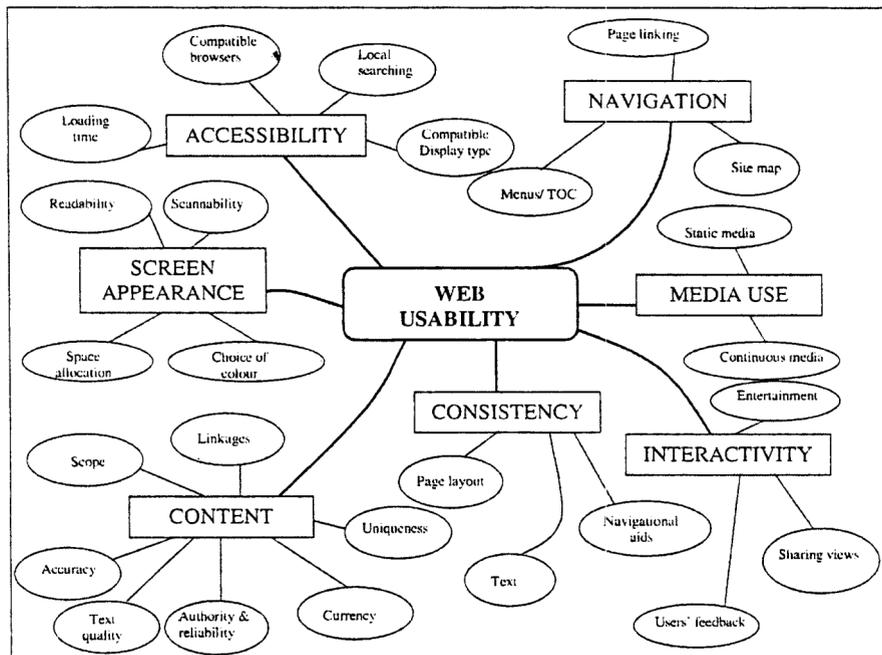

Fig. 2: Factors affecting web usability

6.0 CONCLUSION

The main contributions of the study discussed in this paper are twofold – the introduction of the IGV approach and the identification of key generic criteria for assessing web usability. The approach can be adopted or enhanced by researchers when attempting to identify the criteria for measuring Web success.

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The usability criteria identified from the study, which were categorised into seven major factors, can help web designers or others to evaluate their web sites based on priorities. The criteria can also be used as a guide to trace potential usability problems within a particular web site. The criteria and their groupings were the product of multiple data gathering techniques using the *IGV* approach which include content analysis of the literature, brainstorming, and expert review. Having said that, this study also has its limitation that needs further research. The factors visualised in Figure 2 only propose the usability criteria that can be used in web evaluation but do not explain how these criteria can be measured. In addition, some of the criteria are subjective in nature (e.g., contents meet users' expectations) and thereby very difficult to be measured. Nonetheless, the outcome of this study provides some strong basis for further investigation in this web usability area.

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