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CHARACTERISTICS OF WEB APPLICATIONS THAT AFFECT USABILITY: A REVIEW

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ABSTRACT

The characteristics of a web application are many and varied in comparison to traditional applications. There is a larger spectrum of possibilities for each web application characteristic. These differences provide additional motivation to examine a web application's usability. These characteristics can aide in better defining and measuring web usability, through determining of the set of usability attribute.

KEYWORDS: *Web Applications, Web Application Characteristics, Web Usability, Usability attributes.*

1. INTRODUCTION

A web application enables information processing functions to be initiated remotely from a browser and executed partly on a web server, application server and/or database server. A web application is an application which has been specifically designed to be executed in a web-based environment (Finkelstein et al., 2002), it is more than just a set of web pages setup with navigational links.

Deshpande et al. (2002) identified the following major differences between web applications and conventional software: compressed development schedules; constant evolution with shortened revision cycles; "content is king"; insufficient requirement specifications; small teams working to very short schedules; emerging technologies/methodologies; lack of accepted testing processes; user satisfaction and the threat from one's competition; minimal management support; criticality of performance; evolving standards; understanding of additional disciplines required for web applications; security considerations; legal, social and ethical issues; variety of backgrounds of developers; rapidly evolving implementation environment, encompassing various hardware platforms. These differences show the additional complexities of web applications and highlights potential characteristics that may impact on its usability.

Web usability is a web application that can be used by the specified range of users, given specified training and support, to fulfil a specified range of tasks, within the specified range of environmental scenarios, where the interaction is measured by a set of usability attributes. This definition of web usability has been based on definitions by Shackel (1981) and AS/NZ Standards-4216 (1994).

This research has reviewed the literature to determine characteristics of web applications that impact on usability. Each web application characteristic may represent a spectrum of possibilities with varying degrees of effect on the usability of the web application.

2. WEB APPLICATION CHARACTERISTICS

The characteristics presented, represent aspects to a web application that researchers have found to be important to the usability of a web application. The definition of usability, in general, suggests that there are four common factors that impact the usability of the interactive system (Bruno & Al-Qaimari, 2004): *users*, *tasks*, *technology* and *context*. The characteristics reviewed will be grouped into these four factors.

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2.1. Users

The **stakeholders** of a web application can be categorised by the users affected by the web interface (Hackos & Redish, 1998): *primary users*, *secondary users*, *user communities*, *users as buyers*, and *surrogate users*. Primary users of a web application can be examined based on their competence, which will change over time: *novice*, *advance beginners*, *competent performers*, and *experts*. This competence can be examined from three perspectives: subject matter knowledge, computer skill, and experience with the web application (Nielsen, 1993). If novice users are important to the web application, then ease of use (learnability) is an important usability attributes, whereas an expert user may require greater focus on efficient use.

The **loyalty** of users to a web application is an important characteristic, especially to e-commerce web applications. The basic spectrum of loyalty to a web application is discretionary or compulsory (Tomiuk, 2005). For example, a particular book can be purchased on Amazon or Barnes and Noble or a local bookstore such as Dymocks. The user has discretion to decide which alternative to use to make the purchase, whereas an organisation's intranet gives users no alternative (compulsory) web application.

Users can perform transactions on a web application with varying levels of **credentials**. The spectrum can range from *identified*, *pseudonymous*, and *anonymous* (Clarke, 1999). The level of authentication could be strong, moderate, weak, or unauthenticated. For example, Ebay.com.au provides all credential types; an anonymous user can use the web application to browse the items (anonymously) and/or select interested items into a guest session (pseudo-anonymous) with limited watch list capabilities, and/or become a registered user (identified) allowing unlimited watching of items, bidding selling and purchasing of items.

Accessibility is an important characteristic of a web application. Accessibility focuses on people with disabilities. A web application needs to consider assistive technologies, and compliance to the Web Content Accessibility Guidelines 1.0 (Chisholm, Vanderheiden, & Jacobs, 1999). This characteristic can impact on many of the other characteristics of a web application, like the impact of interaction styles and support for different input and display devices (system variables). For example, a visually impaired user may use a screen magnifier or Braille display device, which requires support for alternative devices.

The psychological aspect of users is a characteristic that plays an important role. **Motivational** factors, as discussed by Zhang et al. (1999), can include: *Work Itself* being challenging, stimulating, interesting, meaningful, useful, creative and fun; *Achievement* with successful completion of task(s); *Responsibility* given through user control; *Advancement and Growth* through the gain in knowledge and skills; *Recognition* by others of knowledge and skill level. A different perspectives by Sutcliffe (2001) describes the concept of **attractiveness** where *motivation*, *arousal* and *perceived utility* are key psychological factors. **Aesthetics** of a web interface can have an impact on user acceptance, Ngo (2001) has determined that the following measures impact on aesthetics: *Balance, Equilibrium, Symmetry, Sequence, Cohesion, Unity, Proportion, Simplicity, Density, Regularity, Economy, Homogeneity,* and *Rhythm.* These characteristics have a great impact on the subject satisfaction usability attribute.

Marcus and Gould (2000) have researched the characteristic **culture.** The spectrum of culture can be measured using five dimensions that include: *power-distance, collectivism vs individualism, femininity vs masculinity, uncertainty avoidance,* and *long vs short-term orientation.* Alternatively, a web applications culture can be limited to a specific *locality or community*, *organisation*, *country*, and/or *global* context. Culture characteristic is important as a usability attribute for a global web application's usability.

Characteristics of web users can vary based on the type of stakeholder, the envisaged loyalty level required, the level of credential that identify users, the motivational factors and aesthetics that appeal to users, and the cultural aspects all of which determine the usability attributes. Traditional applications do not have the same diversity of user characteristics to consider in achieving greater usability.

2.2. Task

Deshpande et al. (2002) proposed the following taxonomy of web applications **categories**: informational, interactive, transaction, workflow, collaborative work environments, online communities (market places), web portals, web services. Transactional type web applications are commonly found in e-commerce applications (Thachenkary, Chatterjee, & Katz, 1997) and can be further broken down into: transaction type, domain/site type, vendor type and product type.

The **interaction style**(s) that can be implemented on a web application is constrained by the technological aspects. The interaction styles provide various levels of usability, and support different types of users, these could include (Nielsen, 1993): *Batch, Question-answer, Command language, Function keys, Form fill-in, Menus, Direct manipulation, Non-command, Natural language*.

The interface **design** (Fraternali, 1999) characteristic of a web application can be represented by its: *structure* describes the organisation of the information space presented by a web application; *navigation* enables moving through the information space presented by the web application; *presentation* describes the interaction styles used to present the information and behaviour of the web application.

Usability is affected by the type of task and its complexity, the interaction style used to perform the actions and the design of the interface. All these characteristics directly affect the learnability, efficiency of use and subject satisfaction usability attributes of web application's usability.

2.3. Technology

The **tools** used to implement a web application can dictate the degree of usability possible, through the architecture developed with the tool. Fraternali (1999) describes these various web development tools as: *visual editors and site managers*; *hypermedia web generators*; *web database gateways*; *web-based form editors and database web publishing wizards*; *model-driven application generators*. Microsoft PowerPoint allows publishing of its presentations using and export into HTML, with a publishing wizard. This tool limits the implementation of characteristics, such as design, interaction style, and aesthetics.

Development of web application can be for intranet, or internet networks. Karlsbjerg (2003) describes implementation strategies for intranet web applications from two perspectives. First, the architecture of the web application is tailor-made or ready-made. Second, it is implemented or configured in-house or outsourced. This **ownership** characteristic of the web application, impacts on the ease by which the web application can dynamically meet the needs of the website owner and its visitors in web time. Web time (Cloyd, 2001) is a term that refers to the tighter development timelines for web applications.

Web environment provides various characteristics that have an impact on the usability of a web application. Lee (1999) describes **system variables** as a characteristic of web application that include visual display device capabilities (resolution and colour), input devices limitations, and internet transmission speeds. The various devices being used to access web applications requires additional consideration focus on usability, for example a small screen device (like a PDA or Mobile Phone) accessing a web application has scrolling issues, in comparison to a desktop computer. **Internet latency** affects web usability, Marshak and Levy (2003) examine various aspects that may improve the latency: a mirror site, wider connectivity to the Internet, better Web server or load balancing. **Visualisation** of the interface to a web application maybe be examined by adapting Price, Small & Baecker's (1993) taxonomy of software visualizations that include: *Scope, Content, Form, Method, Interaction, and Effectiveness*.

The technological characteristics have a greater effect on web application usability than in traditional applications; web application architecture can be more distributed and reliant on a more diverse set of technologies. Ownership and system variables require additional consideration when determining web application usability because of the diversity of devices that are now web enabled.

2.4. Context

An industry classification provides the context of the environment where the users perform the interaction. Traditional application domains and industry classifications have been explored and summarised by Glass & Vessey (1995). An **industry** classification is a characteristic of a web application that highlights special needs of an industry in relation to usability. For example, finance industry requires greater focus on security, while government web applications need greater focus on accessibility. There is a major industry classification prescribed by the Australian Bureau of Statistics (1291.0, 1998), that includes: *Agriculture, Forestry and Fishing; Mining; Manufacturing; Electricity, Gas and Water Supply; Construction; Wholesale Trade; Retail Trade; Accommodation, Cafes and Restaurants; Transport and Storage; Communication Services; Finance and Insurance; Property and Business Services; Government Administration and Defence; Education; Health and Community Services; Cultural and Recreational Services; Personal and Other Services.*

The **contextual** properties (Finkelstein et al., 2002) of a user that is interacting with a web application can vary with each web application. *User* context allows identification and enables personalisation. *Network*

provides network and bandwidth context. *Location* captures information about the location that can enhance context of web application. *Time* context represented at a web server may dictate opening and closing times or relate to a timetable or schedule. Finkelstein et al. (2002) states that because "web application suffering from the anytime/anywhere/anymedia syndrome", that the focus on **customisation** can tackle these contextual issues. Many authors examine customisation from various perspectives, Kappel et al. (2000) describes it as adaptation (static or dynamic) and context (static or dynamic).

Contextual properties, customisation and industry classification provide the characteristics of web application that enable the environment to be tailored to the stakeholders, there tasks and the technology to support the interaction. These contextual characteristics will enable a better focus on usability attributes.

3. CONCLUSION AND FUTURE RESEARCH

When compared to a traditional application, a web application's characteristics describe a wider range of stakeholders, a wider range of tasks and interaction styles, more complex technological infrastructure, and a broader range of contextual issues. The usability attributes can be determined based on the web application characteristics, and conversely the usability attributes that are important can dictate possible characteristics that need to be considered by a web application. Future research will be conducted to derive the relationships between web application characteristics and usability attributes for a web application.

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