Usability Attributes: An Initial Step Toward Effective User-Centred Development

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Abstract

The definition of usability has evolved over time. Some of the proposed definitions have been general, and apply to all types of interactive systems. Others were tremendously influenced by the experience of those who proposed the definitions and the domain in which they practiced usability. The definitions, in general, seem to agree that the targeted users, the complexity of the task, the type of technology (the interactive system), and environment (context of use) are the common factors that impact the usability of the interactive system. However, the attributes of usability that describe "a measure of how well actions are being performed with an interface" do seem to differ from one definition to another. It is precisely these attributes that we wish to focus on in this paper: how to identify them?, why they tend to differ from one definition to another?, why identifying them is crucial to the success of the interactive system?, and finally, how identifying the usability attribute can lead to effective user-centred development?

Keywords

Usability, attributes, human-computer interaction, universal usability, quality of use, user-centred development

INTRODUCTION

Usability has its academic origin in the area of human-computer interaction (HCI), which attempts to bridge the gap between human's goals and technology (Preece 1994). This is being done by introducing the human issues into the design of interactive systems, and by devising practical techniques to observe human behaviour and observe their performance. The SIGCHI (SIGCHI 1992) definition of Human-Computer Interaction (HCI) as a discipline refers indirectly to usability: "Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."

Many researchers have attempted to define usability. A recent usability survey (Folmer and Bosch 2004) concludes that "authors have different opinions on how to measure usability." This lack of consensus has led to a plethora of similar definitions.

The New Penguin Dictionary of Computing defines usability as "a property of any complex system in which humans interact with machines that measure how comprehensible and convenient the operator finds the user interface" (Pountain 2001). Doyle's 'Computer Dictionary' (Doyle 1994) defines usability as, "the ease and adaptability with which a product can be applied to the performance of the work for which it is designed. A high degree of usability implies ease of learning, flexibility, freedom from bugs, and good design that does not involve unnecessarily complicated procedures." Both of these dictionary definitions describe the essence of usability. The first focuses on the "comprehensible and convenient" usage of a system by users as the key usability attributes. The second suggests "ease of learning, freedom from bugs and simplicity of usage" as the key attributes to usability.

Brian Shackel (Shackel 1981), was one of the first researchers to propose a broad definition of usability. He states that usability is "[a system's] capability in human functional terms to be used easily and effectively 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". This was a very comprehensive definition referring to a specified range of users, tasks, and contexts, and describes two key usability attributes, namely ease of use and effectiveness.

In (Preece 1994), usability is defined as "a measure of the ease with which a system can be learned or used, its safety, effectiveness and efficiency, and the attitude of its users towards it." In this definition, safety is identified as another important usability attribute to reflect the fact that we are no longer dealing with desktop machines,

and extent to which the context of use can determine the overall usability of the interactive system when used in the medical arena or used inside a car or an airplane, for example. In a more recent publication, Jenny Preece (Preece, Rogers et al. 2002) distinguished between two types of usability attributes: "usability goals" (namely, effectiveness, efficiency, safety, utility, learnability, and memorability - which seem to have a direct impact on the performance of the user) and "user experience" (eg. satisfying, enjoyable, fun, entertaining, helpful, motivating etc. – which seem to effect the user references or subjective satisfaction).

Krug (Krug 2000) argues that usability is "not rocket surgery." Usability is "making sure that something works well: that a person of average (or even below average) ability and experience can use the thing – whether it's a web site, a fighter jet, or a revolving door – for its intended purpose without getting hopelessly frustrated." Emphasis here is being placed on the ability of the user to do the task at an expected level of experience, to signify the importance of user modelling and need to design interactive systems that match users experience and skills.

Jakob Nielsen and Ben Shneiderman (Nielsen 1993; Shneiderman 1998) placed usability within a wider perspective, namely system acceptability, and distinguished between the usability and utility of the system. They have also identified five key attributes of usability that applies to all aspects of a system with which humans interact. The common attributes are: ease of learning (learnability), speed of performance (efficiency), low error rate, retention over time (memorability), and user attitude (subjective satisfaction). Such attributes are commonly used for usability goal setting and benchmarking of a system throughout a development lifecycle. Usability specialists use different evaluation techniques to measure usability based on these five usability attributes.

A commonly referenced definition of usability is the one stated in a technical report (9241-11.2) produced by the International Standards Organization (ISO/DIS 9241-11.2 1997): Usability refers to "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." In this definition, effectiveness, efficiency and subjective satisfaction are considered the key attributes of usability.

A very broad, catchall definition is presented by Shneiderman (Shneiderman 2000) to describe the term "universal usability." According to Shneiderman, "Universal usability will be met when affordable, useful, and usable technology accommodates the vast majority of the global population: this entails addressing challenges of technology variety, user diversity, and gaps in user knowledge in ways only beginning to be acknowledged by educational, corporate, and government agencies." In other words, a universal design should respect and value the dimensions of diversity intrinsic in human capabilities, technological environments and contexts of use. Universal usability, however, does not imply a system that is well-designed for one culture will necessarily be usable in a different culture. The term 'local usability' has also been introduced to acknowledge that diverse cultures, languages, and regional regulatory restrictions influence how the targeted audience perceive and use interactive systems.

The concept of actability is directly related to usability, but emphasis is on the ability of the user to perform (interact) with a system to accomplish the task in a business context: "An information system's actability is thought of as its ability to perform actions, and to permit, promote and facilitate users to perform their actions both through the system and based on messages from the system, in some business context." (Cronholm et al 1999).

Nigel Bevan (Bevan 1995) identified a broad approach to usability as a "quality of use." According to Bevan, "Quality of use should be the major design objective for an interactive system: does the product enable the intended users to achieve the intended task?" This approach directly links quality of use to the concept of usefulness - it is not enough for the graphical user interface to be well-designed (that is usable); it should also have high utility. Utility refers to the right system for the right users and the right task. For example, a well-designed desktop calendar management system for professionals will not have the same level of utility if used by another category of users within a different context of use - say a taxi driver using the software inside the car.

COMMON THREADS

Despite the different attempts to describe the characteristics of well-designed graphical user interfaces, no standard definition of usability exists: no agreement has been reached as far as the usability attributes are concerned. Others have discovered that the "meanings of usability are often blurred or poorly defined, and with their constant changes reflect the characteristics of the artefact that we use on a daily basis" (Gamberini and Valentini 2003). In synthesizing the definitions and extracting the key aspects, we hope to discover the deficiencies and strengths in current definitions. The definitions, in general, seem to suggest that there are four common factors that impact the usability of the interactive system. These are: the user, the task, the technology and the context of use. To develop a usable system, interaction designers and usability specialists need to know the targeted users, analyse the tasks, understand the potential and limitation of the technology, and consider the environment (conditions) in which the system will be used. However, the attributes of usability that describe "a measure of how well actions are being performed with an interface" do seem to differ from one definition to another.

Why the attributes of usability tend to differ from one definition to another? Interfaces and interaction styles have gone through various generations. Interfaces may have started with simple switches and light bulbs, then punch cards and command line interfaces, now more commonly we have progressed through to full screen, form filling and graphical interfaces (Shneiderman 1998). At each generation of interfaces, lessons were learnt which enhanced the next generation. Now and in the future new technologies are being explored, like voice, gestures, and natural language interfaces, to name a few. The interesting thing about each of the generations of interfaces is that the target users group has grown. It started with only inventors and experts, and was then followed by specialised groups without computer knowledge, business professionals, hobbyists, and even people with special needs (Shneiderman 1998). Current system (like websites) and the next generations of user interfaces and interaction styles will be targeting everybody. The convergence of the computer, entertainment, and telecommunication industries has brought together various interactions styles and added other complexities. Small screen devices have decreased the graphical area size for interfaces, adding other attributes that impact on interaction. Voice recognition presents its own set of issues, which reverts our interaction back to a command line style interface. All this change forces us to re-evaluate the attributes of usability every time we design a new system.

USABILITY ATTRIBUTES

Usability researchers have varying opinions on how to define and measure usability (Folmer and Bosch 2004). The AS/NZS 4216 Standard, which to a large extent is a replica of the ISO 9126 International Standard, describes attributes of software quality. One of these attributes is usability, which is defined as "a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users" (AS/NZS 4216 1994). Here the definition focuses on "a set of attributes" required to performing the task by the user of the product. What is interesting is that the "set of attributes" has been left open to be defined by the evaluator of the system. This suggests a strategy is required to consider the various attributes of a complex system that would define its usability.

The authors' anecdotal experiences indicate that many interface developers, who have no formal training in performing usability evaluations, have difficulty articulating the usability attributes most relevant to the particular graphical user interface or website they are developing. They also fail to appreciate why identifying these attributes is crucial to the success of the interactive system, and how identifying the usability attribute can lead to an effective user-centred development. The authors are currently conducting research in this area in order to answer these questions.

As indicated earlier, to identify the usability attributes, interaction designers and usability specialists need to know the targeted users, analyse the system tasks, understand the potential and limitations of the technology, and consider the environment (conditions) in which the system will be used. We believe that identifying the usability attributes is the first step toward a successful human-centred development: usability attributes become usability requirements and in turn become quantified usability specifications (Nielsen 1993). Consequently, the relevant usability requirements will have a crucial impact on the development process. In one hand, it will become a considerable challenge for the interaction designer to translate the usability requirements into an effective interaction design that supports the best interaction styles to perform the user tasks. On the other hand, during the design and development process, the usability specialist should select the best usability evaluation technique in order to assess each one of the relevant usability attribute and ensure that the system meets the usability specifications.

For example, you will find if you want to develop an intelligent interface that "predictability" is a crucial usability attribute that could make or break the system. Predictability becomes a usability requirement, and as a result, the interaction designer will have to provide continuous feedback about the state of the system, and will have to allow the user to reverse and use the "undo" operation etc. The usability specialist on the other hand will have to devise a few usability experimental tasks to evaluate the predictability of the intelligent systems.

Articulating the usability attributes becomes even more crucial when some of these attributes compete, or even conflict, with each other within the same design. For example, if you are developing a car website, you might find within the set of user tasks two usability attributes that could potentially compete with each other, one attribute is "promoting" the cars, the other is "providing technical information at the appropriate level for the users." The designer needs in this case to consider the right balance between promoting the car (which might involve animation and sound effects) and providing technical information at a level appropriate for the targeted users. Consequently, the usability specialist might have to devise some evaluations specifically for this purpose to ensure that the targeted users will not be distracted by the excessive use of animation and sound effects when they are trying to find some technical information about the car they would like to buy.

CONCLUSION

The definition of usability has evolved over time, and usability researchers have varying opinions on how to define and measure usability. The definitions, in general, refer to four common factors that need to be understood

in order to enable the development of a usable interactive system. These are, the targeted users, the tasks, the type of technology, and context of use. However, these four factors are dynamic and keep evolving over time making it very difficult to agree on a fixed set of usability attributes. In other words, the usability attributes are application specific and driven by these four common factors.

Usability attributes have an impact on the development process because they become usability requirements and in turn quantified usability specifications, which will have direct impact on the design outcome. Usability specialists will also have to conduct usability evaluations to ensure that the final system will meet these usability targets.

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