Applied Ergonomics 46 (2015) 297–303

Contents lists available at SciVerse ScienceDirect

Applied Ergonomics

journal homepage: www.elsevier.com/locate/apergo

Making the case for inclusive design

Sam Waller*, Mike Bradley, Ian Hosking, P. John Clarkson

University of Cambridge, Engineering Design Centre, United Kingdom

ARTICLE INFO

Article history:
Available online 26 March 2013

ABSTRACT

This paper describes the University of Cambridge, Engineering Design Centre's (EDC) case for inclusive design, based on 10 years of research, promotion and knowledge transfer. In summary, inclusive design applies an understanding of customer diversity to inform decisions throughout the development process, in order to better satisfy the needs of more people. Products that are more inclusive can reach a wider market, improve customer satisfaction and drive business success. The rapidly ageing population increases the importance of this approach. The case presented here has helped to convince BT, Nestlé and others to adopt an inclusive approach.

1. Introduction

Every design decision has the potential to include or exclude customers. Inclusive design emphasises the contribution that understanding user diversity makes to informing these decisions. However, the complete set of success criteria for a business should include factors related to people, profit and planet (Elkington, 1998). Based on this framework, an example set of success criteria for a product is listed below:

1.1. People

- **Utility** is the extent to which the functionality of the product offers benefit to the user and society, and offers something better than other ways of doing it.
- **Usability** is the extent to which users can achieve goals with the product with effectiveness, efficiency and satisfaction, in real-world situations. In the context of inclusive design, the 'users' should encompass the range of human diversity across the population, in which case usability overlaps with accessibility.
- **Desirability** is the extent to which the product motivates purchase and ongoing usage, given the total cost of ownership.

1.2. Profit

- **Commercial viability** is the extent to which the product delivers a suitable return on investment over its life-cycle, while conforming to and enhancing the brand.
- **Technical viability** is the extent to which the product can be manufactured and supported at the required production volume, with appropriate levels of reliability, robustness and customer support.
- **Compatibility** is the extent to which the product works together with other devices, and conforms to legal requirements and cultural expectations.

1.3. Planet

- **Resource consumption** is the extent to which the product encourages sustainable use of materials, water, human labour and land.
- **Waste control** is the extent to which the product enables and motivates control of outputs that may contaminate land, air or water.
- **Energy efficiency** is the extent to which the product minimises the energy that it uses across its life-cycle, while maximising the extent to which the product reduces the amount of energy that other things use.

Many of these characteristics are inter-related, and can be conflicting. For example, adding more features to increase the utility of the product will typically make the interface more complicated, which can compromise usability. Successfully managing and prioritising these conflicts is the key to delivering products that best satisfy the needs of the user, the business and the planet. Ignoring 'people' criteria can lead to products that do not sell at high volumes, or suffer from significant return rates. Ignoring 'profit' criteria can result in theoretical concepts that are never taken to market. Ignoring 'planet' criteria exposes the business to

* Corresponding author.
E-mail address: sdw32@eng.cam.ac.uk (S. Waller).

0003-6870/$ – see front matter © 2013 Elsevier Ltd and The Ergonomics Society. All rights reserved.
http://dx.doi.org/10.1016/j.apergo.2013.03.012

risks associated with substances becoming banned, plus rising energy and commodity prices.

This paper focuses on inclusive design for mainstream consumer products, which are produced at high volumes and sold in competitive markets. However, much of the content presented here-in is also applicable to the design of services and the built environment.

The remainder of this paper will focus on 'people' and 'profit' success criteria. However, the future ambition of the University of Cambridge, Designing Our Tomorrow initiative is to promote an integrated response to the challenges of ageing populations and sustainable use of the planet's resources. This initiative will integrate inclusive and sustainable design to holistically cover the complete framework of success factors presented earlier.

The University of Cambridge, Engineering Design Centre's (EDC) case for inclusive design is now presented, based on 10 years of research, promotion and knowledge transfer, as described in Clarkson and Coleman (2015). 'What is inclusive design?' is first considered in further detail, followed by 'Why design inclusively?' and 'How to design inclusively?'

2. What is inclusive design?

Delivering breakthrough advances across the success criteria requires a clear and communicated vision for what the product is about. Setting this strategy requires:

- Understanding diversity within the population.
- Responding to this diversity with informed design decisions.

2.1. Understanding diversity

Most of the commercial organisations that the EDC have worked with have started from a polarised viewpoint that 'mainstream' products are for 'fully able' users, and a separate, dedicated department supports the minority of customers with disabilities (Chamberlain et al., 2015). The case for inclusive design presented here-in was therefore developed to convince people who start from this viewpoint.

The United Nations (2006) Convention on the Rights of Persons with Disabilities defines disability based on being unable to participate in society on an equal basis with others. When determining a specific definition of disability, comparison with the majority is often used to define a threshold that determines when a person's impairment is severe enough for them to be classified as disabled. Defining such a threshold creates a split between the able-bodied and those with disabilities, which can be beneficial for people to gain recognition of their rights and to provide appropriate support.

However, in the context of product design, the 'disability' centric approach tends to encourage commercial organisations to develop specialist solutions to accommodate single types of severe ability loss, such as blindness or wheelchair use. Commercial organisations can easily overlook those with multiple minor ability losses, such as those that commonly occur with ageing, including age-related long sightedness and arthritis. These minor ability losses may not be severe enough to meet a threshold definition for 'disability', but may cause significant difficulties when interacting with products.

Indeed, research commissioned by Microsoft (2003) to investigate the benefit of accessible technology makes the following comment:

> "… the concept of 'disability' may have limited the understanding of the need for accessible technology. Instead of assuming that accessible technology is only useful to a distinct group of people with disabilities, the IT industry must consider the wide range of people who could benefit …"

In order to better understand population diversity, the polarised separation of 'able-bodied' and 'disabled' is first challenged by introducing a segmented pyramid (Benktzon, 1993) to model the full range of ability variation within a population. The bottom segment of the 'Population Pyramid' represents those with no difficulties, and the severity of difficulties increases up the pyramid. Fig. 1 shows a specific interpretation of this pyramid model, where the prevalence data and definitions of difficulty levels are drawn from the Microsoft (2003) survey. An alternative breakdown of the 'Population Pyramid' is also presented within Clarkson et al., 2015.

Having framed ability variation as being continuous within the population, it is then important to consider co-occurring ability losses. Typical conceptions of disability focus on single types of severe ability loss, yet a detailed analysis (Waller et al., 2010) of the 1996/97 Disability Follow-up Survey (Grundy et al., 1999; Department of Social Security Social Research Branch, 2000) reveals that: "Of the people with some kind of severe ability loss, 83% of them also have another kind of ability loss".

Population diversity has been introduced first from the perspective of ability variation, but can be further broadened to consider diversity associated with different real-world contexts, lifestyle, aspirations, gender, and past experiences.

Eden et al. (2007) indicate that US women influence 80% of buying decisions, yet the results of a survey at the Consumer Electronics Show in 2006 indicate only 1% of those surveyed believe that consumer electronics companies took women's needs into consideration.

Population diversity can further broadened to consider a diverse range of usage cases, such as when at home, at work, or on holiday, and a diverse range of environmental factors, such as ambient lighting, rain, cold weather, background noise, social pressure and fatigue (Elton and Nicolle, 2010). Other contextual factors such as looking after children may distract attention, and may limit the use of one or both hands. In summary, 'it's normal to be different, want different things, and do things differently' (Lange and Becerra, 2007; Hosking at al., 2010).

2.2. Responding to diversity

People of different ages, capabilities and social and cultural backgrounds have a diverse range of needs, desires and preferences.

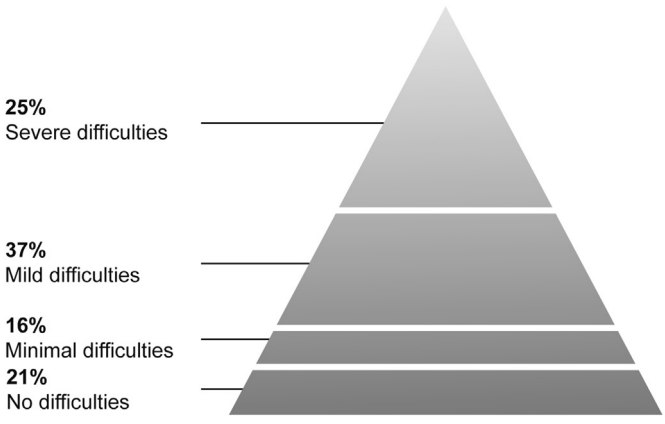

Fig. 1. A segmented 'Population Pyramid' showing a breakdown of vision, hearing, cognitive, speech and dexterity difficulties for American adults of working age (16–64) from the Microsoft (2003) survey. Reproduced from Hosking et al. (2010), which also contains definitions of the different difficulty levels and further details of the survey.