Fuglerud K.S., Sloan D. (2013) The Link between Inclusive Design and Innovation: Some Key Elements. In: Kurosu M. (eds) Human-Computer Interaction. Human-Centred Design Approaches, Methods, Tools, and Environments. HCI 2013. Lecture Notes in Computer Science, vol 8004. Springer, Berlin, Heidelberg. The published version is available at https://doi.org/10.1007/978-3-642-39232-0_5

The link between inclusive design and innovation: some key elements

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Abstract. It is often said that universal design and similar approaches can be a source of innovation. In this paper key elements in inclusive design are identified, and examples of innovations related to inclusive design are presented. Then, some core elements of the inclusive design process that will help spur innovation are identified. Based on this the link between inclusive design and innovation is discussed. Finally, some recommendations for an inclusive and innovative design process are presented.

Keywords: inclusive design, accessibility, universal design, user-centered design, user diversity, user involvement, innovation

1 Introduction

The concept of Inclusive design in ICT is being embraced by politicians as a means to include everybody in the information society. An important driver for the push to develop inclusive technology is demographic change. In particular, populations across the Western world are ageing, and there is a need for more efficient ways of taking care of the ageing population, while enabling older people to use ICTs with independence and success. Inclusive ICT products and services are seen as vital tools in meeting these challenges. It is expected that such tools can empower people, and help them to live more independent, active and interconnected lives. Another important driver for inclusive design is developments within the human rights and disability movement. Because ICT is an integrated part of the society, it is recognized that being able to take part in the information society is a prerequisite to fully be able to take part in the society, and thus inclusive ICT is needed.

While policy makers and human rights advocates have embraced the ideas of inclusive design, it seems necessary with more conviction in order to make the industry, service owners, and buyers embrace these ideas. Common arguments for why industry should do inclusive design are ethics - it is the right thing to do, demographics and customer satisfaction - a growing component of the customer base, in number and in economic power, is older people, commercial - increasing the potential customer

base, and legislative and regulatory concerns - more and more countries includes clauses about accessibility in their legislation. Another important driver for inclusive design is that it can lead to innovative designs [1-3].

While the overall motivation, principles and design objectives of inclusive design are quite easy to grasp, it is less clear when it comes to details in how to do this in practice [4]. The main objective in this paper is to take a closer look at what elements are considered important in an inclusive design process; and to link this with experiences of what have been important aspects of research and development resulting in inclusive innovations. Finally some concrete suggestions for key features of an innovative and inclusive design process are given.

2 Key elements of inclusive design

There are several design approaches that encompass the goal of producing ICT products and services that can be used by broad and diverse populations, including disabled, elderly people and people with poor ICT skills, people with reading and writing difficulties, the poor or otherwise disadvantaged users, etc. Examples of such design approaches are “Universal Design” [5], “Universal Usability”[3], "Universal Access” [6], “User Sensitive Inclusive Design” [7], “Inclusive Design [8], "Design for all" [9], and Ability Based Design [10]. In this paper, these design directions are labelled inclusive design approaches (IDA).

While many think of IDA as design for disabled people, the general intention of these approaches is to design mainstream ICT such that it can be used by as many people as possible, including elderly and disabled people. In the following we discuss some elements that can be regarded as key elements of these approaches.

Adherence to standards and guidelines is a frequently mentioned approach in IDA. Guidelines from the W3C’s Web Accessibility Initiative (WAI) are commonly referred to. Examples of international standards are ISO/IEC 40500:2012 Information Technology - W3C Web Content Accessibility Guidelines (WCAG) 2.0 [11] and ISO 9241:2008, Ergonomics of human-system interaction – Part 20 Accessibility guidelines for information/communication technology (ICT) [12] and Part 171: Guidance on software accessibility [13].

While there is broad consensus that following accessibility standards and guidelines is usually a precondition for accessible design, a number of authors have noted that this this is not enough to achieve genuine inclusive experiences. A solution that conforms to accessibility guidelines may be technically or theoretically accessible, but at the same it may be so difficult to use for certain user groups that it is hard or even impossible to use in practice [14]. Guidelines and standards are helpful to remove many accessibility barriers, but far from all. Results from empirical research have suggested that conformance to WCAG 2.0 will only solve about half of the problems encountered by visually impaired users [15]. It is necessary to complement with other methods such as evaluations with disabled users [15, 16]. Therefore, many researchers have arrived at the conclusion that in addition to conformance with accessibility guidelines, IDA needs to be based on principles of user-centered design (UCD) [16-18].

A central standard for UCD is ISO 9241-210:2010 Ergonomics of human-system interaction. Part 210: Human-centred design for interactive systems. In this standard the term "human" is used instead of "user" in order to emphasize that it addresses a number of stakeholders, not just those typically considered as direct users of a system. According to this standard, a human-centred approach includes the following principles: The design is based upon an explicit understanding of users, tasks and environments; users are involved throughout design and development; the design is driven and refined by user-centered evaluation; the process is iterative; the design addresses the whole user experience; and the design team includes multidisciplinary skills and perspectives. Thus, the key elements of inclusive design processes can be summarized as;

- Include multidisciplinary skills and perspectives,
- adapt and apply accessibility guidelines and standards,
- iterative development
- focus on users with diverse accessibility needs and their usage contexts early and throughout the development process,
- evaluate designs with elderly and people with disabilities, and
- focus on the whole user experience.

3 Examples of innovations related to inclusive design

It is interesting to observe that many efforts at developing technology to assist people with some kind of disability has resulted in innovations which later have laid the foundation for a broad range of mainstream technology [19]. An example is the work of Alexander Graham Bell who was concerned with aiding deaf people to communicate. In 1875, he came up with a simple receiver that could turn electricity into sound. This research has later inspired the invention of the microphone, speaker, telephone, speech recognition, speech synthesis, stereophonic recording and the transistor [19].

Other examples include text-messaging over land lines for deaf people, which later developed into mobile telephone text messaging, early remote control systems which was first developed for motor-impaired people and predictive text systems also first developed for motor-impaired people used, later picked up and developed into T9 word prediction systems in mobile phones [2]. Likewise, assistive technology for blind people has inspired the development of a browser which translates content from Web pages into speech. This technology can provide web access to anyone in eyes busy-environments in [19].

In the book "Innovating with people: The business of inclusive design", a number of successful cases from different design disciplines are presented, among them travel information systems, a telecommunication product – the Two Tone Phone, and the Norwegian governments website `www.gowernment.no` [20].

During the last decade several design challenge events have been conducted to encourage industry to engage in inclusive design. This has for example been done at the European Business Conference (EBC); The Vodafone Smart Accessibility award scheme for mobile phone apps [21] and the SS12 Code for a Cause competition [22]

are other examples. The basic idea of such events is to let designers – who may be professionals, or students - work with disabled people to solve a real-world design challenge. Several such design challenge projects have been widely praised and even resulted in new business opportunities [21, 23]. Companies involved in such events have stated that inclusive design can be especially valuable as a source of innovation and differentiation [24].

The final example is taken from a semester long design class where students were given the task of designing something for a grandparent [25]. The undergraduate teams included students from product design, interaction design and art programmes. The student assignment was to design networked objects for a grandparent. While the students would learn about elderly people as a group, they would at the same time deliberately design for an individual and not a whole population. The results in this particular class stood out from other similar design classes. The panellists from industry, chosen to give expert critique after the student presentations, were impressed by the originality and creativity of the student projects [25].

4 Experiences from design of inclusive innovations

In reflecting on why the student project referred to above made such an impact, the authors highlight several aspects [25]. Among them is the importance of designing for one particular person in contrast to a group or a whole population. It is pointed out that the details, far from being mere details, actually are what constitutes the design [25]. Designing for a grandparent meant that the students could develop deep knowledge and an empathic relationship with the user. It is also pointed out that the student teams were multi-disciplinary. Similarly, one of the winners of the Vodafone Smart Accessibility award originally made the app for his five year-old autistic son. It had more than 4000 users two years after its first release [24]. Although one cannot generalise from one disabled individual to all people with similar impairments, these examples demonstrate that an in-depth exploration of a single case can spur new and creative ideas.

When interviewing participants in the EBC inclusive design challenge mentioned in the previous section, it was found that designers considered the opportunity to interact with disabled people as particularly useful and valuable [26]. The interaction with disabled people during the design informed them about latent problems that they would not have predicted otherwise [23].

In the book “Design and the Digital Divide – Insights from 40 years in computer support for older and disable people”, Alan F. Newell reflects on the development of assistive technologies that later made the way into mainstream products. When considering the development of the predecessor technology for TV subtitles he says; “The most important aspects of this research were the multi-disciplinary approach of detailed research into the requirements of deaf viewers and the analysis of the captioning process” [2]. In other words, the research team acquired a deep knowledge of the user group in question, i.e. the deaf people, and of the application area in question, i.e. the captioning process. The importance of examining the use of any system in real contexts is also emphasised [2].

In a report conducted by the National Council of Disability in the US it was found that that leadership, more than any other single factor, accounted for the various agencies embrace of accessibility and for success in achieving it [27, 28]. The leadership had taken different forms in the different agencies. However, in all the cases a person's leadership and engagement seemed to have sprung out of some kind of life experience or personal commitment, and this had evolved into sustained efforts in the workplace. Thus, it is not unlikely that such commitment has sprung out of a deep understanding and knowledge about the situation of disabled people, either because of own disability or disability of a person whom which they had a close relationship to.

A number of successful cases from different design disciplines are presented [20]. In all the cases, various people-centered research techniques were used, and the selected approaches in each case are described. They vary from being low contact methods, such as questionnaires, to medium contact methods, such as interviews, to high contact methods, such as workshops with users. The people-centered research in the cases are characterized by being based on real life first hand observation, or direct information through dialogue, mostly performed in context and involving older or disabled users and other users that challenges the design.

In general, there is a growing recognition among researchers of the crucial role of users in innovation. Empirical research from world-class best practices innovation companies has found that market orientation, and customer knowledge is one of the key factors that drive innovation. Getting close to the customer is a top priority in industrial innovation [29], and users are found to be important in radical and especially in discontinuous innovation [30]. In order to suggest fruitful changes to a situation, it is necessary to understand the situation as it is. A deep understanding of particular users and their context can provide excellent conditions for creativity that matters [31]. The deep knowledge acquired are valuable when the development teams need to evaluate and prioritize ideas based on how well they may fit into or enhance a particular situation for particular users [31]. Although acquiring such deep knowledge may take some time in the beginning, it can also improve design efficiency because it can help to limit the exploration of dead ends. The benefits of user involvement to software design have been shown in several studies, and lack of user involvement has repeatedly been associated with failed software projects [32].

Also newer forms of user involvement seem to be promising. In one study it was found that crowdsourcing among users can actually outperform professional idea generation, particularly when it comes to ideas to solve their own needs, and providing that the users had some knowledge about existing solutions [33].

5 Inclusive design practise in industry

Studies of inclusive design practices in the ICT industry reveal that there is a gap between theory and practice, i.e., design practices in industry does not include all the key elements of inclusive design. While automated accessibly tools have a strong attraction in terms of efficiency, manual evaluations and evaluations with users are less frequently performed [16]. Tight delivery deadlines may be an important obstacle [23]. It is found that the concept of iterative development is not always fully under-

stood, and that it can be difficult to incorporate it in a development organization because it does not fit well with the organization's project management methods or the business plans [34]. Another major obstacle is that design teams may have difficulty gaining access to representative users, and particularly users with disabilities [23]. It is also found that designers worry that they may inadvertently offend people with disabilities because of lack of experience in interacting with them [23].

Encouragingly, ethnographic approaches which are used to gain deep insight and knowledge about human domains, have become increasingly popular. Such approaches are not only used in academia, but also by successful design teams in industry, such as at Xerox Palto Alto Research Center [24], IDEO and Microsoft [31].

6 Discussion

There is a pressure on industry to make inclusive products and services. The emphasis is on conformance to accessibility standards and guidelines. Surveys of industry practices indicate that important principles of inclusive design, such as user involvement and iterative design are not followed, although there are exceptions. From the examples presented in this paper, it seems that deep knowledge of older and disabled users and their context has been important in many successful inclusive design stories. The role of interdisciplinary teams and close engagement with users are frequently mentioned.

It must be emphasized that the examples in this paper are not drawn from an exhaustive study of inclusive innovations and all the circumstances surrounding them. Therefore, there may be other common characteristics of these cases, other than those mentioned above, which has also been important for the development of the aforementioned innovations. Drawing of conclusions must therefore be made with caution. Nevertheless, the examples, experiences and research referred to above suggest that acquiring a deep and detailed knowledge of disabled people and their needs in relation to a context, such as a particular situation or application area, has been important in inclusive design innovations. Moreover, several such innovations have sprung out of work based on few users, or even one single user. Pullin [35] illustrate this point by a quote by Dunne; "Populations can validate a design, but individuals can inspire new thinking".

While usability and accessibility testing is valuable in order to uncover usability and accessibility problems, evaluation by itself is not particularly effective for soliciting constructive suggestions from users about how to improve a design. It is mainly a means to identify problems, not to provide solutions [36]. In order to inspire suggestions high contact methods, such as participatory design may be more suitable [37]. Moreover, it seems that genuine innovation and effective inclusive design stems from involving disabled people early and throughout the design cycle, rather than as subjects of accessibility testing of more or less finished designs. However, in order to let disabled participants contribute, the methods used need to be inclusive. Examples of some interesting approaches to modifying existing methods to enable people with specific accessibility needs to take part design activities is described in [38].

An important reason that technology developed for people with disabilities has resulted in mainstream innovations, is that there is often an overlap between the needs of people who have a particular disability and the needs users without disabilities in particular contexts or situations. Careful design for disabled people can result in technology that can be useful in situations or contexts where one or more senses or abilities are constrained [39, 40]. Disabled people can contribute with very creative ideas by suggesting unusual ways of doing things, or even by describing how they use existing technology and solutions in new or alternative ways. Because people with disabilities have had to cope with specific needs in various situations during their life, they have lots of experience with ways to cope. They have developed practices that are effective in accommodating their particular needs in particular situations. In that way, people with disabilities have a much broader base of experience related to certain design challenges, such as designs for situations where a capability are constrained, than people without disabilities do. This base of experience can be a rich source of ideas and creativity. For example, a blind person may have a lot of experience in of how to manage and operate technology without vision, which can be valuable when developing technology for situations where eyes are busy or for technology without a screen, etc.

Some of the main obstacles to the uptake of inclusive design in the ICT -industry are related to perception, technical barriers and organizational barriers [1]. The perception barrier may be related to the seemingly elusive goal of designing for everybody. The goal of designing for everybody may easily give an impression of something that is totally utopian and impossible to do. The question is, where to start if we wish to complement the guidelines based approach, how shall we go about it, what type of users should we look for and how many users is enough?

Are there some useful strategies for selecting and involving users? Pullin et al [35] suggest focusing on “outriders”, or so-called “extra-ordinary” users. These extra-ordinary users are older users with multiple minor disabilities and users with some severe disabilities, but otherwise in the target population of the solution in question. Another similar approach may be to select “edge-cases”, i.e. disabled people who are on the borderline of being able to use a product, but who would commonly be expected to be able to use it [41]. In [20] “lead users” are users that places greater demands on a product or system and therefore challenges it in ways beyond that of the average mainstream user. The lead users can be older people, people with disabilities, children or people with diverse cultural backgrounds. The selected users should be included in the design process from the beginning to inspire innovation. If selected carefully, involving between six to twelve people in such a process can be enough [20]. In order to ensure inclusivity however, the design should also be evaluated with broader samples of users [41].

Parallel design is another approach to broaden the design space and not to narrow into one idea too soon. Research suggests that when designers create multiple alternatives in parallel, they produce higher quality, more diverse work and experience a greater increase in self-efficacy [37]. A suggestion is to create parallel design for users with reductions in different types of capabilities (e.g. vision, hearing, mobility and cognition), and then work to integrate these ideas into one solution [42]. This allow for insight into each case and a period of concentration on coming up with god

design ideas for each case. By doing it in parallel, it can be done without increasing the overall design period.

A less resource-intensive approach could be to consider seeking out alternative and existing products working for various user groups as inspiration in the first parallel design phase. These solutions should have some similarities with the design task at hand, or at least have related or interesting parts. The search for such products should include assistive technology. After the initial exploration some of the best ideas are combined into one solution. There may be conflicts between user groups, and therefore, the deep knowledge of each of the cases is essential in order to be able to identify impossible solutions and to prioritize design ideas that may not work for certain user groups. This knowledge can also be used to decide whether particular features or functionality should be common for all users, or whether personalisation or adaption based on user profiles might be appropriate.

7 Conclusion

There is evidence that some of the key principles for inclusive design, namely engagement with users with disabilities, as well as iterative design are rarely followed in industry, although there are some noticeable exceptions. Thus, there is currently a gap between theory of inclusive design and practices in industry. At the same time there is a political and legislative pressure for industry to develop inclusive ICT-solutions. However, the legislative requirements tend to put a too one-sided focus on accessibility standards which do not emphasize the development process. By reducing inclusive design to a matter of compliance to accessibility standards, one do not only risk designing solutions that are in practice not particularly inclusive, but one also risk missing out on one major potential gain of inclusive design, namely the potential for innovation. Finally, some suggestions for inclusive design processes that may spur innovation are provided.

Acknowledgements. The work with this paper has been partly financed by the Norwegian research council through the e-Me project. Special thanks to Abertay University Dundee, UK, which hosted the first author during autumn 2012, and colleagues at Dundee University, UK, whose work within inclusive design has been a rich source of inspiration.

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