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User-centered Inclusive Design: Making Public Transport Accessible

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Abstract
This paper describes an inclusive design case study. We discuss a commissioned inclusive design project, where we have had to meet client needs as well as the needs of an exceptionally heterogeneous group of end users. With the overall aim of seeking to make public transport more accessible, this project has specifically focused on information issues relating to train stations. The objective has been to design and implement a prototype of a train information terminal that can provide accessible information to as wide a group of users as possible. To fulfill this goal, we have taken a user-centered path, working with two groups of users. First, a heterogeneous group of users took active part in the early phases of the project, allowing us to quickly assess new design ideas and mock-up prototypes; provide entirely new design ideas in a participatory manner; as well as help us abandon some of our own preconceptions. A second, similarly heterogeneous user group, more formally tested and evaluated a finalized prototype of the system in situ at a real train station, in real time, and using real train information.

Keywords
Inclusive design, design for all, accessibility, user involvement, heterogeneous users, information, travel, public transport, train

Introduction
Inclusive Design is often described as “whereby designers ensure that their products and services address the needs of the widest possible audience” (DTI, 2001). The value of incorporating principles and design ideals along these lines is becoming widely recognized by governments as well as industry throughout the world. In some countries, these ideals have even started to find their way into core legislation. In 2000, the Swedish parliament passed a government bill stipulating that no later than 2010, all public spaces in Sweden should be made accessible (see SP, 2000). With 2010 now only a year away, much of this work remains to be done and various bodies of public administration are currently struggling to meet up to these new requirements and expectations. In this paper, we will introduce, describe, and discuss the practice of carrying out an inclusive design projects: how can it be done in practice? Commissioned by the Swedish Railroad Administration, seeking to meet the legal requirements of

making train travel accessible, this project focused on information issues relating to train stations. The Swedish Railroad Administration had some basic client requirements. From the start, the objective of the project has been to develop a prototype of a train information terminal providing accessible information about arrivals and departures to as wide an audience as possible. The resulting implementation should also be reasonably possible to mass-produce, maintain, and withstand wear and tear.

Project Description

Below, we will present the various phases of the project. The project has been conducted by a group of design researchers at Umea Institute of Design during 2006 to 2008. It may be divided into four overlapping and interrelated phases: First, we conducted contextual studies at locations where existing arrival and departure information systems are already at hand and in use. Second, we started the design phase using low-fidelity prototyping with some participatory elements. Third, we designed and implemented a fully functional prototype system and, fourth, tested and evaluated it with users in situ in real time, based on which a number of improvements were made to our final design proposal.

Contextual Studies

In a first phase, we conducted contextual observations at several train stations, airports, bus stations, subway stations, etc., i.e. locations where existing examples of things such as arrival and departure information, guiding maps, and other tools for helping travelers find their way around are already at hand. Here, we visited stations in Örebro, Gothenburg, Malmö, Helsingborg, Stockholm, and at other locations. We observed all existing accessibility aids put to use, all information systems used to distribute arrival and departure information, and talked to a great number of passengers at each location. All these observations and interviews were documented using written notes, video, and photos. In this phase, we also carried out a literature review. Later, during the design process, we used the gathered material to discuss our experiences, ideas, and potential obstacles with an experienced accessibility consultancy.

Figure 1: Contextual observations

The main objective of these initial efforts was to gain a first hand impression of how the question of accessibility has already been handled. While most people, including members of the design team, have a great deal of experience of moving through and trying to navigate various train stations, bus terminals, and airports, we found it very productive to approach these contexts using a specific pair of glasses, those of accessibility. We found these contextual studies useful in at least two ways: first, they

helped the team to not rely too heavily on their own previous experiences, and second, they provided a number of hands-on implications for the design process.

User-Centered Design Process

Second, in line with Eisma et al (2003), we argue strongly for the reimbursements in involving real end users early on in the inclusive design process, due to the cultural and experiential gap that always exists between designers and users but which is perhaps even more emphasized when dealing with a user group that is explicitly put together because of its heterogeneousness. Involvement and engaging end users in all phases of the project hence become useful means in finding ways of bridging this experiential gap (Clarkson, 2003). Throughout the design process, a user group consisting of a number of people with various kinds of disabilities, impairments and other kinds of challenges—as well as some everyday users—has had an important impact on the process. The ideas, need, requirements, and opinions come to guide our design process, where the group's explicitly heterogeneous nature has also from the start contributed to design solutions that are not specific to for instance one particular kind of disability. The user group consisted of: everyday users; people with visual impairment; people with hearing impairment; people with intellectual disability; people with mobility impairment depending of a wheelchair; people short in stature; people with deficits in motor control and perception; and people with dyslexia.

To deal with user inclusion early on in the design process, we developed an approach using low-fidelity prototyping with participatory elements, seeking to find ways of allowing users to engage hands-on with the future (Ehn & Kyng, 1995). In our approach, we took an interaction design stance and worked hard from the beginning to try not to separate the virtual aspects of the system (e.g. the user interface design, information presented to the user, etc.) from its physical appearance (shape, physical functions, etc.) more than necessary, but rather try treat these as one and see the system as a whole throughout the design process. The design process has been a process of cycles of ideation (often together with members of the user group), scenario building, sketching, low-fidelity prototyping in cardboard and simple print-outs, testing, discussion, and evaluation.

Figure 2: Users and design researchers discussing early prototypes

During these cycles of prototyping, a number of important design implications were unveiled, some of which challenged the design team's expectations and pre-understandings. For instance, users with perceptual challenges showed a great deal of opposition towards the now popular horizontal wide-screen format, which for them

caused confusion and disorder. Additionally, one of our early prototypes presented the users with a large screen (40 inches). Fairly quickly however, it became clear that this was not at all to the benefit of our user group's visually challenged members, as many of them are only able to read at a distance of around 20 centimeters, which means that a large screen becomes very difficult to survey and take in as a whole.

Prototype Implementation

Based on the two previous phases, we designed and implemented a fully functional prototype system. Unlike many other prototypes, we knowingly strived to come up with a prototype that was as close to a final product as possible. Thus, the prototype combines a finished physical form using sturdy outdoor materials with a fully functional user interface and a complete set of backbone computer systems connecting the prototype to all necessary existing sources of data. The main reason behind producing such an integration prototype (Houde & Hill, 1997) was that we wanted the system to be able to provide the user the chance of having a complete user experience, without the need of having to imagining or visualize certain features of the system or having to work with off-line or made-up information.

Figure 3: The prototype in use (left, middle); finalized design proposal (right)

The terminal has a vertically adjustable screen, which can slide down to be used by users in wheelchairs, short users, or children. The terminal holds information about all near-future arrivals and departures and gives users the opportunity to both listen to and read transcripts of loudspeaker calls. The terminal has a digital map of the station area, providing information about the shape of the station, staircases, elevators, tracks, etc. An on-screen animation shows which way the user should go to get to a certain point, and a synthesized voice talks the user through the route. All information throughout the system is available both as text and as synthesized speech.

The user interface has been designed to be imminently accessible and usable without the need for the user to spend any time learning how to use the interface. The interface is flat, knowingly avoiding depth and different modes. From the user's point of view, the interface works like an accordion, expanding and contracting sections vertically on the screen. This design allows the user to keep track of where she is in the system at the same time as the amount of information given at any given point is not overwhelming, the latter being a specific request from perception-challenged users participating in the

study. Navigation is carried out by directly pointing at different areas of the touch-sensitive screen, or by using Braille-enhanced buttons located at the bottom of the screen. All on-screen graphics has been designed to provide good contrast.

The terminal, constructed in stainless steel, has been given a simple yet elegant physical shape, allowing it to blend in with the Swedish Railroad Administration's other systems and signs. Blue light sources attached to the terminal aim to attract users.

User Evaluation

The resulting prototype was exposed to users in situ at Örebro train station in the fourth phase. Apart from the purposes discussed above, putting the system to a test in its real environment also provided a realistic noise level, lighting conditions, and movement in the physical space, all influencing how the users conceive the system. In total, the prototype was tested formally with 18 invited subjects (10 female, 8 male) as well as with a number of spontaneous everyday users. None of these users had been part of the earlier group participating in the design phase, but represented the same kinds of challenges and disabilities. Tests were carried out with the members of the test group one by one during the course of three days. The process was as follows: each subject was asked to provide some information about their experiences of public transport and what kind of challenges they face when going by train, bus, or subway. After that, we provided them with a train ticket and asked them to use the terminal to get additional information about their upcoming travel. While the subjects were using the terminal, we asked them to explain to us what they were doing or trying to achieve. The test team video filmed each use situation for later review, and we also took written notes about the various problems the users came across. After having used the system, the users were able to reflect on their experiences with the system as well as to provide any immediate suggestions for improvements.

After having analyzed the gathered material, a large number of suggestions for improvements to the design surfaced, ranging from physical features to minor interface issues. Based on the results of this test and our own reflections of seeing it in use, we have suggested a number of improvements and re-designed the prototype system. The changes made are too many to discuss in detail here, but a few examples are: first, the terminal has been made easier to recognize and locate in the physical environment through various signs. The terminal has also been given a partly different color scheme (see Figure 2). Second, to increase the accessibility for people in wheelchairs, the horizontal depth of the terminal has been increased. Third, what became the most significant re-design from an interaction perspective, all buttons have been moved from the screen to off-screen areas below the screen itself to provide easier access and use.

Conclusions

In this paper, we have introduced, described, and discussed the practice of inclusive design, i.e. how a commissioned inclusive design project can be carried out in practice. In collaboration with the Swedish Railroad Administration, seeking to meet the requirements of making train travel accessible, this project has focused on information

issues relating to train stations and public transport travel. The project's objective was to develop a prototype of a train information terminal providing accessible information to as wide an audience as possible.

To fulfill this goal, we have conducted a user-centered design project. To do this, we have used an approach with two groups of users. First, a very heterogeneous set of users took active part in early phases of the project, helping us quickly assess new design ideas and simple mock up prototypes, provide entirely new design ideas in a participatory manner, as well as help us kill some of our own darlings. A second user group, similarly heterogeneous in nature, more formally tested and evaluated a finalized prototype of the system in situ at a real train station in real time. These tests led to a number of improvements to be made to the prototype system. Our final proposal and the many lessons learned from this project currently serves as a base for Swedish Railroad Administration in setting up inclusive train information terminals at all train stations in Sweden.

End users have hence taken active part in all phases of the project, where they have been involved in at least three ways: first, in providing inspiration for design; second, in being involved in valuable collaborative design efforts; and third, as participating subjects in the test and evaluation of the fully-functional prototype terminal. With this work, we believe we have shown an example of a successfully carried out commissioned inclusive design project, where we have strived to meet both client needs as well as the needs of a truly diverse group of end users.

References

Clarkson J, Coleman, R., Keates, S. & Lebbon, C. (eds) (2003). Inclusive Design: Design for the whole population. London: Springer-Verlag.

DTI Foresight (2001). Making the future work for you. Department of Trade and Industry, London, UK.

Ehn, P. & Kyng, M. (1991). Cardboad Computers: Mocking-it-up or Hands-on the Future. Design at Work: Cooperative Design of Computer Systems, Greenbaum, J., & Kyng, M., Eds. Hillsdale, NJ: Lawrence Erlbaum.

Eimsa, R, Dickinson, A, Goodman, J, Mival, O, Syme, A and Tiwari, L (2003). Mutual inspiration in the development of new technology for older people. Paper presented at Include 2003, Royal College of Art, London, UK.

Houde, S. & Hill, C. (1997). What Do Prototypes Prototype? Handbook of Human-Computer Interaction (2nd ed.), Helander, M., Landauer, T., Prabhu, P., Eds., Elsevier.

SP, Swedish Parliament (2000), Bill 1999/2000:79, In Swedish: *"Från patient till medborgare – en nationell handlingsplan för handikappolitiken",* http://www.regeringen.se/content/1/c4/14/78/e9da3800.pdf