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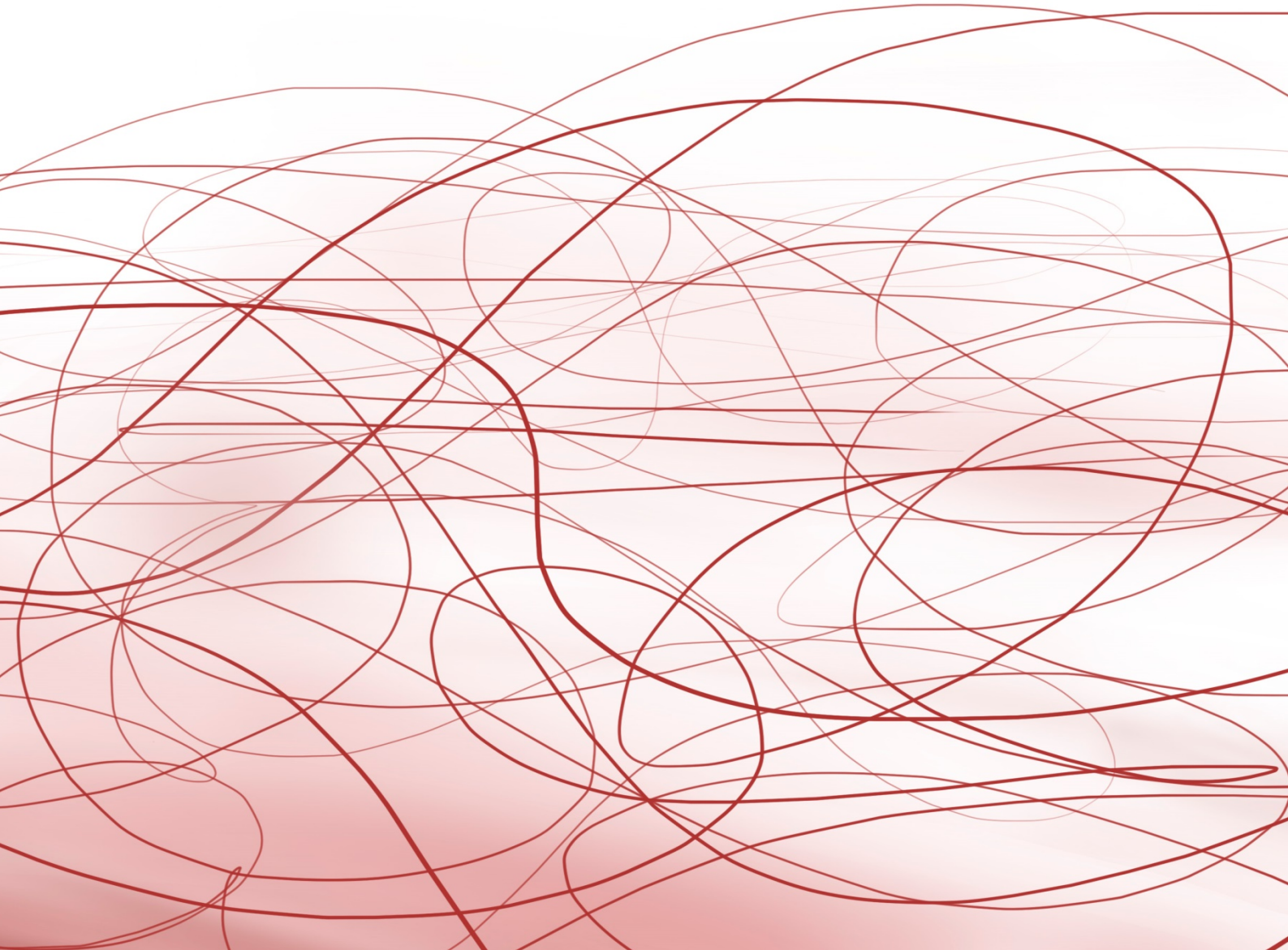

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Office

Accessibility Chair

Universitat Politècnica de Catalunya · Barcelona Tech

Av. Víctor Balaguer, 1. 08800 Barcelona.

Telf. +34 93 896 78 31

jacces@catac.upc.edu

Twitter: @Journal_JACCES LinkedIn: JACCES page

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EDITOR'S LETTER

This number includes several articles focused on inclusive design. Particularly, studying aspects of daily activities such as social relations or going for shopping to the grocery. The research efforts invested in these topics are remarkably meriting because the huge impact that improvements discovered can bring to daily life activities for so many people.

This is the case of the second article, "The use of proxies" (pages 100-124) of the current issue, that is dealing with social aspects. A group of designers tried to improve social relations of severely disabled residents in a care home in Denmark. The challenge for the designers was to gather information from users with severe communication difficulties. Their approach was to combine design methods on the borderland between assistive technology and social design.

"Rethinking the grocery store" (pages 125-156) is related to wayfinding in this type of built environment. Researchers deal with barriers that many people with disabilities face while shopping in grocery stores. The objective of their research is to design an inclusive and innovative wayfinding system in for visually impaired shoppers to help them find the center zone, orient between different aisles, decide where to go, move easily between different sections, and select products with ease. In the case of "Understanding the barriers" (pages 157-173), the aim is to understand the barriers that shoppers with vision impairment face in the grocery stores.

Regarding the research process itself, it is crucial to detect special needs and preferences of people with disability. Thus, participatory approaches are used. These techniques entail challenges regarding the involvement and maintained participation of these users. Particularly in large-scale R&D technology projects. The first article of this number, "Managing the participation of people with disabilities in large-scale R&D technology projects" (pages 77-99), discusses some strategies to overcome these barriers. Authors are based on their experience in two large-scale technology projects, AEGIS and CLOUD4all, funded by the European Commission. For

JACCES, the publication of this type of results is considered essential to enhance future research of this nature.

Daniel Guasch Murillo

Accessibility Chair Director UPC-BarcelonaTech

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Articles

Journal of Accessibility and Design for All

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MANAGING THE PARTICIPATION OF PEOPLE WITH DISABILITIES IN LARGE-SCALE R&D TECHNOLOGY PROJECTS: BEST PRACTICES FROM AEGIS AND CLOUD4ALL

R. Ignacio Madrid[1], Iván Carmona[1] and Juan Bautista Montalvá Colomer[2]

[1] ILUNION Accesibilidad, Estudios y Proyectos, Madrid (Spain), [2] Life Supporting Technologies, Universidad Politécnica de Madrid, Madrid (Spain)

[1] nmadrid@consultoria.ilunion.com, [1] icarmona@consultoria.ilunion.com, [2]jmontalva@lst.tfo.upm.es

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***Abstract*:** People with disabilities are frequently mentioned as beneficiaries of participatory approaches during the research and development of technology since their special needs and preferences can be unveiled and channeled through participatory techniques. However, there are some challenges affecting their involvement and sustained participation in large-scale R&D technology projects. This paper discusses some strategies to overcome these potential barriers, based on the experience of the authors in two large-scale technology projects funded by the European Commission: AEGIS and CLOUD4all.

Keywords: participatory research, user involvement, people with disabilities, accessibility.

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Introduction

Given the current economic situation and increased competitiveness in the field of research projects, European policies have been focusing on enhancing the research, development and innovation in technologies, products and services nearby the market. That is why the implementation of a research project increasingly resembles the development of an industrially produced product, which must ensure adequate quality factors to the success of the project developments. To design methodologies that engage the main stakeholders from the commencement of the project is essential to ensure the success of research projects focused on assistive technologies.

This is the approach adopted by two large-scale research projects focused on accessibility and assistive technologies funded by the European Commission: AEGIS (www.aegis-project.eu) and Cloud4all (www.cloud4all.info). These two projects have some similarities: 1) their approach building a new generation of accessible technologies, 2) the active participation of user organizations in the project consortiums, and 3) the involvement of several hundreds of individuals with disabilities in participatory research activities.

AEGIS (active in the period 2008-2012) was aimed to empower people with disabilities, as well as elderly and anyone else disadvantaged when using Internet services, PC or mobile phones (Korn, Bekiaris, & Gemou, 2009). To make accessibility to new ICT products open, personalized and configurable, realistic and applicable in many contexts more than 40 solutions were developed for both developers and users with disabilities in three mainstream ICT areas (desktop, mobile and rich internet applications).

Cloud4all is a four year-project running in the period 2011-2015. It was aimed to provide new ways to face accessibility by tailoring any device, any platform, minority or mainstream solution, to the user needs and preferences (Ortega-Moral, Peinado, & Vanderheiden, 2014). By the end of the project, Cloud4all will provide tools to collect and store the needs and preferences (N&Ps) of users regarding technology, which can be invoked to provide ubiquitous auto-configuration of devices, systems, and applications.

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Key solutions were integrated in Cloud4all for desktop and mobile devices, as well as other public and private devices as TV sets or eKiosks.

The nature of these large-scale R&D technology projects imposes some challenges for the participatory activities that are organized in their context. First, the wider range of user needs and preferences should be represented along the project lifetime to validate their approach and outcomes. Second, research activities in these projects last for several years being necessary that users can have an overview of the project evolution and not only on the first prototypes or the final product. Therefore, the involvement of user communities should be part of a general strategy for recruiting and sustaining diversity in research.

AEGIS and Cloud4all both applied a users' involvement plan along the whole project for actually fulfilling the needs of the users in the developments that were carried out. Although needed, the participation of users in the design and development of products can carry out some barriers due to the difficulty of finding users with the right profile, their selection in a balanced way and the economic cost of users' time. To overcome these barriers, it is needed to follow a specific users' involvement methodology to develop specific protocols for user management. The aim is to establish trusted relationships with communities, participants, and stakeholders, determining the profiles of users and the way to contact them, as well as the specific way to deal with them from the moment they confirm their participation until they leave the premises of the tests.

Notice that the aim and scope of this paper regarding participatory design is limited to users' management in the context of large-scale R&D technology projects. Other important issues not considered here are how to involve users and stakeholders prior to the project starts, during the ideation and planning phases, or how to adapt current participatory design methods and practices to allow people with sensory or cognitive limitations to equally contribute to research (Sainz, Turrero, González, & Madrid, 2014; Slegers, Duysburg, & Hendriks, 2015) .

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This paper is structured as follows: First, an overview of participatory research approaches for users' involvement is provided. Following, we describe our recruitment approach from user definition to call for participation. Next, we describe the participatory processes followed to sustaining participation it the long term, focusing on the management of ethical and legal issues and the dissemination of results. Lastly, we discuss the knowledge gained on both projects, and we draft some conclusions.

The value of user involvement in large-scale R&D technology projects

Technological advances in the information society are a significant opportunity for people with disabilities; for example enabling new opportunities for social participation, for accessing information, and improving the quality of life in general. However, they also imply some risks, as the possibility of being excluded from the benefits of these advances due to lack of access, ability, and (or) motivation (Gregor, Sloan, & Newell 2005; Macdonald & Clayton 2013). Despite the abundant norms and legislation for making accessible different types of technology, technological development seems to be faster than barriers removal. It is frequent that, after the introduction of each new technology, some time passes before its benefits are available to all users. The development of Digital TV in Europe can be used as an example: after the digital switchover DTV devices were not fully accessible for some years (TECH, NOVA, & CNIPA, 2011). This problem may appear recurrently if future generations of interactive or Smart TV are developed without considering the diversity of user needs and preferences. To prevent this kind of problems, the perspectives of people with disabilities should be not only considered in the commercialization stage, but also in the previous phases of technological research and development.

Participatory approaches are potentially able to contribute to minimizing exclusion and to promote access. Nowadays, these are extensively applied in the process of creating and adapting new technologies for people with

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disabilities and other user groups with special needs (e.g. De Couvreur & Goossens, 2013; Vines, McNaney, Lindsay, Wallace, & McCarthy, 2014). However, although there is evidence of their effectiveness in this context, there are also some barriers and concerns that should be overcome when involving people with disabilities. For example, Holone and Herstad (2013) identified three tensions that arise in these participatory design activities: the need of time versus rapid prototyping, the role of users as active participants vs. recipients, and the use of direct communication versus the use of proxies. While it could be discussed that these tensions are present when involving people with other profiles (e.g. people with low digital literacy), it should be recognized that these are more prominent when working with persons with disabilities.

Together with technical and methodological challenges appearing when trying to apply participatory design in such R&D projects, there also other sociological and organizational issues that could affect the liaison of users with the objectives and procedures of research. Some questions that should be answered when managing the participation of people with disabilities are: Who are the specific user profiles to be involved in research? Why should they participate actively? How will the project recruit and contact them? How could they be motivated to be involved in the long term?

The active participation of people with disabilities and their representing organizations in all areas of society is flourishing, but their implication in research projects and activities is less evident today. In this context, new perspectives appear that claim for a more active role of people with disabilities in research, as emancipatory research (Barnes, 2003) or inclusive research (Walmsley & Johnson, 2003). People with disabilities themselves recognize the need for playing a more active role as partners and consultants in research and not only as mere study subjects (Kitchin, 2000).

Participatory methods, techniques, and tools can be used to foster the active participation of people with disabilities in the different phases of a technological research project, empowering them to make their opinions heard and represented, so the resulting products and services will cover

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their needs and preferences. For example firstly, during initial phases they can participate in the exploration of barriers and problem definition, focusing the ideas towards a possible solution. Secondly, during design and development they can collaborate in identifying issues and propose alternatives. Finally, during the validation phases they can evaluate whether the product or service fulfills their requirements (Muller, 2009).

The participation of people with disabilities in research requires the engagement of researchers, designers and other project stakeholders with user communities at the long term, which rarely happen spontaneously (Vines et al. 2014). Appropriate resources should be allocated to the liaison with user organizations and the identification, recruitment and sustainment at the long term of the participants in research activities.

Recruiting people with disabilities

Definition of user groups, sample composition and assignment to research activities

First, it would be worth to notice that there is not a unique criterion for defining target populations of people with disabilities, defining the role they will play and assigning them to the most appropriate research activities. The definition of target user groups should be based on a deep knowledge of their characteristics and variability. In the special case of technological R&D, there are other variables (such as digital skills, use of assistive technologies, socioeconomic status, age, and gender) that are sources of diversity and should be also taken into account (Ashok & Jacko, 2009).

Defining user groups allows structuring the participation of people with similar needs and preferences regarding the use of technology. Frequently, user groups can be classified in different subgroups and sub-subgroups. For example, the *people with visual impairments* group can be categorized in *blind* and *low vision* subgroups, and the *low vision* subgroup could be also categorized in different groups as *colour blindness* or *loss of visual acuity* sub-subgroups.

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Moreover, the number and concrete profiles involved in research activities is largely determined by the scope, objectives and technology being developed for each project. For example, if one project is focused in developing a new screen magnifier, the sample should be largely composed of users with low visions while the participation of other profiles will be reduced to profiles that could also benefit from such AT (e.g. older people or people with reading difficulties). This principle guided the recruitment in AEGIS and CLOUD4all, which final sample is described in Table 1.

Table 1. User groups and sample composition in AEGIS and CLOUD4all.

User groups	**AEGIS**	**CLOUD4all**
Visual impairments (Blind users)	80	104
Visual impairments (Low vision users)	72	111
Hearing impairments (including deaf and hard-of-	63	11
Deafblind users	-	31
Motor impairments users	101	-
Cognitive impairment	106	25
Speech impairments	40	-
Complex disabilities (motor, cognitive and/or speech impairments)	44	-
Learning difficulties (users with dyslexia)	-	20
Older people	-	55
Users without disabilities	4	6
TOTAL	**510**	**363**

As Table 1 shows, AEGIS largely focused in some profiles as motor or speech impairments that are not considered in CLOUD4all. The reason is that the

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AEGIS project considers the development of different solutions specifically addressed to these profiles, as a mobile as an Augmentative and Alternative Communication (AAC) device for severe motor and/or speech impairments (Gemou & Bekiaris, 2010).On the other hand, the CLOUD4all project involved a deafblind user group that was not considered in AEGIS, to analyze its unique complex characteristics regarding the auto-configuration of ATs (Sainz et al., 2012).

Defining user groups is the first step to ensuring that the individual participants will represent the range of needs and preferences of their group of reference. The representativeness is a crucial aspect that, if it is not addressed properly, could lead to a entirely wrong product or service. Very frequently, people with disabilities are defined as having standard functional characteristics that rarely represents the wide range of existing disability conditions.

In practice, it is very tough that the sample of participants involved in the project could represent the full range of needs and preferences of a certain user group, and just a sub-sample of them will participate in participatory activities. To mitigate this problem, we adopted some strategies in AEGIS and Cloud4All:

- **Use a combination of constructed and random samples:** 50% of the participants in all research activities are actively selected to ensure that all key dimensions are represented (e.g. ensuring that blind Linux users are involved even when this circumstance is rare compared to blind Windows users), and 50% are selected by circumstance (e.g. the individuals are present at pilot sites or volunteer after seeing an online call for participation).
- **Replace part of the sample after each iteration:** For example, the Cloud4all project has the goal to have 50% of participants involved from the beginning and for the four years duration of the project. Being the development process structured in three consecutive pilot iterations, the other 50% of the sample can be new for each pilot phase, increasing the chance of representing different needs and preferences along the project.

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- **Involvement of experts and stakeholders in participatory activities:** It is advisable to involve people that do not only represent themselves but also speak for their user group. A probed strategy is to include stakeholders (such as tutors, relatives, educators, rehabilitators and user-organizations staff) in focus groups and co-design sessions for complementing the perspectives of individual with disabilities.

At the same time that the sample composition is defined, the users should be assigned to specific research activities. These activities are of different nature (e.g. surveys, interviews, user testing, focus groups, co-design sessions, and so on), which required varying degrees of skills and active involvement. For example, the participants in surveys should represent a broad range of needs and preferences, while the participants in user testing or co-design sessions may need to have some special characteristics regarding their expertise with ATs or awareness about their needs and preferences.

Once user groups and sample composition are defined and assigned to specific research activities, it is possible to start the recruitment, which is not a straightforward process. Next section describes some practical strategies to manage the recruitment of people with disabilities and to overcome communication barriers to obtain the collaboration of certain user groups.

Recruitment and call for participation

The first instance in the recruitment of people with disabilities for participatory activities in large-scale R&D technology projects is the production of project documentation. Although it may seem that people with disabilities could be highly motivated to participate in research activities, this is far from reality. Especially when addressing to people with cognitive impairments, other people are mediating in the decision of the user to participate in research (such as tutors, family members, and healthcare professionals).

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Time constraints, logistics and the availability of the participants should be carefully considered to foster their participation. An apparent lack of purpose of the activity could prevent users' engagement, so the project aim and the potential benefits derived from users' participation should be clearly communicated in advance.

Therefore, project documentation should be produced prior to initiating any contact with people with disabilities or even planning specific activities. This should include the project description and objectives, the expected outcomes and implications and the nature of the participation of people with disabilities in the project. Different formats can be used to provide project information (such as videos, websites and leaflets). When producing this documentation, as well as in subsequent communications, accessibility should be one of the main concerns (such as videos with sign language, captions and audio description, easy-to-read document versions and accessible web pages).

After the project information is produced, it can be used to support a first contact with the potential participants. The recruiter could approach the different contexts in which the user groups considered in the project can be accessed to reach collaboration:

- **Through user organizations, as project partners.** The organizations of people with disabilities usually have a close, trusted relationship with users and their relatives. Trust will greatly facilitate the recruitment process, especially when involving people that are not fully able to give their consent for participation.
- **Through user organizations, as mediators.** In the cases that the organizations cannot participate as partners, it is advisable to include them as project associates, to play an intermediary role between the researchers and people with disabilities. Otherwise, they can somewhat limit the user involvement even actively if they do not trust in the institution responsible for research (e.g. creating obstacles for communicating the project or increasing inflexibility about ethical procedures) (Vines et. al. 2014).

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- **Search user databases.** It is common practice to start by searching in user databases built from previous projects. However, the use of these databases has some disadvantages. First, international data protection policies include limitations for the utilization of these databases, especially when they include data about health or disability conditions. Therefore, maintaining these databases requires additional management efforts to cope with ethics and the legal issues of data protection and privacy. Second, people that frequently participate in research activities are in risk of becoming "professional users", acquiring response biases and being unmotivated. To mitigate this bias, it is advisable to involve participants with different previous experiences of participation in research.
- **Open call for participation.** Announcements in specialized newspapers, magazines or forums and leaflets distributed in institutions, conferences or meetings are usually effective. The dissemination through specialized online communities is encouraged here. For example, both AEGIS and Cloud4all projects have used the most visited disability portal in Spain (DISCAPNET, www.discapnet.es) to call for potential participants.

In practice, these four channels are used at the same time to maximize the impact.

After this first contact, some expressions of interest for participation should have been collected allowing for further communications. Each research activity requires a specific call for participation, addressed to the specific participants that have been identified in previous phases and including a description of the concrete activities to be performed, the role that the people with disabilities will play in them, and the date, place and schedule of participation. Appendix 1 includes an excerpt of the call for participation used in CLOUD4all (AEGIS used a very similar template).

Sustaining long-term participation in research

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One major issue in large-scale technology projects is the assurance of the continued availability of participants along all the project phases. It is considered wiser to keep involved the same pool of participants to the maximum possible extent, to keep track of the degree up to which their initial expectations and needs have been fulfilled by the project iteratively upgraded solutions.

Managing ethical and legal issues

The construction of trust between people with disabilities, researchers and designers is needed for long-term involvement. For this, a pre-requisite is to manage adequately ethical and legal issues that normally arise in any research but that are even more relevant when people with disabilities are claimed to play an active role as participants (Sainz & Bustamante, 2014).

The first thing to highlight is that recruiting users and managing participatory research with people with disabilities – especially persons with cognitive impairments - requires additional time and resources compared with those required when working with people without disabilities. On the other hand, even when the benefits of participatory approaches are clear, it is not rare that some conflicts of interest or ethical issues appear between different actors during research (between people with disabilities and researchers, between designers and researchers, between researcher and disability experts and other possible combinations) (Aldred, 2008; Sledgers, Duysburgh, & Jacobs, 2010).

Some aspects that should be considered when involving people with disabilities can be highlighted:

(1) Confidentiality, privacy and data protection. The anonymity of participants in research projects should be guaranteed. It should be noticed that data regarding health records or the disability profile of participants has the higher protection status in several national legislations. Specific consents should be required to take and distribute pictures or videos from disabled persons. If necessary, data anonymization procedures will be applied to results and dissemination of research outcomes.

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(2) Personal safety. Most R&D technology projects do not imply any potential physical harm, considering that the premises and equipment are complying with the accessibility and safety regulations. However, there always exist low risks of psychological discomfort or inconveniences during research activities. In the particular case of R&D projects pursuing the development of new assistive technologies, there is a chance of invoking unrealistic hopes and expectations for personal benefits in terms of access to new and better solutions, and the subsequent risk of disappointment. This should be counteracted by very explicit and adequately communicated information about the limitations of such personal benefit and also established in the explanation of the informed consent.

(3) Informed consent. From the legal point of view, the national and international regulations regarding the participation of users or patients in research should be considered. Consents should describe the rights of the participants and their role, the volunteering nature of participation, the aim of the activities and how the data collected will be used. It is understood that, based on the information that the participant receives from the project, he/she is aware of the data treatment. Consents should be signed by the participant and, in the case that he/she is not able to give full consent, by a proxy. Take into account that, in these cases, the assent should also be obtained from the participants. The consent forms have to be provided in accessible format so that all participants, regardless their disability, are able to read the consent information and sign it on their own.

(4) Compensation. Participants should receive a compensation for their time and effort during research and development activities. This compensation can be of different type and value (such as cash, gift cards, or cinema tickets), and should be fixed in advance depending on the budget available for this activity and the characteristics of the tasks to be performed by users. It should be specified to the participants that the compensation is not payment and does not depend on their performance in research activities, so their behavior and attitudes will be not biased. Additionally, compensation for transport to the facilities should be provided in case of specific profiles of users with mobility difficulties. Within this type of users, not only

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physically impaired users with problems when moving, walking or taking transport are included, but also visually impaired users that can be dependent on reaching a new place because of their visual limitation for moving.

(5) Ethical committees and controlling mechanisms. It is common practice in research organizations (e.g. Universities or hospitals) to have and Ethical advisory board or committee that provides ethical guidance and controlling mechanisms for research. In our experience, the complex nature of R&D technology projects requires from specialized ethical committees. This can be formed by external experts and stakeholder with a deep understanding of both the constraints of research with people with disabilities and the particularities of a participatory approach. An additional controlling mechanism is to evaluate with users if the ethical procedures are adequately fulfilled. For example, in the CLOUD4all project an *Ethical aspects evaluation form* is delivered using an accessible document to each user participating in research activities to validate the procedures and identify potential issues (see Table 2).

Table 2. Ethics aspects evaluation form for CLOUD4all participants

Questions (YES/NO and Open ended)
1. When you were volunteering, did you know about the need, on the part of the project consortium, to ensure that ethical and legal guidelines were followed?
2. Do you think existing norms and regulations regarding volunteering are generally followed?
3. Are you, as a volunteer, aware of your rights?
4. Did the informed consent form provide you all information you wanted /expected?
5. What was the main motivation for you to participate in these tests?

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Questions (YES/NO and Open ended)
6. Did you experience any physical, psychological or social discomfort during the tests?
7. Is there any ethical issue that concerns you regarding the project?
8. Are there any ethical concerns you might have regarding the test session you have just finished?

The formal requirements of ethics are also sometimes difficult to apply in practice. For example, Munteanu, Molyneaux, and O'Donnell (2014) reported users' difficulties in understanding informed consents, fully ensuring privacy and confidentiality, or implementing the pre-approved data collection methods. In any case, researchers should initiate a conversation and negotiation about these ethical and legal issues to build trust between the different research parties.

Dissemination of research results

Dissemination activities are a key instrument to maintain the commitment of people with disabilities. However, very frequently the results of research are just disseminated to stakeholders and experts (such as research centers, universities and standardization bodies, policy makers, industrial organizations, and service providers), through conferences or scientific papers, but this information does not really reach the end-users. Due to this, participants could be disappointed because they do not see the results of their contribution to the research activities in which they participate. It should be emphasized that the outcomes of these research projects should be transferred to the end-users and their environment.

To inform people with disabilities about the advances and outcomes of the project, different channels can be used: web portals, social networks, emails, newspapers and magazines, and special events. For example, project

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website should be the main reference for reading information about project results, so its design and contents should be adequate for all users, caring for web accessibility.

Organizing special events have been also showed a successful strategy on AEGIS and Cloud4all. Two kinds of events can be identified:

- **User forums:** Collocated with project workshops and conferences, these events provide an opportunity for the end-users as well as other stakeholders and experts, to know about the different ideas and solutions and give their technical and practical feedback, suggestions and concerns about prototypes being developed. An example of this kind of events is the AEGIS user forum organized at the University of Seville (Spain) on October 2010 that involved a total of 103 individuals, 86 of which were external to the project. The focus was on providing an overview of the AEGIS project and collect feedback on specific prototypes, for which different disability-specific parallel sessions were organized to make presentations to people with similar needs and preferences (Figure 1). Full proceedings of the user forum are available (Carmona, Azpiroz, Scheuhammer, Welche, & van Isacker, 2010).

Figure 1. User discussion at the 2nd AEGIS user forum

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- **Open days and Demo events:** Open days are structured events lasting one or more days to present the most mature and close-to-market demonstrators. Moreover, conferences and exhibitions offer ample space to present demos during which user feedback can be gathered. Several events of this kind have been organized by CLOUD4all partners along the project duration (Figure 2).

Figure 2. CLOUD4all Open Days at ILUNION in Madrid

Conclusions

In this paper, some issues have been considered for the involvement of people with disabilities in large-scale R&D technology projects, using the AEGIS and the CLOUD4all projects as examples of best practice. From a perspective related to inclusive research, it addresses how to foster the liaison between project partners and people with disabilities and their user organizations, and how to maintain this participation over time. These issues frequently impact the quality of the collaboration users in research, affecting the practice of researchers and designers in participatory activities indirectly.

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User organizations are key actors to guide project objectives, facilitate recruitment of participants and transfer the project results to society. They can also support researchers in the management of the complexity of ethical and legal issues, which are intrinsic to disability research, but that can impose a burden for technology researchers. Therefore, some efforts should be difficult allocated not only to involve individual participants but also to foster a deeper liaison with user organizations.

People with disabilities can and should participate in all the phases of an R&D technology project: ideation and planning, collection of requirements, design and development of technology, and pilots and validation. However, it is hard to sustain their participation if trust is not build between them and other actors in research. The paper has discussed two aspects that have been shown useful in our projects: caring of ethical and legal issues and creating a dissemination strategy addressed not only to researchers and funding bodies but also to people with disabilities and their user organizations.

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Appendix 1. CLOUD4all project call for participation

Dear participant,

Thank you for considering taking part in the evaluation activities of Cloud4all research project (Contract Number: 289016) which aims to develop a complete new concept in accessibility, by replacing adaptation of individual products and services for a person with automatic-personalization of any mainstream product or service. This new concept uses cloud technologies to activate and augment any natural (built-in) accessibility the product or service has, based on a profile of the user´s needs. The evaluation will happen under the direction of *[supervisor name, name of test site]*. This study is being held in the context of the *[iteration order]* evaluation round of Cloud4all project. In this round of evaluations we aim to test some of our technological outcomes with you, expecting to get your valuable feedback and investigate to which extent they meet your needs. Your feedback will be very valuable in improving our solutions. I have enclosed some information about the project to help you decide whether to participate in this part of the study.

Participation involves

If you agree to take part you will be asked to sign the consent form at the bottom of this information sheet.

Interviews, questionnaires completion and testing prototypes will take place at a time which is convenient for you at your place of work e.g. school or offices or at a convenient centre or at *[name of the supervisor centre]*. The session will last approximately 2 hours.

If you think you would be willing to become involved, arrangements will be made to contact you to discuss the possibility of your being observed using the prototypes and asked for your views on them. This can be conducted through focus group interviews or individually.

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What will happen with the information collected in this activity

With your permission, some interviews and tests may be digitally recorded. These will then be transcribed and the recording deleted. If you are observed using the devices, field notes will also be taken. At no time will your name be used in any subsequent report, shared or made public in anyway.

All transcriptions, field notes, responses to questionnaires and session logs will be treated confidentially. These will be allocated a unique test ID to retain anonymity and stored electronically on a private computer with security measures. You will have the right to access, review and/or ask for the deletion of these data from our databases. In any case, these data will be destroyed in October 2016 (i.e. one year after the completion of the project).

Risks

It is entirely at your own discretion whether you participate in this project. There are no risks involved and all data will be treated confidentially. This data will be destroyed one year after the completion of the project.

If, after having taken part you subsequently change your mind, you are still free to withdraw from the project up to three weeks after the day of your participation and any data you have submitted will also be destroyed if requested, without any need to give a reason.

You also preserve any right to withdraw from the tests at any moment if you wish so, without further justification.

Benefits of the research

The final report will summarize the findings from a range of different perspectives and will be available to you upon your request. Additional information on the progress of the Cloud4all project can be accessed at the project Website www.cloud4all.info.

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It may also be shared with the wider research community to help others with an interest in accessible solutions. All names will remain anonymous in any publication.

Contact details

If you have any questions or require further details of if you consider that this study has harmed you in any way, please contact me at the following address:

(To be filled by the supervisor)

Name (in capitals):

Expertise:

Post Address:

E-mail:

Telephone:

Fax:

This project and its testing activities fully comply with local Data Protection Laws and the Cloud4all specific Ethics Policy, approved by its Ethical Advisory Board.

On behalf of the Cloud4all Consortium, thank you.

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THE USE OF PROXIES: LESSONS OF SOCIAL CO-DESIGN FOR INCLUSIVE DESIGN FOR PEOPLE FOR COGNITIVE DISABILITIES

Richard Herriott

Industrial Design Department, Design School Kolding, Denmark.

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***Abstract*:** This article concerns how designers sought to create improved social relations among severely disabled residents in a care home in Denmark. Rather than to rely on paid help, the care home management wanted to increase the number of voluntary friendships between the residents of the home and members of the local community. From a design standpoint, the project explored ways to determine the needs of individuals with severe communication difficulties. This presented a very demanding challenge since the key "users" were unable to express themselves. The methods designers typically choose to find out about their target user group involve interviews and discussions. Most design processes assume the user is able and willing to communicate their needs. This condition did not apply here. The paper builds on work done (Herriott 2012) which looks into methods and approaches that get past the problem of the "absent user." The paper examines how the use of proxies affects the design process and the way in which social design produces not only a "product" but affects the conditions in which it will be used.

Keywords: Inclusive Design, Industrial Design, Welfare Design, Fourth-order design

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Introduction

This paper deals with designing for individuals with cognitive disabilities. The individuals are unable to communicate verbally and as such the usual channels for communication with the users are not available. As Brereton notes "When participants have a different cognitive, sensory experience of the world, it is particularly important to engage them fully in the design process, as designers have little experience to see the world from their perspective" (2015, p4). In such cases, design processes must be adapted (Francis *et al.* 2009, p.121) Nonetheless, the project described did achieve useful results by finding workarounds for the communication barriers.

For many designers working in the area of disability, Inclusive Design (ID) is a reference point. ID is "....design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible on a global basis, in a wide variety of situations and to the greatest extent possible without the need for special adaptation or specialised design." British Standards (2005) and has a two-decade history behind it, beginning in the Universal Design movement (Storey *et al.* 1998). It differs from Universal Design in that it has a stronger emphasis on industrial design for consumer products and does not expressly deal with architecture. Work such as Herriott, (2012) has shown that ID´s roots in consumer product desig can explain why it has not addressed the problems of providing for those with communication difficulties. Primarily, this is because the disabilities and capacity losses that ID works to accommodate do not include communication and cognitive disorders to any great extent. The literature of ID also emphasises design for tangible products (Brown, 2011 is an example of one for cognitively impaired users).

This paper examines a case where the users were severely cognitively impaired and where the "product" was improved social connections between residents of a long-term care home and the local community. By examining how to discover the needs of the "users" it explores how to design for people who are hard to communicate with so as to provide intangible, non-material outcomes. Although the designers in this case study were not using

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Inclusive Design (and were not aware of the concept) it is possible to analyse their processes in the light of ID methods to see how the Skansebakken project can inform Inclusive Design.

Skansebakken is both a home and a workplace. Severe cognitive and developmental disability characterises the residents, all but one of whom have no capacity for speech. This factor dramatically reduces the means by which the residents can communicate their wishes. Thus, the carers take on an important role as proxies for the needs of the residents.

In this project, the users of the resultant "product" are understood to be the residents and the carer while the direct beneficiaries are the residents. The managers and carers of Skansebakken recognised that there existed a need to improve the social relations of the residents whose primary social interaction was with employees. The local municipality recognized that many of their care institutions had a similar situation where social relations were essentially paid for. They wished to improve voluntary social relations so that their institutions gained better connections to the wider community. It was also implicit in this that voluntary social relations had an extra dimension that staff-resident relations lacked. With this in mind, the municipality asked the Design School Kolding to investigate ways to create and implement changes to the way the home was run. The Design School Kolding (DSK) is one of Denmark´s leading design and research institutions. It has a strong tradition of interdisciplinary work in industrial design, communications and graphic design.

Skansebakken: a home and workplace

Skansebakken is located in Vejle Municipality, central Jutland, Denmark. 45 residents live there full time and 110 people serve as carers, administrators and general staff. Built in the mid-1960s, the buildings of Skansebakken typify mid-century Danish modernism that emphasizes simplicity in material and forms. However, coupled with the functional requirements of caring for its extremely physically disabled residents, the physical structure resembles a hospital more than a home. Its residents thus lived in a setting that had an institutional and impersonal quality. Before the Designing Relations project

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began (2013 to 2014), the common rooms were devoid of personal decoration. The presence of features such as suspended ceilings, hospital furniture and assistive technology indicated that functional requirements dominated the more social, human need for conviviality.

On the social side, regarding the relations of the staff and the residents, it had been recognised by the municipality that there was a need for change in the direction of less reliance on the paid staff and greater contact with the wider community. For the 45 residents, most social interaction was with the staff and their activities were organised around the daily routines of the residence which was seen as a workplace first. The municipality recognised that there were not many links to the wider community and that to improve the well-being of the residents, the development of voluntary social relations was necessary. This was also seen to be a problem existing at all social care institutions under the local authority´s management; by using Skansebakken which was an extreme case, the municipality hoped that methods could be found to improve social relations at other institutions under their management.

Design Process

The Design School Kolding´s (DKS) methodology is derived from a process devised by IDEO (2015). As used by DSK the method has these phases: collaborate, collect, comprehend, conceptualise and create. For comparison purposes, the ID design method outlined by the Cambridge Engineering Design Centre (EDC, 2015) has these elements: explore, create and evaluate. Each of the three phases has between three and five sub-steps and these are interdependent, which is indicative of the iterative nature of the design process.

There is other work related to-design for people with cognitive disabilities where family members and teachers helped in the design process (Dawe, 2005 and Dawe, 2007). In these cases, the individuals were not severely cognitively disabled. Interviews and ethnography were deployed to gather data. Boyd-Graber (2006) described using proxies to assist in design for

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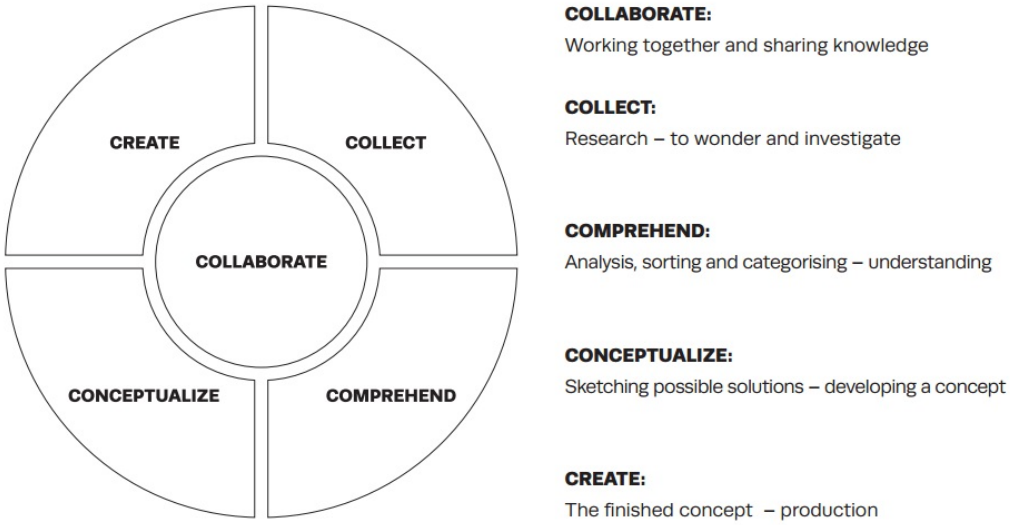
people with aphasia. Here the problem is not that people cannot communicate but that the verbal channel is not available. Francis *et al.* (2009) discuss revisions to the co-design process, an instance where the users are people with autism and high-functioning Asperger´s syndrome. It was possible to make use of written methods of inquiry, a means not available to the residents of Skansebakken. Brereton *et al.* (2015) worked with "people living with cognitive or sensory impairments and children identified with language delays and autism spectrum disorder" (p.4). Again, like much of the work involving cognitive disorders, it relates to individuals capable of some level of expression.

Figure 1. Design School Kolding´s process



Design School Kolding´s Process

The process (See Figure 1) starts in the collaboration phase by defining the terms of co-operating with the stakeholders, to do with where, how and who shall contribute. Thereafter the success criteria and framework for reporting is defined.

In the 'collect' phase it is through desktop research, user-centered processes, observations and discussions with expert consultants that designers gather knowledge about the "ecosystem" to be changed. There is a broad look at the work locations' physical conditions, cultural and social resources as well as the practices, values and the history of the site. Design

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methods are chosen to support the establishing of participative courses with the stakeholders.

In the 'comprehension' phase insight is gained into the existing situation by organising the gathered material to show links between the elements and how they are related causally. This insight leads designers to the possibility of dealing with the material and thinking about the form change may take. What are set out in this stage are 1) the relevant interests of the various stakeholders, 2) the emotional barriers to, and 3) drivers of change. The insights are presented to the interested parties in small workshops which create a shared understanding of the next phase. The range of participants is broad so that they feel that it is a project they have responsibility for. Thereafter the analysis is processed with a focus on those aspects which offer a means to effect change. This phase, according to DSK, is not just about understanding, but about creating a sense of ownership for all the parties.

In the 'conceptualise' phase new ideas are developed to encourage original ways of doing things. With fresh ideas, the existing barriers to change can be identified. Some ideas are not successsful but a few can be identified which can have meaning for those involved. The ideas are tested in controlled conditions to determine possible problems. Thus, the difficulties encountered are not too costly to rectify in terms of time and effort. At the same time, those involved in the process were able to see their input having an influence on how the concepts were worked through. This further re-enforces the shared sense of "ownership" of the resultant solution.

In the 'create' phase the designers try to show the project´s potential to the various interest groups; the concepts are prepared and then, in conditions that are close to realistic as possible, they are tested. In the test phase the entire process is subject to examination in the sense that the prototypes´ validity is a proxy for the validity of the process. In this part of the project, a larger number of users get to validate the design than are involved in the initial stages. Seen from a broad perspective, the scale of the process increases: more people involved, there are more detailed solutions and they

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are tested in more and more realistic conditions. This *"create"* phase constitutes a combination of making and testing.

In the Conclusion section the DSK approach will be compared with the model proposed by the Cambridge Engineering Design Centre. Both will be considered in the light of Buchanan´s (2007) concept of fourth order design.

Inclusive Design

Having discussed the DSK process, it is time to turn to a general look at the Inclusive Design process which is aimed at generating accessible designs for people with capability loss.

The original ID process was a waterfall model (Fig. 2) but was modified by the Cambridge EDC in 2013 to suggest better the iterative nature of working through a project (Fig. 3). The main stages are: explore, create and evaluate. The relevance for this paper is that Inclusive Design is a design method intended to focus attention on users with capability loss. This method primarily assumed to be physical, for example, Mountain *et al.* 2006, Mayagoitia 2006, de Couvreur 2011. Savitch *et al.* (2006), Orpwood *et al. (2008)* and Van Steenwinkel *et al* (2012) deal with design for dementia sufferers but not those cases where the individuals have lost much verbal capability.

Figure 2. Original Inclusive Design process (after Cambridge EDC). Source: author.

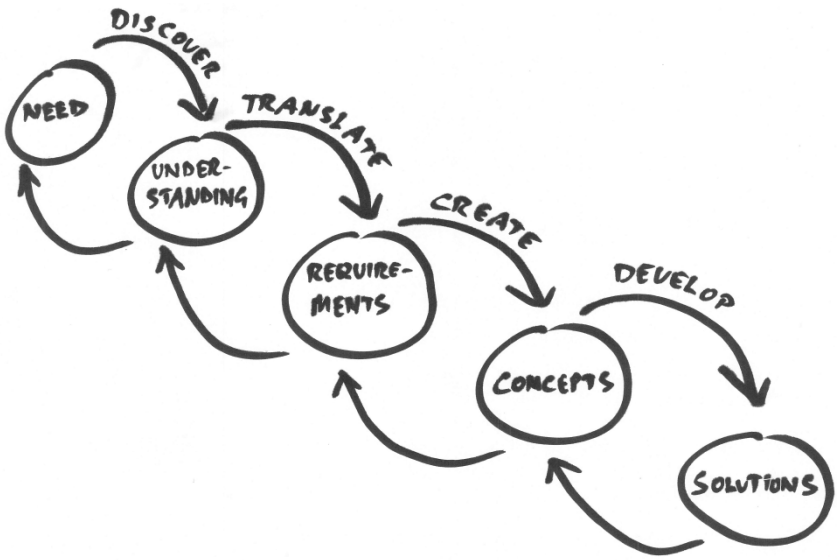

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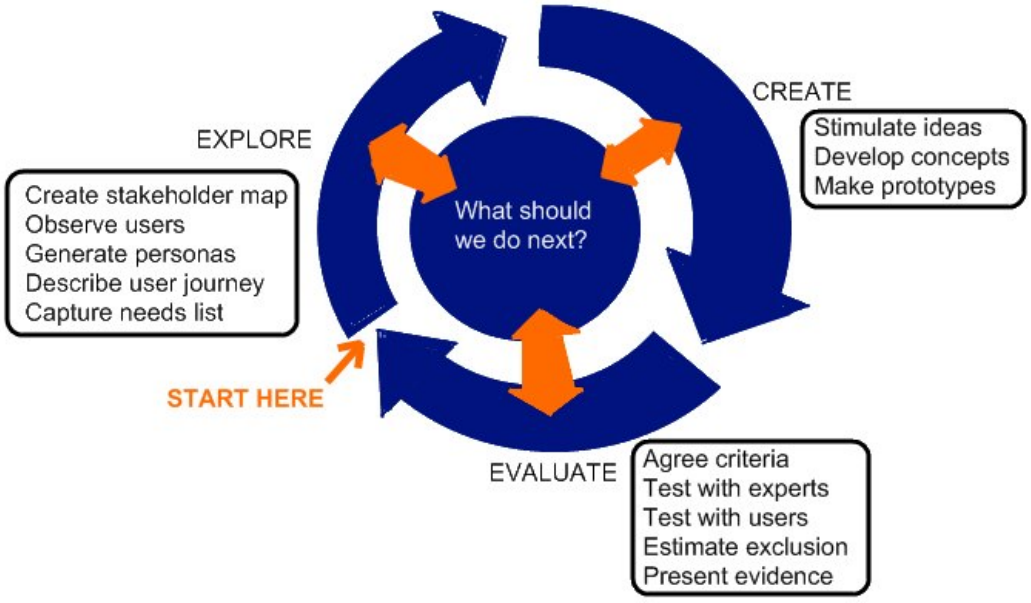
Figure 3.Inclusive Design Process (after Cambridge EDC). Source: author.



ID has two approaches to design for accessibility. The first is to ensure that the research makes full use of ergonomic methodology regarding the physical aspects of the design, to objectively measure capability loss and physical dimensions as well as reference to ergonomic best-practice.

This approach relates the solution to guidelines for physical dimensions and force requirements for manipulating objects or operating controls. The other dimension is cognitive, relating to objective and subjective perceptions of the design. When using ID, one ideally carries out intensive user consultation at all stages of the process; relevant stakeholders are as much a part of the process as the end-user. The method is generally reliant on the users and stakeholders being capable of communicating their preferences. Inclusive Design also proscribes self-testing, one of the fallacies of ergonomic testing (Porter *et al* 2002) but as we shall see, when the user can not be directly involved, one needs another means to test the acceptability of the design.

One of the benefits of ID is that in trying to avoid exclusion by design, the resultant product will have greater usability for users who have no capability loss. An example might be designing the controls of a device with large, clearly contrasting lettering and easily sensed buttons. While such a design

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might be just sufficient for users with reduced visual capacity and poorer fine motor skills, they will be extremely usable for users in the normal range. Another example is the elimination of level changes in the floor of a rail carriage. This is useful for wheelchair users and older people with walking aid, but it also makes life easier for people pulling suitcases, pram users or parents with small children.

Unlike the work cited above, Herriott (2012) and Herriott and Cook (2013) addressed the matter of trying to design for users who have greater levels of difficulty communicating directly with researchers. In Herriott (2012) the users were not addressed directly by designers on the grounds that cognitive or psychological disabilities made this unfeasible. Others were severely restricted in their capacity for communication due to their illness (chronic obstructive pulmonary disorder). In Herriott and Cook (2013) some of the users were individuals with middle to late stage dementia for whom toilet equipment was required. Both of these papers looked at design for assistive technology through the lens of inclusive design processes. The iterative nature of the inclusive design process was observed but the elements relating to users´ direct validation was necessarily reduced or absent. The aim of the design was to produce a tangible product and in that sense the processes were versions of the classic industrial design methods. The 'explore' stage in the inclusive design process was conducted in the expectation of a generally understood design solution that needed refinement for an optimum fit. In the DSK method there the collaborative element at the centre of the model, implying that the user or their proxies participate throughout. In contrast, the process described in Herriott (2012) and Herriott and Cook (2013) imply that the user is encountered periodically or intermittently in the process. Where they are similar is in the type of user and the type of capability losses, and the user-centredness of the ethos of the process.

Methodology

The data used in this paper was gained from conducting interviews with designers from the DSK and examining the literature produced to support

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their work. For clarity the interview material has been edited to present a readable narrative. The approach described is then compared and contrasted with work reported in Herriott (2012) and Herriott and Cook (2013), which described cases where the users had difficulties in communication but were still able to articulate their wishes verbally. In this way, two design approaches are explored and explained. The insights gained in understanding design for those who lack communication skills then informs and description and analysis of an inclusive-type design process.

Data

DSK´s approach in Skansebakken

An introductory (or "kick off" in their terms) workshop began the process. It was used explain and introduce the project to all the stakeholders and participants, or 100 people. In this instance, the design team used a food event. The aim of this 'meal-design' process was to change the staff´s preconceptions of design. The process of specifying and selecting the exact form of a new meal was used to show the salient features of a design process. In this instance, a meal stood in for the designed object and the participants´ intentions were to be passed on to the chef ("producer") to be turned into a dish. In using the food metaphor, the participants could understand the process of deciding what is needed, how to define it, and communicating their notions or ideals to a producer and thereby understanding what can and can´t be defined. This makes clear the distinction between the explicit and the implicit.

To help the designers understand the conditions of the residents and staff, the participants drew up schemes known as user journeys which were journals in which was recorded what the residents did on various time scales (day, week, months). The findings served to reveal which activities were more meaningful than others. Some of the routine activities that were not considered social turned out to be very much worthy of special significance . Through the use of the journals, the staff and design team thus gained a shared awareness of the way the institution ran. It changed the way the staff

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viewed their activities as well. The design process, through triangulation for example, helped to align the understandings of the designers and the stakeholders. Initially, the problem formulation was not clear; it became so through the initial stages of data review and small workshops (of 5 to 20 people, divided into groups of five). The later and larger workshops (20 people) added more data to that already gathered and the path to a design solution was laid out more clearly, with all stakeholders having an increasingly shared vision of the way forward.

During fieldwork staff completed detailed charts recording what happened throughout the day, also noting locations. This generated a dynamic impression of the way the staff and residents used the home´s interior and exterior areas. Ethnographically, the designers observed the relations between the staff and the residents. In so doing they noticed it was more of a workplace than a home in terms of the rhythms of the routine. For example

Figure 4. Creating photo-ethnographic presentation with photos arranged associatively.

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workplace routines governed the sequence of activities. In other words, the residents were not the the drivers of the activities. This was shown in the photo evidence where designers made a gallery of grouped photos that illustrated these aspects. The photos showed the place in a way the staff had not previously seen it. Semi-structured interview with workers, leaders, relatives, nurses supported this visual ethnographic data.

To investigate non-verbal means of communication, six individuals formed a test group. For example, in the case of Dorthe, an adult who has a developmental age of three, pointing served as her means of expression. This information, the importance of pointing, was then noted on a Facebook page set up for her. Having this information available to new visitors to Dorthe meant a shortened process of getting to know her and her needs. Another example is Jens, the only resident with any speech capacity. Jens, who is in his 50s, can be reached through song and by relating through his pet. Thus, resident-specific information was made accessible to visitors who did not necessarily have to communicate with staff.

In principle then the pattern of research was to find out the special needs and particular modes of communication of each resident and then make that clear and available for all who were to interact with them socially.

In the *comprehension* phase the design group triangulated the data gathered. This meant cross-referencing between the data sources (a strategy mentioned in Inclusive Design too). During desktop research the designers found that an employee had written a report as part of a diploma course. The conclusions contained therein indicated resistance to change. A commercial consultancy firm had also studied Skansebakken but their analysis underplayed the problematic aspects of the residence.

Following this stage, the group identified three areas of opportunity. Initially, the designers and management had intended to choose only one for further development but eventually it was seen that all three could be developed as part of the proposed design solution. The construction of an entirely new building solved the physical problems of the site. The two remaining social categories eventually fused into one unified design solution.

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The areas of opportunity had these themes: 1) home and work 2) help for social contact and 3) a need for change. Under the first category, designers planned to improve the surroundings by making the place more clearly home-like and to have it less visibly governed by eight-hour shifts and work routines. Under category 2, it was seen that the citizens needed considerable help to make contacts; their needs and preferences were not easily found out which slowed or stopped new people from developing social contacts. It was concluded that visitors to Skansebakken needed a communication platform to introduce themselves. Such a platform, if introduced, would reduce the mediating role taken up involuntarily by the staff (discussed above). Under category 3, there was a need for physical change and a need for the organisation´s mind-set change along with the attitudes of the local community. Regarding this, the staff at Skansebakken were discovered to be anxious about unexpected contact with the community. This had a discouraging effect on the formation of new links between the residents and the community.

Following this phase, the designers developed ideas that could solve these problems, and they then tested them. In the co-creation workshop people from the community – "experts in everyday life" were called in to provide insight and also to ensure a sense of ownership to the solutions. A second workshop involved co-creation and validation with the staff. A relations-tree diagram showed who could be invited in from the outside community and this helped the staff visualise the otherwise abstract relationships that existed. Then the team and staff developed ideas about how better to link from inside to outside the home; in other words, diagrams were developed which explicitly showed the two-way relations between the home and the community: people going out and people coming in. A third workshop dealt with the relatives and their needs.

Evaluation of the process occurred constantly. Given the varied inputs (verbal and written) plus ethnographic methods, it was possible to triangulate the data and increase confidence in the interpretation of the findings. The indicators the team looked for were accord from the stakeholders and acceptance and comprehension of the proposals. The stakeholders had to signal comprehension of the design process (and were asked to test these methods themselves). Each set of work-shops (see Fig. 4) built on agreed understandings developed from the previous ones and in one sense can be viewed as prototypes themselves.

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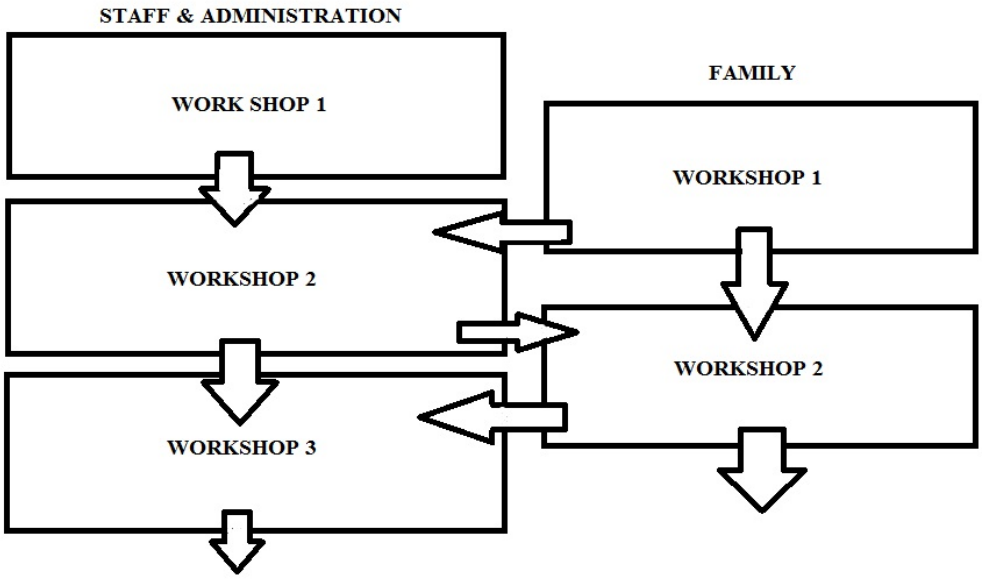
Figure 5. Schematic diagram of inter-relationship between workshops. Data from one builds on the other. Other inputs such as ethnography and literature review also inform this structure.



Designers used material models as communication tools. These included wooden materials, iPads and coloured adhesive tapes which allowed tangible representation of the ideas and their mode of interconnection. It is important to note that none of this material could be used with the residents due to their limited communication capacity. The staff served as proxies for the residents. The designers identified the range of needs described by all the stakeholders and synthesised them to produce a compromise blend which met the needs of the residents themselves. What they found out was that visual means were the best tools to communicate with the residents. Sound recordings could also be used. All of this pointed towards using iPads to mediate the visuals and sounds to which residents could react. Some of these solutions existed in an undeveloped and underused form: there existed a communication book that the residents sometimes used but it was not transportable, and it was not personalised in the way the iPads could be. In contrast, the iPad tablet was transportable and it allowed the data to follow the residents who could see the pictures. Guests could read the photos and use it as a shared reference.

The design team and the stakeholders found that other sense channels besides speech were most important. It was non-verbal with respect to the residents but

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there was a heavier emphasis on the stakeholders' verbal communications. In other words, communication channels other than speech were being under utilised.

During the 'create' phase social prototyping allowed the simulation of new activities. Illustrating this, a designer arrived at Skansebakken unexpectedly and set about trying to find the space to make waffles. Waffle making was not part of the normal routine and the staff needed to understand how routines and the spontaneity of social visits had to be reconciled. The waffle-making demonstration tried out the concept of unexpected visits and helped the staff understand the concept of spontaneity which was missing from the institution. Another social prototyping trial resulted in the creation of an "idea tree". Guests could hang up a thing that could serve as inspiration for something to do with the residents. These could be objects such as a spoon to suggest something to do with food or an activity set which is a set of cards which provides details on how to engage in some game or interaction. People arriving could choose a suggestion from the idea tree if they could not think of one themselves. This idea-tree structure acts as an aid to memory and a visual prompt. It externalises the mental process of casting around for ideas for activities.

Finally, a method workshop was held to help the staff understand how the designers reached their conclusions. This meant the staff tried to experiment with design methods – to fly the plane themselves, as it were e.g. they made three rapid prototypes for communications: an iPad, a colour fan and "Top Trumps" cards so that the staff of Skansebakken could understand their possibilities. The participants agreed the iPad was the best tool to achieve the objectives. They had had gained first-hand understanding of the tool of and the other possible alternatives. As a result, they also accepted the validity of the process and of the proposals it generated.

This section has outlined how the generalised design process of the Design School Kolding was used in specific conditions. It specifically deals with two areas that Inclusive Design (discussed below) references but which might be said to underplay. Those are 1) designing for those who can not communicate and 2) finding accessible ways to ensure that stakeholders have ownership of the process and can validate the outcomes.

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Results

The methodology of the DSK´s work and its results are closely intertwined. Some of the physical and behavioural aspects have been discussed in the previous section. From the outset, the managers of Skansebakken and the designers wanted to improve social relations between the residence and the local community and thereby to bring more voluntary social interaction into the lives of the residents. Resulting from the introduction of digital media and physical interventions such as the ideas tree, they attained these objectives. In the first instance, students from a local school began visiting the residents as part of a school programme. However, most of the social relationships continued when the programme stopped. Further, local members of an organisation for disabled citizens also began to visit Skansebakken. The staff became more open to the outside world and no longer viewed the residents as "theirs" only. The Social Inclusion Lab´s work allowed the staff to step back a little from their previous role, allowing space for others to join in the life of Skansebakken.

Seen from a more general point of view, the project showed how multi-sensory communication can aid the process of design research. When dealing with users in the regular range of capabilities there can be a natural reliance on verbal and written modes of communication. This process demonstrated that even when these methods can not be so easily used, there are other ways to open channels for dialogue with individuals and to thereby determine their needs, using proxies.

Dealing specifically with design using proxies, it becomes more necessary to focus on careful observation of the resultant prototypes in action. If one can not ask the intended user about their responses, ethnographic methods take a position of increased importance. The designer needs to define what a successful outcome is in changes of behaviour. A precisely and testably formulated question about what success looks like is needed. In the case of Skansebakken that test related to an increase in social connections, simply the arrival of more, new people into the residence and the continuation of social relations after the project period. These conditions were met so even

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if it was not possible to directly ask the "users" about their experience one can monitor how many new visitors were getting involved. One could suggest there is always an element of doubt about design for proxies – how can one really be sure the design is appropriate? The answer is that essentially all design assumes a level of pragmatism. It is good to be cautious about proxy-based design but at the same time, this must not lead to a state of design paralysis. All design is, to some extent, merely the best that could be done under the circumstances. If the alternative is to leave the status-quo, then it is apparent that proxy design can lead to an outcome one can conservatively term "much better than doing nothing".

The Skansebakken project showed how even when the target user groups have severely limited communication ways can be found to gain useful insights. The strategies of co-design workshops and the triangulation of information allowed the designers to be confident that the design requirements were valid and appropriate for the special needs of the user group.

Conclusion

The Designing Relations project forms a useful example of a fusion of design methods, being as it is on the borderland between assistive technology and social design. Many of the problems that concern Inclusive Design are at play in the Skansebakken. However, the design solution is assisting not a physical disability but cognitive and social ones, though the physical disabilities are naturally part of the context. Bühler notes (1996) "assistive technology plays an very substantial role for independent living of people special needs". The design solutions described here allow the users to be more independent of their paid carers which in a sense, makes it assistive *social* technology. Further, if Inclusive Design understandably focuses on the user, albeit part of a wider context, this case can be said to have a holistic approach. The users – the residents – are still at the heart of the design activity, but the purpose of the solution is about the devices and new social arrangements putting the residents in contact with other people. It is a means to allow some form of

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communication and social contact. The design solution is not operating at the same level as the walking frame or hearing aid, for example, but at a level more fundamental, person to person interaction.

As stated in the introduction, Inclusive Design explicitly sets out to design for the needs of excluded users; the residents of Skansebakken fall into this category on the basis of their disabilities. Inclusive Design has not addressed this class of user so much as extended consumer product design in the direction of greater inclusivity. In interviews with the designers, the author discovered that they were not familiar with the concept of Inclusive Design but nonetheless demonstrated the approaches one could use in dealing with excluded user-groups. Thus, it is instructive to see how a design method which ought to be able to address disability (but was not used) compares with a method that not so specialised (and which was used successfully).

Orpwood *et al.* (2004) go partway to treating the problem of users with communication difficulties and acknowledge that it is best to leave user testing to the point where the product is quite mature. The Designing Relations project goes further than this in its attempt to ensure reliable data gathering. Of particular interest is the dynamics of triangulation. What did it mean to "triangulate" between the information offered by the stakeholders who were management, staff, relatives? It centred on obtaining a wider range of responses than can be obtained using verbal and written tools and by workshops and expert discussions where the data gathering was tuned in the light of previous discoveries. This parallels the findings of Boyd-Graber *et al.* (2006) who used speechtherapists to stand in for aphasic users when devising a communication system. However, that work did not exhaust the implications of using non-verbal communication in the research phase itself and the proxies could stand in directly for the user group, which was not possible here.

It is also an aspect of non-verbal means of communication that they will tend to elicit strong yet very emotionally laden responses. It is precisely this kind of subjective yet relevant and valuable feedback that can have the greatest value. Purely quantitative, verbal research might provide a logical

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statement e.g. "the user does not like orange" but perhaps a sound, an image or a sculpted form might better capture the aversion to the phenomenon and so better alert the designer to the significance of the phenomenon.

It is time to turn to examine this work in the light of the concept of Buchanan´s Fourth Order design. First and second order design are best understood as classic design methods applied to objects. Buchanan´s (2013) argument is that third order design deals with how people relate to people and fourth order design relate to the environment and systems in which the people and things exist. The ideas are set out in greater depth in Buchanan (1992, 1996 and 1998). DSK´s work can be seen to be a manifestation of Fourth Order design, yet also touching on first and second in that specific objects were created too.

Buchanan (2007) addressed two boundaries of service design, which in essence, the DK project is. The first boundary was the crossing over of graphic design methods to be used a communication tools. The second is the use of products to mediate communications: "How do we use artifacts in establishing relationships among people? Now this is not something that's a news flash for industrial designers. But to shift the focus toward the use of the artefact and its role in experience or activities or being together. That's different. A boundary was crossed" (Buchanan, 2013). DSK´s work crosses those boundaries or can be said to form a nexus between what are fields considered to be separate.

The Designing Relations project is one in which design for inclusivity is relevant as an end in itself and as a means. The disabilities of the user group necessitated an inclusive approach and the involvement of all stakeholders. It was a service design project in as much as it did not aim to create a new product but to alter the way in which people relate to one another; finally, its methodology illustrated points made by Buchanan generally and also specifically (2007) with regards to the inter-relation of third and fourth order design.

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Turning to Buchanan´s observations which are at the methodological and teleological level (after Love´s classification, 2000), this project is illuminating in several ways. At a high level, the project has addressed a "wicked problem" by not only asking the stakeholders to contribute to the information gathering but also by getting them to try out the data gathering method. This dual approach to what is the most contested aspect of a project – defining the problem – creates trust and ownership of the resultant process. In a sensitive case like this, the emotional state of the affected parties matters as much as their well-being. Potential causes of anxiety and disagreement have been avoided by ensuring that the point of the project is agreed by all involved. This makes this a fourth order design issue under which is nested a particular design outcome, the use of off-the-shelf digital devices to support a change in behaviour and to facilitate relationships.

Sanders and Stappers (2014) discuss approaches to making in co-design. They present a concept for movements in design (ibid., p.13) which places social design as being a development for the near future. They also assign this mode to the category of designing "with" the users. However, looking at the kinds of interventions the Lab made with Skansebakken, we can also see that the project to some extent used aspects of critical design and design interventions. Here one thinks of the "waffle chef" strategy which was a way of drawing attention to the institution's awkward response to unexpected visitors. Sanders and Stappers situate designing *for* and designing *with* on opposite poles of a spectrum (which may very well be merely a graphic design artifice) but it is useful to note that design-for and design-with can happen in the course of the same project.

Additionally, the project demonstrated how designers skills and methods can be used to repurpose existing technology. In Broadbent´s (2003) outline, the first phase of design was to shape materials to a new purpose; the second was to design by drawing and entrust manufacture to another; in the third hard-systems methodology was used to define each aspect of the physical problem; in the fourth, psychology was taken into account (soft-systems methodology). All four deal with making a thing. Designing Relations has used the fourth generation of design to re-purpose an existing object.

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Conceivably, in the digital age, the role of the designer will be as much working out what can be done with infinitely flexible hardware and software as designing these things in the first place. It is about finding out new functions for existing tools. This echoes the findings of Dawe (2005, p.21) about how most AT in the home is existing technology with a new purpose assigned to it.

Brereton *et al* (2015) discuss the view of design as relational process and in so doing cite the following: "Suchman (2002) has argued that rather than focusing on the designer/user opposition, we should see design as an 'entry into the networks of relations that make technical systems possible'". The Skansebakken project is precisely this where the 'output' is not only a 'thing' to be used but also a re-ordering of the understanding of how stakeholders relate. In a simplified view of various Design For All processes and design in general, the designer bolts on a new product to an existing set of elements. In a classical version, there is a need or a problem and a new product satisfies that need. This model can only be extended so far before it does not reflect what is going on in projects as described here. We are thus made alert to the boundary of a model derived from traditional product design. If one approaches a situation and a set of relations that need to change, the design process is not an only examination of what is going on but also an intervention. Assuredly there is an element of this in all but the simplest design projects. What happens clearly in Designing Relations is that the process itself becomes, as it were, the product. The *inputs* into the process are changed. Skansebakken´s community is not the same as it was before the project began whereas one could say the consumer with the new toothbrush or even stair-climbing aid is the same person only with an improved device. The teeth still need to be cleaned and the stairs climbed. In designing relations the end result of the process feeds back into the process itself. That reflexive characteristic becomes more and more apparent the more cognitive and social elements become features of the problem to be handled.

An important point to emphasise in closing this article is that Designing Relations showed how design methods can make a profound difference to the

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most vulnerable members of our society. While some of the theoretical aspects are of interest, the immediate value of this kind of work that it echoes the ethical spirit of Papanek´s (1971) Design for the Real World and is design that matters.

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Journal of Accessibility and Design for All

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RETHINKING THE GROCERY STORE: INCLUSIVE WAYFINDING SYSTEM FOR VISUALLY IMPAIRED SHOPPERS IN GROCERY STORES

Doaa Khattab

Department of Inclusive Design

OCAD University, Toronto, Canada

khattabdoaa@gmail.com

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***Abstract*:** Many people with disabilities face considerable barriers while shopping in grocery stores. One such barrier is that they cannot find their way around easily, especially when they visit the grocery store for the first time and have not yet built a cognitive map in their memory. They may also experience delays in finding the right product or waiting for assistance from store employees, thus leading them to rely on family, friends, relatives, or volunteers to help them with their shopping. Problems start when these people are not available, in which case the individual is forced to cancel their visit to the grocery store and reschedule the trip.

Grocery stores include many different zones and services, the aisles area being one of the main barriers to access for people with different disabilities. This area features many different sections such as canned goods, dry packaged goods, spices, drinks and snacks, baking supplies, baby items, cereals, cleaning products, pet supplies, and health and beauty items. For visually impaired individuals, however, it can be hard to reach these various sections and find the relevant products. The objective of this research is to design an inclusive and innovative wayfinding system in grocery stores for visually impaired shoppers in order to help them find the center zone, orient between different aisles, decide where to go, move easily between different sections, and select products with ease. The research approach will be based on the literature review and the application of the Delphi method.

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Abbreviation:

AODA: Accessibility for Ontarians with Disabilities Act, HCD: Human-Centered Design

LV: Low Vision, PL: Grocery Store Planner, VI: Visually Impaired, CNIB: Canadian National Institute for the Blind

Keywords: Grocery store, Wayfinding, visually impaired shoppers, vision impairment, accessibility, inclusive design, sensory environment.

Introduction

The use of self-serve grocery stores is very popular today, providing the consumer a range of product and cost choices, and ability to gauge quality to individual standards. The first self-serve grocery stores began to emerge in North America and Western Europe during the middle of the 20th century, and large self-serve supermarkets became common since the late 1960s (Humphrey, 1998; Shove & Southerton, 2000). In-store grocery shopping has emerged as a common personal task indicative of our ability to lead an independent, capable, and engaged life. Shopping in grocery stores however commonly requires the use of visual and physical abilities.

People who are visually impaired (VI) face considerable barriers while shopping in grocery stores. They cannot find their way around easily especially when they visit the grocery store for the first time and have not yet built a cognitive map of the grocery store environment. They may also experience difficulty in finding desired products or delays while waiting for assistance from store employees. This often leads to the reliance on family, friends, relatives, or volunteers to help them with their shopping. When such help is not available, they are forced to cancel their visit to the grocery store or reschedule the visit.

Some alternative shopping services, such as home delivery and online shopping are available for VI people. These services, however, are not

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available everywhere and they require the shopper to place their order with the store and wait for delivery. Furthermore, anecdotal evidence shows that VI people would prefer to shop in person and enjoy the shopping experience of exploring the store.

Grocery stores are divided into different zones: a decompression zone, a front zone, a center zone, and a checkout zone. The most challenging zone for VI shoppers is the center zone with aisles as they are often challenged to shop independently in that zone even if they are familiar with the store. The aisle area consists of different types of aisles such as food aisles, cleaning aisles, and health and beauty aisles that have minimal visual or physical differentiation. In each aisle, there are many sections, and in each section, there are different types of products. The built environment in the center zone is not specifically designed to be accessible to shoppers with different abilities, and for this reason, VI shoppers often have difficulties orienting, navigating between the different aisles and sections.

The questions that naturally arise are the following: What then of VI people who want to do their shopping independently? How can we design an inclusive system to help them find their way around the grocery store independently? And what is the role of interior design in the solution of this problem?

Purpose of the Study

Although human beings are differently sized and abled, people with vision impairments are usually not considered when formulating designs for private commercial spaces that attract the public. Built environments are designed according to the size of the average person. A well-designed model is one that can enable all users to function easily and successfully within the environment and can be adopted by any business. Architects, designers, and other professionals should be encouraged to create inclusively designed environments that fit the needs of a diverse range of people, including people with disabilities (Advisory Committee on Accessibility, 2010).

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The objective behind the research is to design an inclusive and innovative wayfinding system in grocery stores for VI shoppers in order to help them find the center zone, orient between the different aisles, decide where to go, move easily between the different sections, and select products with ease. The design proposes the following:

- Creating at least two sensory environments
- Applying Wayfinding cues for VI shoppers
- Adjusting current shelving systems and the physical environments that surround them

What is Wayfinding?

Wayfinding is a basic task in daily human activity where individuals navigate from one place to another in a built environment to reach the desired destination and to locate different zones and objects within a space. Wayfinding is the planning stage that precedes dynamic motion, where the navigation process is a combination of wayfinding (cognitive elements) and motion.

Spatial cognition relates to how people behave, navigate, and find their way in the space, while simple cognition is the mechanism of processing information in the brain; it varies from one person to another depending on mental function and intelligence. One element of cognition skills is spatial orientation, which is the ability to orient within a space in relation to other objects (Hajibabai, Delvar, Malek, & Frank, 2006).

Wayfinding is a process where the person behaves and orients within a built environment. It is the user's dynamic relation with space. Wayfinding is dynamic while spatial orientation is static. According to Passini and Aurthur (1992), wayfinding has three different processes:

1. Developing a plan and deciding where to go
2. Executing the plan moving to the right place
3. Processing information by understanding the perception of the environment

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In order to accomplish that, the wayfinder should be able to,

1. Orient
2. Know their destination
3. Know which route to select for the new destination
4. Follow the route
5. Know when to reach the new destination

A good wayfinding system assists the wayfinder's decision-making process. Tools of good wayfinding are components designed to assist spatial orientation and cognitive mapping. These tools can help people with different cognitive skills, including:

- Cognitive-focused users who rely on maps and written directions
- Visually based learners who respond to landmarks, art, graphics, and colours
- People who respond to verbal communication when someone explains direction to another

All of these include diverse people with different abilities (Huelat, AAHID, ASID, & IIDA, 2007).

Wayfinding design principle

Wayfinding is a model that helps solve spatial problems in a built environment. The mental map is developed by the information gained by the built environment's cues. Wayfinding in a built environment can be developed by using a combination of the following:

1. Develop a simple layout that is easy for no-/low-vision users to memorize
2. Add acoustic characteristics to the space
3. Use colour and bright contrasts
4. Provide tactile information
5. Use of signage
6. Use audible signs to provide information by hearing
7. Use lighting to differentiate between areas
8. Use texture and tactile to help shoppers' find direction

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The design shall include identifications and marked spaces; the spaces should be linked and grouped, and this experience should be communicated to the user. Signage, audible signage, colours, contrasts, light, acoustic characters, texture, and materials should follow the AODA standards in order to be accessible by VI shoppers. (limited, 2014)

Research Methods

This study employs two different approaches to answer the main research questions. The research approach will be based on the literature review and the application of the Delphi method. The literature review will focus on two central contexts. The first context consists of grocery store planning strategies for the aisle zone, accessibility, and wayfinding requirements within the building environment for VI people. The second context will focus on the science of LV and on how people who are affected by LV cope with their vision impairment, while the Delphi survey will be employed in the study to collect reliable information and enhance the effectiveness of the store planners and LV experts' decisions regarding the proposed design.

The aim of the Delphi survey is to determine which different themes should be included in the design to create an inclusive wayfinding system that will enhance VI shoppers' independent shopping experience. A successful wayfinding system should allow VI shoppers to (1) recognize the start points and end points of the shopping journey, (2) identify their location within the space, (3) recognize whether they are travelling in the right direction, (4) orient themselves within the building environment, (5) identify the destination upon arrival, and (6) escape safely in emergency situations (Innovation, 2007). Wayfinding criteria should include the following: (1) architectural clues, (2) graphic communication, (3) audible communication, and (4) tactile communication. Wayfinding cues, together with wayfinding design, give rise to a successful and inclusive grocery store wayfinding system (Innovation, 2007).

With the application of the principles of universal design, inclusive design can accommodate people with different disabilities. These principles include

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(1) simple and intuitive use (comfort/appeal theme), (2) size and space for approach and use (accessibility), (3) low physical and vision efforts (convenience theme), (4) perceptible information and flexibility in use (legibility theme), and (5) tolerance for error (safety theme) (Innovation, 2007). Guidelines or accessibility building codes for people with vision impairment are unavailable for the grocery store building environment. Hence, the Delphi method will be suitable for gathering experts' opinions on the design process and testing the design for its capacity to meet the five different themes and to create an inclusive wayfinding system.

Moreover, the Delphi method will collect information from the PLs about the design limitations and will test whether the design features are applicable by grocery store organization or not.

Delphi Survey

This study will use a Delphi survey to gather experts' opinions on the design process (Gunaydin, n.d.). A Delphi survey is a technique for collecting reliable information from subject matter experts and promoting effective decisions. This technique presents groups of experts with a series of questions. These data are then compared and analyzed in order to develop a design.

This study will survey two groups of experts: (1) store planners and (2) LV specialists. Two surveys were developed, one for each of the expert areas, that would collect data from the experts about what physical features derived from the socio-ecological framework would address the five concepts for independent use of grocery stores by LV individuals relative to the other set of factors associated with their expertise. As such, LV experts addressed issues that linked individual factors of LV with physical environmental factors of shopping and store planners addressed issues that linked organizational factors of grocery stores with physical environmental factors of shopping. The survey, was provided in written format to the experts with follow-up interviews by phone or in person and utilized check-box, Likert scale answers along with open-ended answers.

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A Delphi survey can include repeated iterations to achieve the required result. This study will include two rounds with two surveys, one for each group.

Round 1

In the first round of Delphi survey, LV experts have been asked very specific questions about grocery shopping for LV shoppers, the science of shopping and the science of vision, and recommendations about wayfinding cues for LV users. The PLs were asked to answer structured questions about what are the standards to design a grocery store, the science of shopping and shopping behaviour, and wayfinding cues and techniques that can be adopted in grocery stores building environment.

The answers to these questions will help to understand the needs of LV shoppers to shop independently in relation to the five main concepts that relate to the physical environmental factors; also, it will address the limitation in the design that relates to the organizational factors of the grocery store.

Round 2

The second round of Delphi survey will gather experts' comments and feedback about the preliminary design. Each participant will receive a copy of the design model, along with a second questionnaire intended to gather more detailed information. In this round, experts will make detailed clarifications and adjustments in order to come out with final recommendations (Chien Hsu, 2007).

Design Approach: Human-Centred Design (HCD)

The research considered HCD for the interior design model that will be used to create the wayfinding experience. HCD is about empathy and understanding people's tasks, goals, and ways to approach challenges. HCD can be used in the design of products, spaces, services, and systems. Physical environments give people cues on how to behave and feel; by

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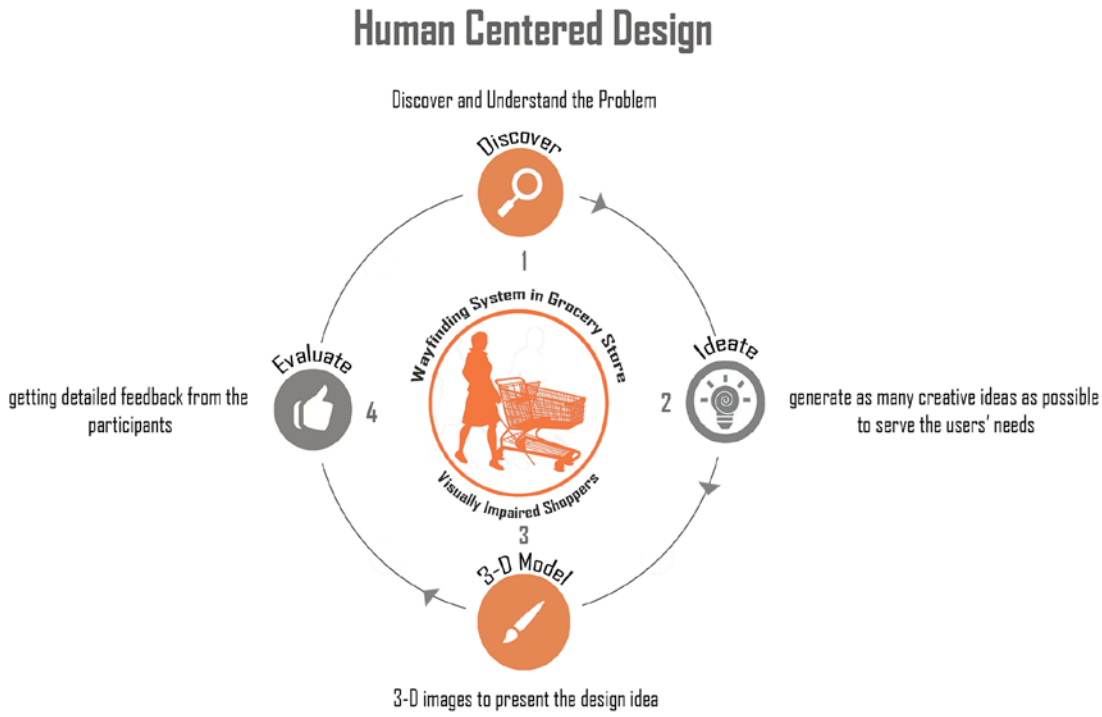
rethinking the design of any space, we can create an experience and provide cues for the user when interacting with his or her physical building environment. HCD is one of the methods for creating barrier-free spaces (Greenhouse & Semsie, n.d.).

Figure 1. Human-centered designd design.



Design Process

HCD has different stages. For the research, the design process consists of four main stages: discovery, ideation, 3-D modeling, and evaluation.

Discovery. Different methods can be used to discover and understand problems, and these methods also have differing strengths and weaknesses. The ethnography has been developed from previous research (Khattab, 2015), literature reviews, Delphi surveys, and conversational interviews. These methods were used to understand users, their needs, the barriers they face, and the contexts and purposes they use the system for. These methods resulted in qualitative and quantitative data (Lindstrom & Malmsten, 2008).

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Ideation. Ideation identifies the end users' needs and generates as many creative ideas as possible to serve these needs. The goal of the ideation phase of this research was to provide solutions to the problem presented in the first Delphi survey and to check whether or not the participants agree on the suggested ideas. After getting the participants' feedback, a 3-D model was presented to create better communication and to help in the final evaluation (Dorta, 2008).

3-D Modeling. Using 3-D images is a fast and efficient way to present a design idea; this approach will help participants make firm decisions about the design, give detailed feedback, and add different options.

Evaluation. The design model will be evaluated by getting detailed feedback from participants, LV experts, and PLs. The 3-D model will be submitted to both groups in the second Delphi survey to get their opinion about the design to decide whether the eight elements of design are applicable by grocery stores and whether this design will enhance VI shoppers' independent shopping experiences.

The essential elements of HCD are the consideration of appeal/comfort, accessibility, convenience, legibility, and safety for the users in the design model.

Appeal/comfort. "Appeal/comfort" will be used in this study to describe the physical and digital elements in building environments that provide visual and sensory appeal as well as comfort.

Accessibility. "Accessibility" for the physical environment is defined as the presence of zones that can be easily entered and exited (width, height, and spatial orientation), have reachable shelving (height, size, and locating the needed shelf), and have easily available wayfinding cues (location and usability). For the digital environment, "accessibility" refers to the customers' ease of identifying aisles, sections, and shelves by using digital factors including sound or light.

Convenience. "Convenience" relates to three factors: (1) the simplicity of the layout to navigate the center zone, (2) the minimal physical effort and

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time required to locate the desired aisle, section, and product, and (3) the information can be accessed by LV individuals.

Legibility. Legibility in a space provides an understanding through helping create cognitive maps and wayfinding. Legibility relates to (1) perception (zone, aisles, and pathways), (2) usability of wayfinding cues in relation to users, and (3) intelligence of wayfinding cues.

Safety. The objective of the safety factor is to provide a secure environment for VI shoppers in grocery stores in the aisles area, and that will be achieved by removing all physical factors that may cause injuries while shopping due to unseen elements.

3D Wayfinding Model

The design proposes creating a dual-sensory environment that incorporates visual and haptic elements. For this dual-sensory environment, eight elements related to individual and organizational physical environmental factors for shoppers with VI will be presented. The wayfinding model consists of eight design features:

1. Aisle signage
2. Product signage
3. Metal transition stripes at the two ends of each aisle
4. Light-projected floor numbers
5. Coloured flags
6. Raised texts and numbers
7. Red clip to code products on sale
8. Clear pathways

Figure 2 presents the 3-D wayfinding model with these eight components. The image presents five aisles. The shelving system is gray, and the product signage and the shelves' skirting is white. In addition, it uses vertical metal dividers to create different sections in each aisle. The floor for this design is light gray colour in which it will create a colour contrast with the white skirt and the dark grey shelves, with stainless steel floor stripes at both ends of

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the aisles. The lighting system consists of two types of lighting fixtures: general lighting fixtures and projected light (which will project the aisle's number on the floor when the grocery store identifies VI shoppers in the store). Also, an image for an existing grocery store will be presented to compare the design model to an existing grocery store model.

Figure 2. Center zone (aisles) with eight design features.

Figure 3. Center zone (aisles) for an existing grocery store.

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Aisle Signage

The image presents aisles number 4 & 5 in white colour and green back ground. The products for aisle 4 displayed on the right side as it represents the international products (European, Caribbean, Asian, and soya products). While the products on aisle 5 are shampoo, hair colouring, and hairstyling products. Products` text are in white colour and black background.

Figure 4. Aisle signage.(Design feature 1)

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Figure 5. Aisle signage for an existing store.

The image below presents the aisle signage for an existing grocery store. The signage is 300 cm above ground which is not accessible by VI shoppers.

The design proposes changes to the aisle signage by providing two numbers for each aisle; each number will identify the side of the aisle so it will be more convenient for the shoppers and VI shoppers to orient themselves and to know the products in relation to the aisle number. For example, if the VI shopper is passing in aisle 4, the aisle signage to the right side will show the aisle number (which is the number 4), and the types of products will be displayed on the right side of the aisle. The left side of the aisle's signage will not only show the aisle number (which is also the number 4) but also display the types of products on the left side of the aisle.

In addition, the design proposes changing the location of the signage to be over the end cap and within the eye level (180 cm [70 inch] to 220 cm [86 inch]). The aisle numbers will be displayed in white on a green background. The aisle text (types of products contained within each aisle) will be displayed in white on a black background.

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Product Signage

Figure 6. Product's signage. (Design feature 2)

The image below presents the product signage in which it will be located over each section in the aisles area (black text with white back ground) with 30 degree angle towards the shopper`s sight line.

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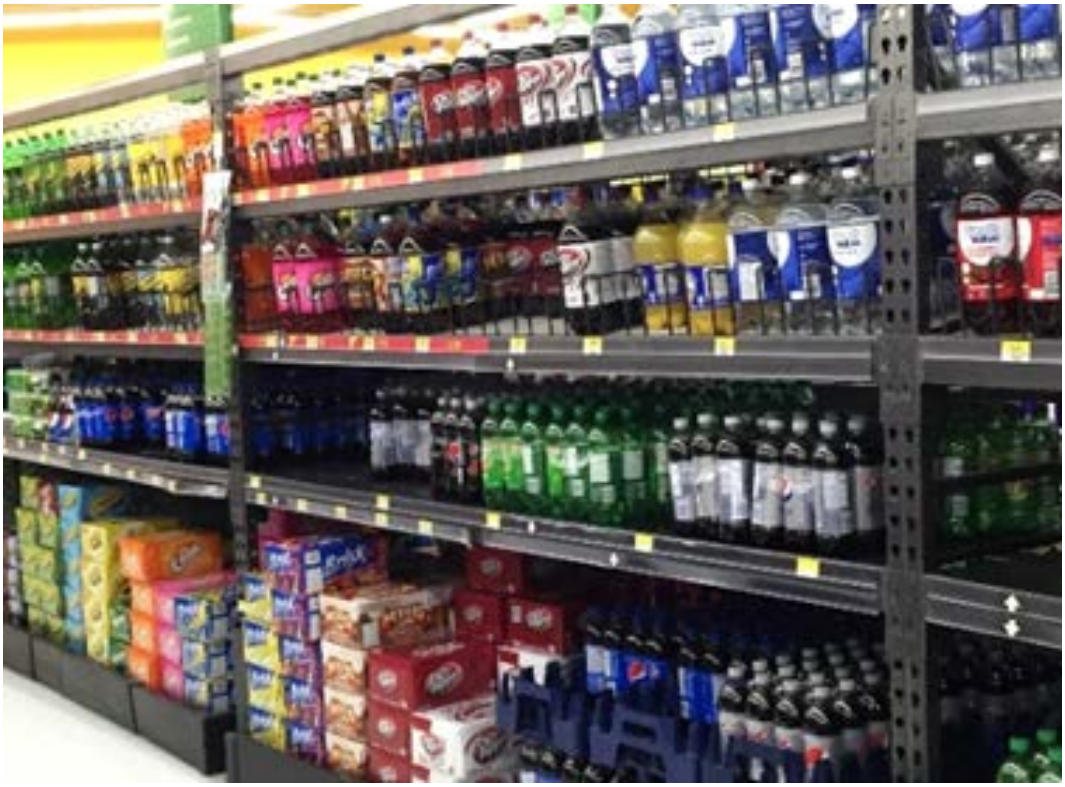
Figure 7. Products with no signage for an existing store.

The image below presents sections in the aisles area in an existing store. The sections have no signage in which it will be difficult for VI shoppers to recognize the sections and products.



The design proposes adding product signage over each section in each aisle, and this signage has an angle (30 degrees); the signage will be located at the top end of each aisle. The text will be in black, and the background will be in white. The product signage design and colour contrast will be effective for VI shoppers to find the needed section within the aisles area; also, the proposed angel will reduce the vision effort needed for VI shoppers.

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Metal Transition Stripes

Figure 8. Metal transition stripes. (Design feature 3)

Figure 9. Center aisle floor in an existing store.

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It is very important for VI shoppers to know when the aisle starts and ends. To aid VI shoppers, the design proposes using a metal transition stripes on the floor before entering and exiting from the aisles area, as per the 3-D image. The floor's metal transition will function as a haptic wayfinding cue and a haptic landmark. VI shoppers will feel the floor's metal transition by either stepping on it or moving their carts over it. This will serve as an indicator that they are entering or exiting the aisles' section.

Light-Projected Floor Numbers

Figure 10. Light-projected floor numbers. (Design feature 4)

The image presents a light projected floor number # 6 in white colour over grey flooring

The design proposes using ceiling light to project aisle numbers on the floor (digital element) as it will help VI shoppers identify which aisle they are in; also, it will provide accuracy in navigation. When a grocery store identifies that a VI shopper is in the store, a light from the ceiling will project numbers on the floor for each aisle so the shopper will get to know which aisle they

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are in, and by that time, they will get to know what products are available in each aisle.

Using Flags to Colour-Code Sections and Products

Figure 11. Coloured flags. (Design feature 5)

The image below presents vertical flags (blue, yellow, green, and red colours) on the vertical dividers for the different sections in the aisles area.

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Figure 12. Center aisles.

The image below present the beverage section in the aisles area in an existing grocery store. Different kind of beverages on a grey shelving system.

The design proposes using flags to colour-code the aisles and some sections. These flags will be on the vertical dividers of the shelving system and 2" wide. Their purpose is to colour-code the products and aisles. For instance, baby blue flags are used in some sections to mark baby products in aisle number 6. International food will have different colours in the same aisle so when the shopper passes by different colours in the same section, he or she will get to know that the aisle presents international food.

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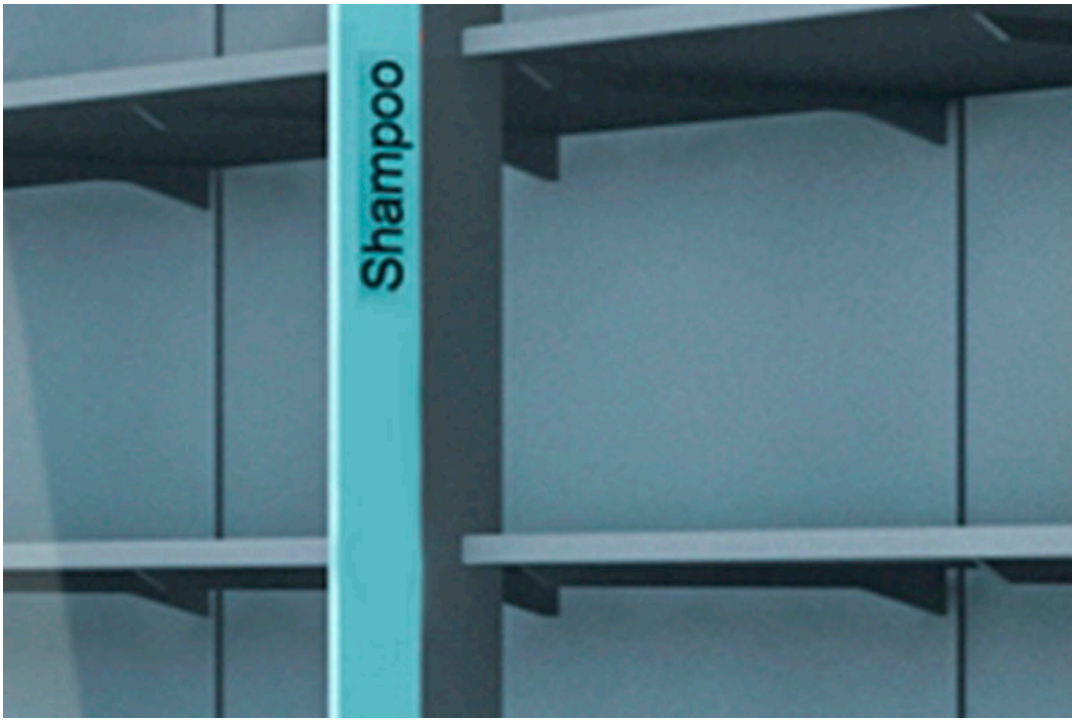
Raised Text and Numbers

Figure 13. Raised text & numbers. (Design feature 6)

The image presents the shelf within the different sections in the aisles area with the blue flag and raised text (shampoo) .



The design suggested adding the product's name and aisle number on the coloured flags beside each shelf; the print will also be raised to be convenient and legible for VI shoppers and will be depicted in the 3-D model. Also, it will work as a haptic wayfinding technique.

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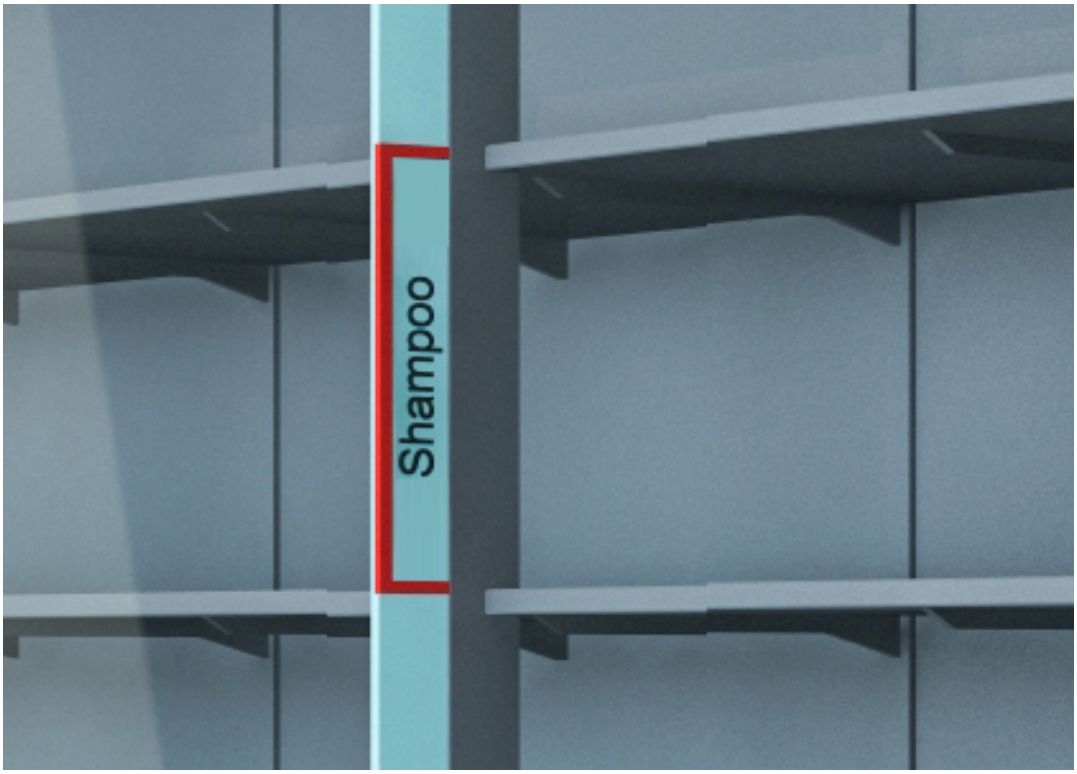
Coding products on sale

Figure14. Coding products on sale. (Design feature 7)

The image presents the shelf within the different sections in the aisles area with the blue flag and raised text (shampoo) and a red clip around the text to code products on sale.



VI shoppers are not able to find the products on sale easily; the design model suggests designing a red clip to be clipped on the coloured flag beside the shelf that has products on sale.

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Removing the freestanding displays and columns

Figure 14. Clear pathways. (Design feature 7)

Figure 15. Clear pathways. (Design feature 7)

Structural column in the middle of the pathway in an existing store.

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Safety is one of the main factors that should be considered while designing the building environment. Most grocery stores use freestanding displays in the pathways between different aisles or have a structural column in the middle of the pathway; as per a previous ethnography to a VI shopper doing the grocery shopping, the shopper bumped the cart many times on freestanding displays, and that made him feel unsafe in his shopping journey. Providing clear pathways with no freestanding displays or columns in the shopper's pathway in the aisles is very important.

The 3-D wayfinding model that incorporates the eight different components will be assessed by the two groups of experts in the second Delphi survey. This survey will aid in checking whether the suggested changes will enhance the shopping experience for VI shoppers and if these elements are applicable by grocery store organizations.

Results

PLs and LV experts have agreed on six design features out of eight that would improve the shopping experience for LV shoppers: (1) aisle signage, (2) product signage, (3) light-projected floor numbers, (4) raised text, (5) coding products on sale using red clips, and (6) removing all freestanding elements in the center aisles. Both group of experts did not agree on using (7) metal transition stripes (8) and coloured flags.

Aisle Signage: Removing All Freestanding and Fixed Elements from the Pathways

Both sets of experts have agreed that aisle signage and removing all freestanding and fixed elements from the pathways in the center aisles are the most effective features in relation to the five main themes: (1) appeal/comfort, (2) accessibility, (3) convenience, (4) legibility, and (5) safety. PLs have agreed that the aisle signage design feature is highly applicable by grocery store organization; also, LV experts have ensured that the design feature is usable for different shoppers with different vision impairment. Both experts have agreed that removing the freestanding displays and the fixed elements (columns) from the aisles area would

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increase the safety factor for all shoppers especially when they need to escape for emergency issue, PLs' main concern is that they use the freestanding displays to display product's on sale and removing them may affect their profit.

Product Signage

PLs agreed that product signage design and colour contrast will be really effective for finding the needed section within the aisles area; also, they ensured that the proposed angle will reduce the vision effort needed for VI shoppers. Michael Farquhar from Loblaws stated, "Product signage will block the light from hitting products on shelves making it harder to see for all." Gordon Legge (LV expert) suggested to use bright letters on black background since it will be more accessible to read for shoppers with advanced cataracts.

Metal Transition Strips

PLs did not agree on the metal transition strips. Dan Philip is the only PL who strongly agreed on this design feature, and he mentioned that this element would work as a wayfinding cue to identify the two ends of the center zone. It also would work as a haptic wayfinding landmark. Moreover, it would not affect the legibility of the shopping experience for the general shoppers. According to Gordon Legge (LV expert), "VI shoppers are able to read the aisle signage, and this feature will identify the two the ends of the aisle without the haptic stripe, but this strip may be helpful for blind and severely VI shoppers, but it is narrow enough that it might be missed." The metal strip is a feature that may be considered or redesigned to enhance the shopping experience for blind shoppers, which is a population that was not considered in the original design.

Light-Projected Floor Numbers

Both group of experts agreed that the light-projected floor numbers will help VI shoppers identify which aisle they are in; also, it will provide accuracy in navigation. Three LV experts agreed that this design feature will serve all types of shoppers with different vision impairment.

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Coloured Flags to Code Sections and Products

David Yehuda and Dan Philip (PLs) did not agree on using coloured flags to code sections and products. Yehuda mentioned that this design feature might annoy the general shoppers. On the other hand, Gordon Legge, who is a LV expert and a specialist in wayfinding, stated "These flags may be useful as a landmark for shoppers who become familiar with them, but we have to keep in mind that many VI people do not have good color discrimination." Sumreen Siddiqui, a LV expert from the CNIB stated, "It's important for the proposed flags to be in bright colours, as these will be much easier for people with visual impairments to see. Light coloured flags may be missed altogether."

Raised Text as a Design Feature

Both groups have agreed on using raised text as a design feature, but Gordon Legge was concerned about this design feature and stated that "this design feature will require reading vertical text, and this may be effortful for VI shoppers and may require more time."

Finally, Lawrence Polyner, a PL, stated the following, "Grocery resets are one of the biggest obstacles for a VI customer. The aisle signage, colored flags, and product signage are excellent solutions to keep this VI customer independent, but these elements would need to be designed to be flexible to ensure that the grocery could easily and accurately relocate 'inserts' or flags when their business model changes and they are required to do some type of reset. Also, I don't feel that completely removing cross merchandising (freestanding displays) opportunity via spot merchandisers is the answer. They could be reduced and placed in locations that allow adequate flow but I believe that they too could be signed correctly."

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Conclusion and Recommendations

In conclusion, wayfinding is about effective communication, and it relies on successful communication cues delivered to our sensory system. Wayfinding is the ability to know where you are, where you are heading, how to reach your destination, and how to find your way independently and safely. The effectiveness of the wayfinding system is measured by the users' experience in the environment and how they communicate with the cues that take them from A to B (Innovation, 2007). The wayfinding system should provide comfort, accessibility, convenience, legibility, and safety for the user. According to Innovation's (2007) table, a successful wayfinding system should provide information for users to:

Table 1: Inclusive wayfinding system

Inclusive Wayfinding System Should Provide Information for Users	Design Feature
1. The start and finish of the wayfinding journey	Metal transition strips and aisle signage
2. Identify their location	Aisle signage, light-projected floor numbers, and product signage
3. Ensure they are travelling in the right direction	Aisle signage and light-projected floor numbers
4. Orient themselves within the space	Aisle signage, light-projected floor numbers, product signage, and metal transition strips
5. Identify their destination on arrival	Product signage and raised text
6. Escape safely in an emergency	Remove all freestanding and fixed elements from the centre aisles from the

Providing proper accommodations for a group of customers (VI shoppers) not only conforms to inclusive design principles, but it will improve the quality of life for people with vision impairment and will enhance the legibility general shoppers' shopping experience. When the grocery store building environment is designed with reasonable consideration of people with vision impairments' needs, it will provide equal rights and opportunities for everyone to access their facilities and services. Removing barriers makes good business sense to the service provider. Based on the Delphi study and

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the literature review, the study proposes the following recommendations be adopted by grocery store organisations in the centre zone to accommodate the needs of VI shoppers: the layout, aisle signage, product signage, haptic landmarks, light-projected floor lights, raised text and numbers, coding products on sale, and removing the freestanding displays and columns.

Grocery Store Building Environment (Center Aisles)

This research study supports that a combination of the following design principles will support the wayfinding system for LV people in grocery stores and other aisle-based spaces, such as libraries, retail stores, convenience stores, and pharmacies.

Layout

The circulation system is the key organising element in a building for people to build a mental map of the space. The center zone (aisles area) layout in grocery store should be simple enough to be memorised by VI shoppers. Grocery store experts have agreed that the grid layout will provide wayfinding comfort and ease for VI shoppers, and grocery stores should maintain the grid layout for the center zone.

Aisle Signage

It is recommended to redesign the aisle signage by providing two numbers for each aisle; each number will identify the side of the aisle so it will be more convenient for the shoppers and VI shoppers to orient themselves and to know the products in relation to the aisle number. In addition, it is recommended to change the location of the signage to be over the end cap and within the eye level (180 cm [70 inch] to 220 cm [86 inch]). The colour of numbers, text, and backgrounds should follow the AODA regulation in terms of colour contrast. Colour contrast should be at least 70% between the text colour and its background.

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Product Signage

Product signage should be added over each section in each aisle. This signage should have an angle of 30 degrees because it would be more convenient for VI shoppers to read the information. The signage should be located at the top end of each aisle with the text in black or with bright letters with a dark background in order to accommodate different shoppers with different vision impairment.

Haptic Landmarks (both ends of the aisle)

It is important for VI persons to know where the aisle starts and ends. To aid VI persons, it is recommended to use floor stripes, floor grooving, or different floor material because it will work as a haptic wayfinding cue and a haptic landmark. VI people will feel the floor haptic mark by either stepping on it or moving their carts over it. This will serve as an indicator that they are entering or exiting the aisle section.

Light-Projected Floor Numbers

It is recommended to use light-projected floor numbers to identify the different aisles. Different coloured lights can be used depending on the floor colour. A light from the ceiling will project numbers on the floor for each aisle, so the shopper will learn to know which aisle they are on. In time, they will get to know what products are available on each aisle.

Raised Text and Numbers

The benefit of using raised text is it will increase the convenience and legibility in the shopping journey. The raised text will help the VI shopper identify and confirm the different types of products for each shelf. It will also enable touch reading for shoppers who are blind and touch enhancement for shoppers who are VI. It is recommended to position the text horizontally, not vertically, to be more convenient for VI shoppers.

Coding Products on Sale

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VI shoppers can use a barcode reader to know if the product they are planning to buy is on sale, but this reader will not help them with unplanned and impulsive purchases. Using a red clip to code products on sale is one way to enhance the impulsive and unplanned purchase decisions.

Remove the Freestanding Displays and Columns

Safety is a main factor that should be considered when designing the building environment. Most grocery stores use freestanding displays (cross merchandise) in the pathways between different aisles or have structural columns in the middle of the pathway. VI shoppers and blind shoppers may bump their carts into the freestanding displays and columns. It is not safe for emergency escapes for all shoppers.

Limitations and Future Research

The findings of this study were based on the literature review and two rounds of Delphi survey, according to C. C. Hsu and B. A. Sandford (2007). Ten to 15 subjects will be sufficient for the Delphi survey, but most Delphi studies have used 15 to 20 participants. In future studies, it is recommended to involve a larger group of experts in the study or to use a new research method. It is recommended to use more statistical power in analyzing the data. It is also recommended to test the design model with different shoppers who have different types of vision impairments. Finally, empirical research is recommended for future study; empirical research by using a mock-up in actual spaces will facilitate and support the decision-making process.

Finally, the purpose of the study is to provide an inclusive wayfinding system that aims to remove all of the barriers that create unreasonable effort and separation. An inclusive design should enable people with different disabilities to participate independently in everyday activities.

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UNDERSTANDING THE BARRIERS: GROCERY STORES AND VISUALLY IMPAIRED SHOPPERS

Doaa A. Khattab[1], Julie Buelow[2], Donna Saccuteli[3]

Department of Inclusive Design

OCAD University, Toronto, Canada

khattabdoaa@gmail.com[1], julie@ufoundit.ca[2], donna.saccutelli@senecacollege.ca[3]

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***Abstract*:** The Accessibility for Ontarians with Disabilities Act, 2005 (AODA) is legislation that aims toward having complete accessibility within the province of Ontario by the year 2025. The accessible built environment is one of the key areas covered by the legislation; therefore, grocery stores, as part of the built environment, should be designed to accommodate shoppers with different abilities.

Grocery stores include many different zones and services with the aisles area being one of the main barriers to access for people with impaired vision. This area features many different sections such as canned goods, dry packaged goods, spices, drinks and snacks, baking supplies, baby items, cereals, cleaning products, pet supplies, and health and beauty items. For visually impaired individuals, however, it can be hard to reach these various sections and to find the relevant products. The purpose of this paper is to present a study that sought to understand the barriers that shoppers with vision impairment (VI) face in the grocery store`s built environment.

The research approach was based on the application of the ethnography method, Think-aloud Protocol (TAP), Interviews, and behavioural mapping method.

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Abbreviation:

AODA: Accessibility for Ontarians with Disabilities Act, 2005, LV: Low Vision, VI: Visually Impaired, CNIB: Canadian National Institute for the Blind

Keywords: Grocery store, Wayfinding, visually impaired shoppers, vision impairment, accessibility, inclusive design, and sensory environment.

Introduction

The term "visually impaired" (VI) refers to individuals with low vision (LV) who can rely on a combination of their limited vision and other senses to do daily tasks. VI individuals are unable to read from a normal viewing distance even with the aid of eyeglasses and contact lenses (Catteneo & Vecchi, 2011, p. 138). Two terms in vision impairment that need to be understood are "object vision" and "travel vision." Object vision is the ability of people to determine what kind of object they are seeing but not knowing its type or details. An example of this is seeing a person but being unable to recognize them. Travel vision refers to the ability to move in space independently without the help of a cane, a guide dog, or a guide (Chapman, 2001, p. 14).

When designing a layout for a grocery store, the main focus is the relationship between the seller and the consumer, with the seller always thinking of what to display and where to display it. One of the main elements considered when designing a grocery store is the floor layout and the human behaviour within that layout; as a result, retailers focus on the store magnets, which are the main sections that attract the most customers. The types of sales sections have a pronounced effect on customer flow. Each section can be designed in a way to have a magnet that attracts customers and increases sales.

When designing a grocery store, the main layout elements are the entrance, exit, aisles, and the different zones, such as meat, vegetables and fruits, dairy, and the cash out area, which all should be welcoming and friendly

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(Ohta & Higuchi, 2013). According to a study where magnet areas inside of 64 grocery stores were analysed, all of the displays designed for the perimeter of the store had more magnets than the middle area displays. Most stores are designed to have the fruit and vegetable section near the entrance, with the cash out and exit on the other side, and the aisles usually located in the middle area.

Most grocery stores use these designs and do not make special assessments for people with vision impairment. According to the literature review, no grocery stores have been designed to provide access to visually impaired people to shop independently. Visually impaired people depend on friends, families, and a store's customer service department because they want to find their items and shop fast. How can retailers provide a physical environment to help visually impaired people shop independently?

In Ireland, 240,000 people are living with vision impairment. A study by the National Council of the Blind Ireland (NCBI) estimated the barriers in grocery stores as follows ((RNIB), n.d.).

- 79% stated that the shop is not easy to navigate through the different zones
- 96% had difficulties accessing the information on signs
- 95% had difficulties accessing the information on labels
- 73% face obstacles in the aisles
- 89% mentioned that to improve their shopping experience they want their bill to be read to them.

What about finding the right section in a zone? And how they can find the right shelf and right product?

The Royal National Institute of Blind People (RNIB) has researched the shopping experience for those who are visually impaired and found that users are looking for someone to help (customer service) and to navigate them to find their products.

Customer service. It is important for customer service to be found easily by the blind or visually impaired. Customer service should be aware that most people who are visually impaired can distinguish between light and dark

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colours and that not all of them carry a white cane or use a guide dog. In addition, some visually impaired people are also deaf. How can they be included in a design to help them shop independently?

Customer service should be near the entrance to be easily accessed by users and where customers can be monitored.

If customer service employees see a customer who needs help, they should introduce themselves, tell why they are here, and help the user through the shopping journey ((RNIB), n.d.).

Navigating, locating, and selecting products. Usually, visually impaired people push the cart and their assistant picks up the products. The problem they face in this process is there may be many obstacles between the aisles: staff may leave their pallets, some freestanding displays block the aisles, or some products may be on the floor after being dropped from the shelves. Moving around to find the needed product is really challenging, especially when the products are arranged seasonally. Another barrier can be reading detailed product information if it is in small letters. When product information is not accessible, the customer is prevented from knowing the ingredients, the items on sale, and the promotions.

Some solutions provided by the NCBI are to:

- Keep aisles as free as possible from any obstacles
- Use colour contrasts in the building environment and product packaging
- Use floor signs
- Ensure customer service is located near the entrance and accessible by users
- Use larger print text
- Use audio-labelling

As mentioned previously, all of these are some solutions, but they are solutions that do not make visually impaired people fully independent in a grocery store ((RNIB), n.d.).

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Paying for products. Most visually impaired people have difficulties in cashing out; for example, if they pay by cash they do not know which bills the cashier returned in change. The different chip and pin machines may be stressful and challenging because of the different layouts and the periodic updates that make it hard for a visually impaired person to use ((RNIB), n.d.).

Some solutions have been suggested, such as sales staff reading the final amount for the customer, confirming the amount handed to that customer, and count out any cash amount handed back to the customer. For chip users, the sales staff can scan the card and the customer can sign it. It has been suggested that all chip machines should retain the same layouts and have raised letters for accessibility.

Objectives

The objective of the study was to investigate the barriers that people with vision impairment face in grocery store`s building environment and to identify the gaps in the retail design.

Research Methods

Six low vision (LV) participants took part voluntarily in the research to help identify the barriers faced in their shopping journey. This created an inclusive study of a participatory action research method that included different vision-impaired groups as well as their experiences through different shopping stages.

Different methods were used to gather information, such as ethnography (shadowing), behavioural mapping, and interviews. Each method was documented using different tools and will be discussed later in this paper.

Ethnography (Shadowing)

Ethnography is a social science research method that helps to deepen the understanding of people's daily practices and behaviour. In researching

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individuals with vision impairment, ethnography helps understand their behaviour and how they interact within a building and the environment during a shopping journey (Hoey, 2013). Shadowing techniques are used throughout the study; this is an observational technique in which the observer tracks the participant while they are completing their tasks, which helps the observer to understand a participant's experience and their pain (D-Lab, 2012). Shadowing observation should be documented through behavioural mapping, photos, videotaping, and field notes. The think-aloud method is another way to support the shadowing technique and is needed to understand the 'why' behind patients' behaviours. During the research, two male participants participated in the shopping journey.

The research team met with a low-vision volunteer on Nov 9, 2013 at the Liberty Village Metro in Toronto to document his shopping journey within the store. Field notes, video recordings, photos, behavioural mapping, and think-aloud method were used in the research. The participant was looking to buy seven items located in different zones. A map of the store and the behavioural mapping records for the needed items in the different zones are shown in Figures 1 to 9 below.

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Figure 1. Metro Grocery Store.

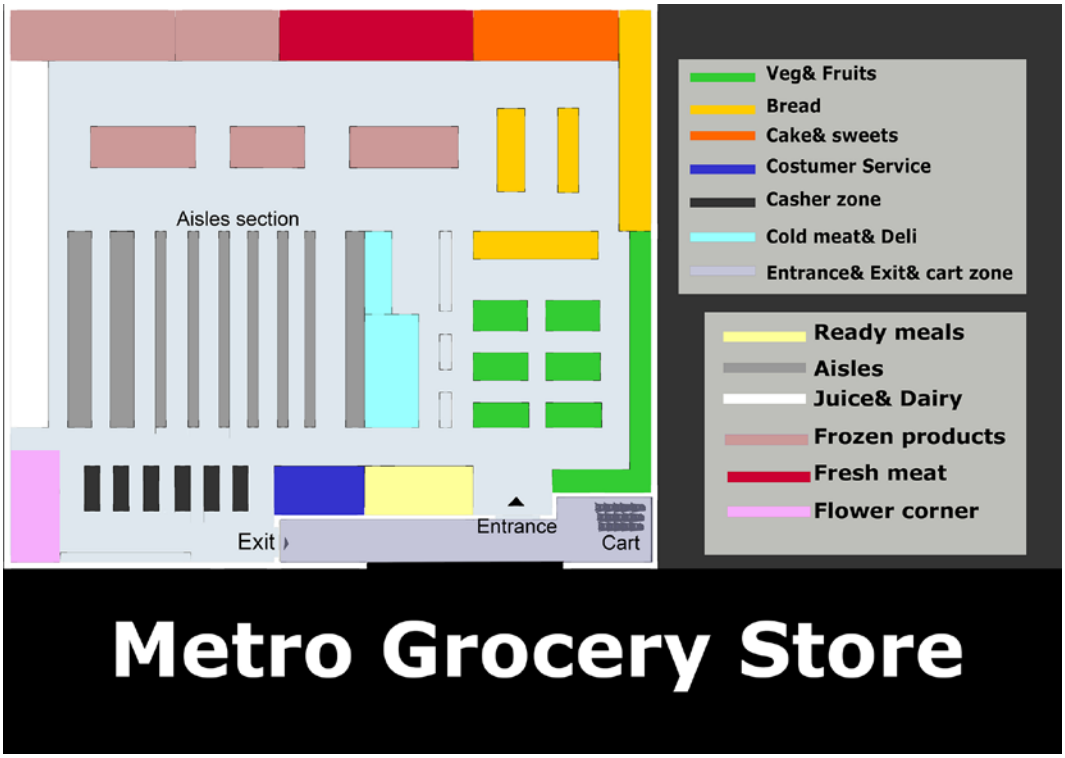

Figure 2. Entrance.

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Figure 3. Wayfinding cues. Veggies and fruits.

Figure 4.Wayfinding cues. Searching the product.

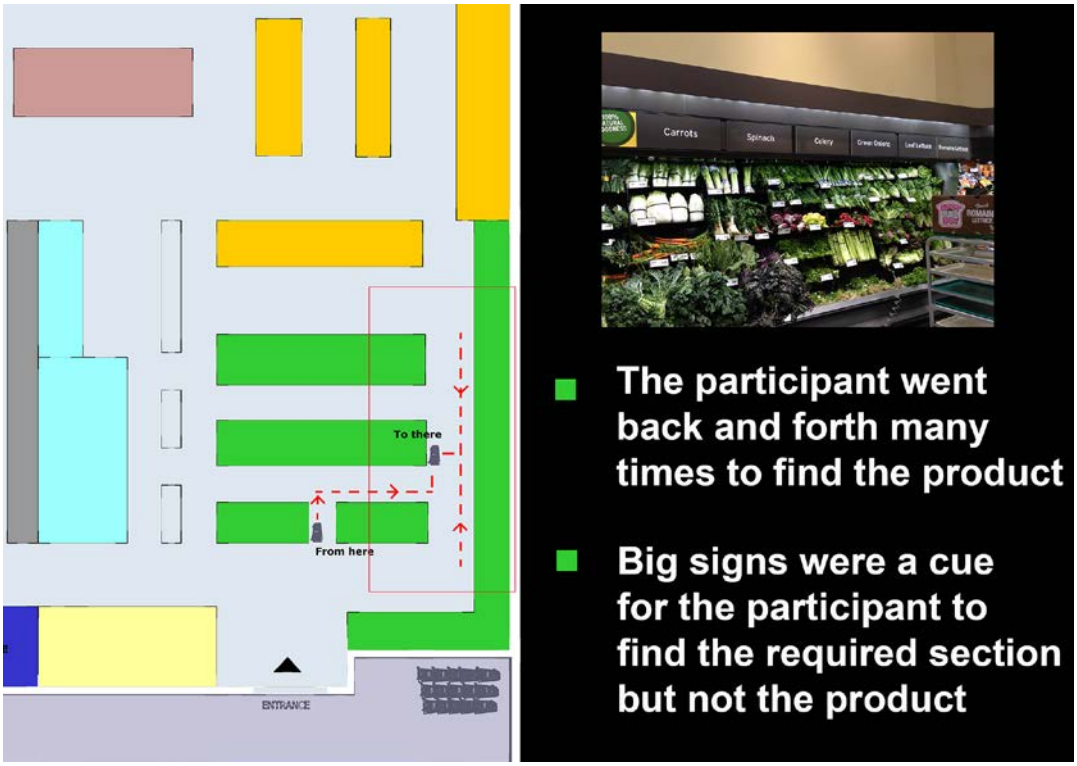

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Figure 5. Wayfinding cues. Freash meat.

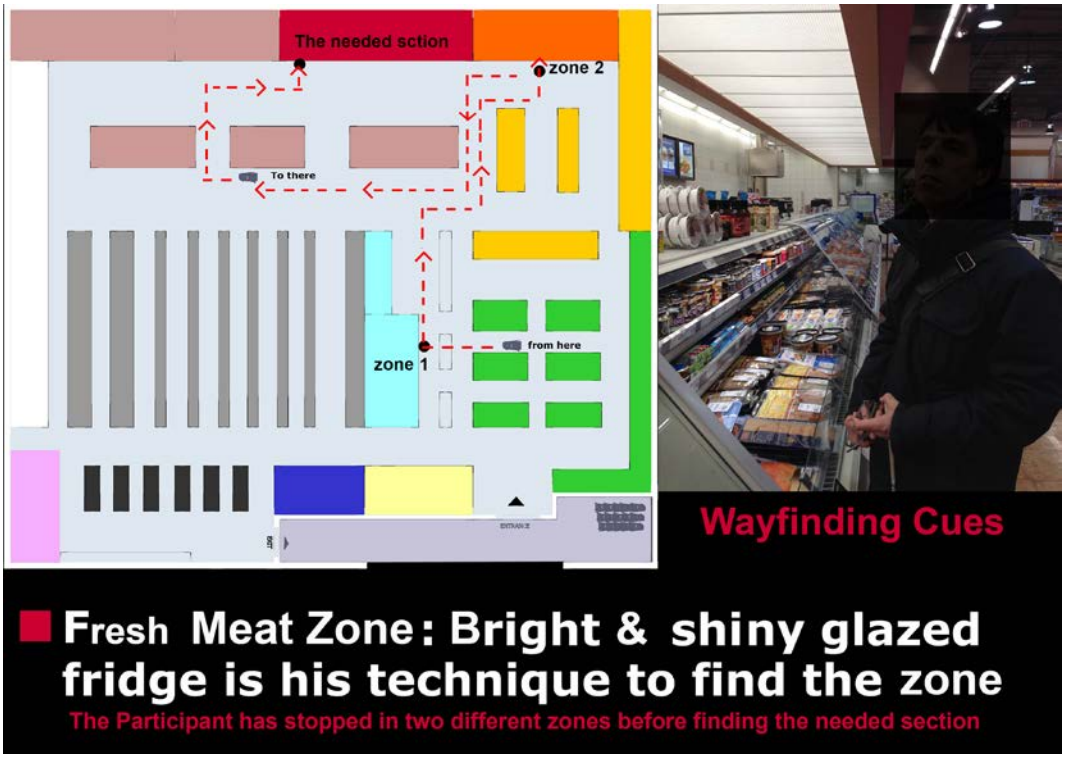

Figure 6. Wayfinding. Veggies and herbs fridges.

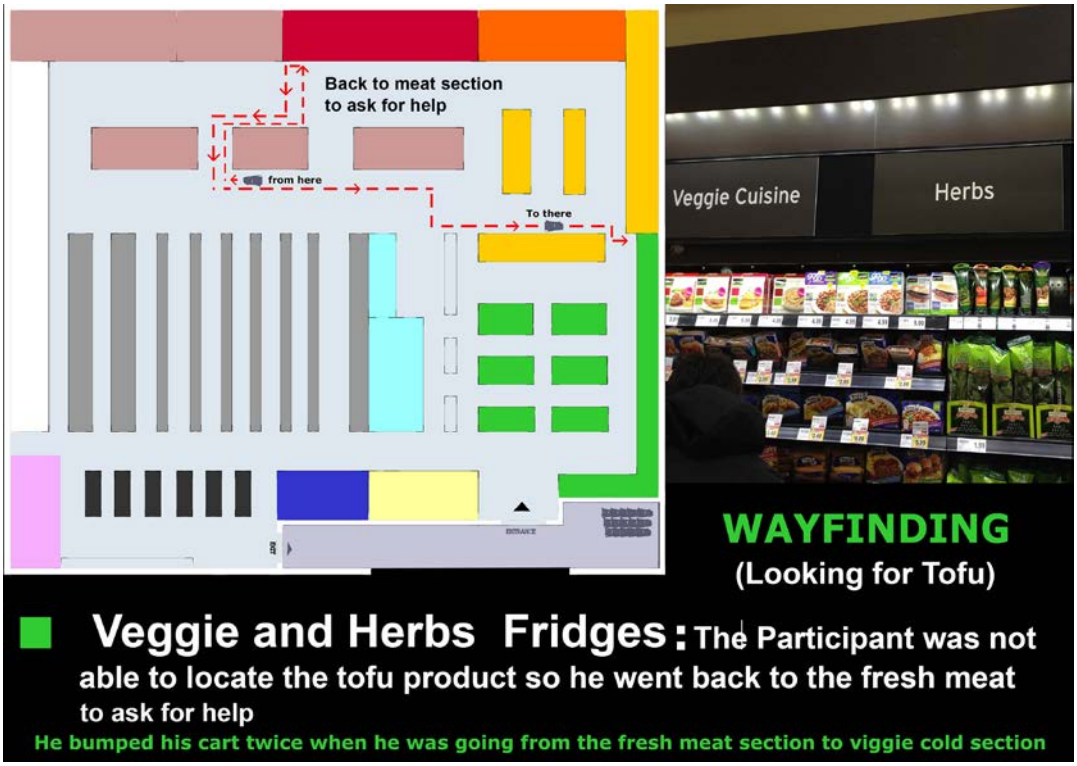

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Figure 7. Aisles.

Figure 8. Wayfinding. Dairy.

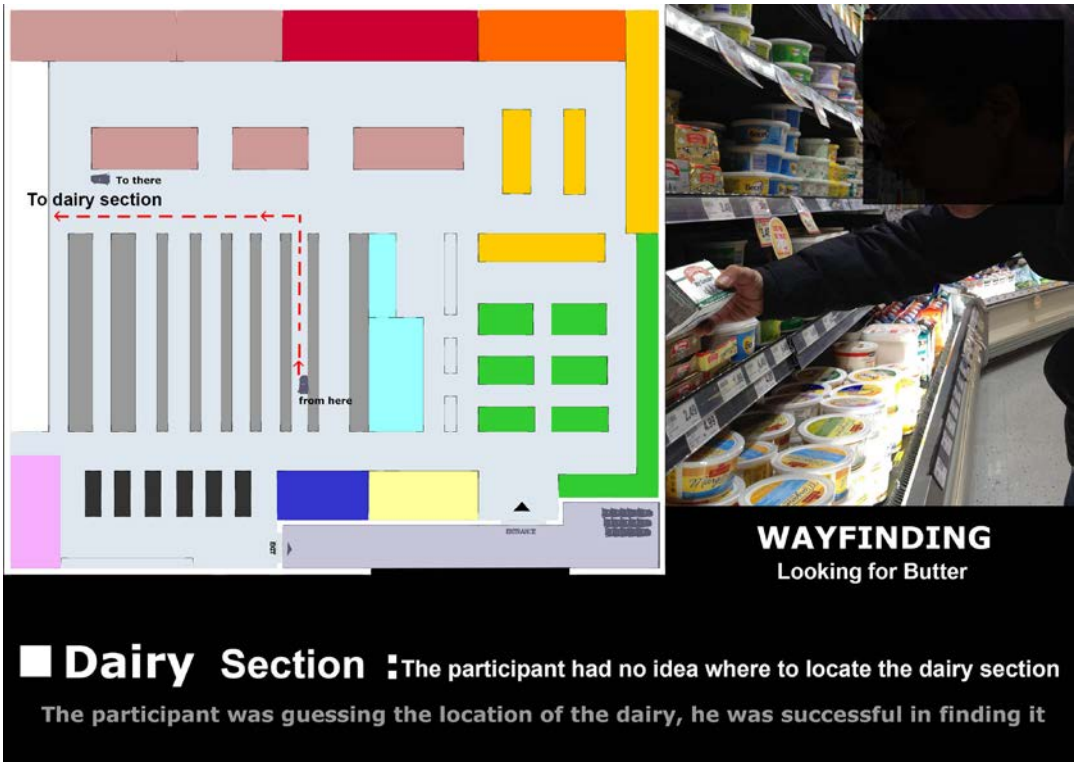

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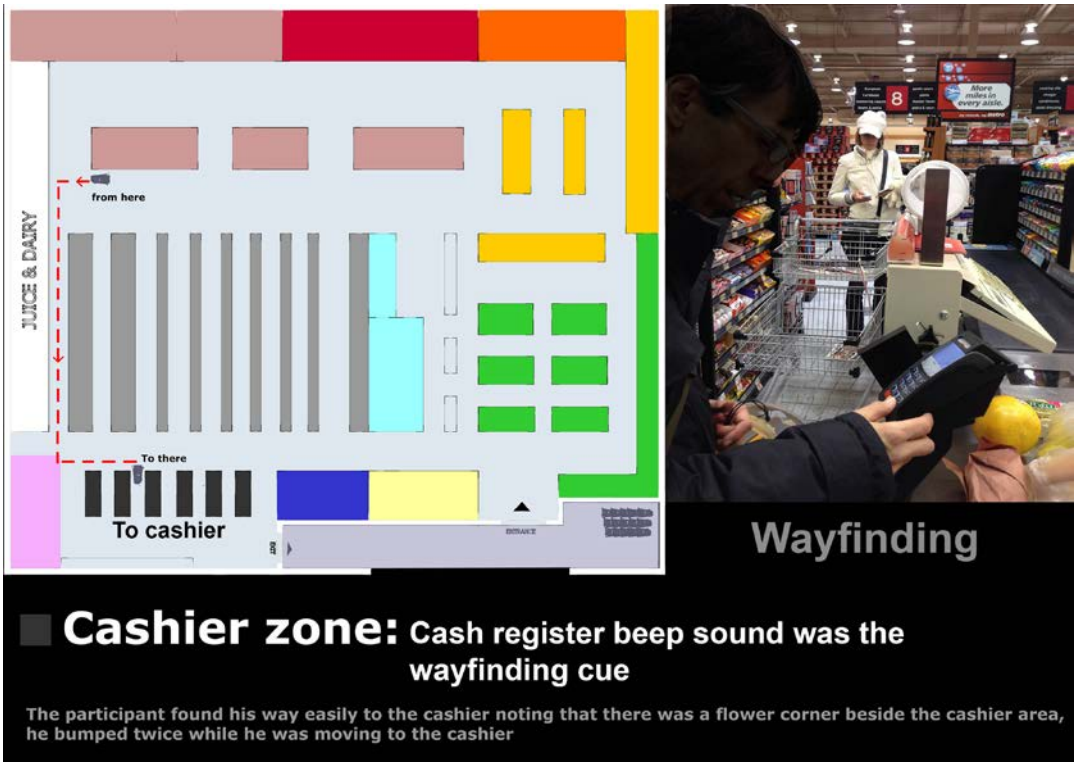
Figure 9. Wayfinding. Cashier zone.



Behavioural Mapping Method

Behavioural mapping is used to document individuals' behaviours, their interactions, and circulation from one space to another. How individuals orient, interact with people and the environment, and the techniques they use to find their way helps researchers understand low vision people's patterns and how they interact with the building environment. Behavioural mapping also allows the study of low vision people's behaviours by culture, age, and gender within the building environment (Hanington & Martin, 2012, pp. 18–19). Through this research, behavioural mapping documented the behaviour of people with vision impairment through the different stages in the shopping journey starting from arrival at the store entrance, the movement through different zones, and then finally the arrival at checkout. We observed their routes of circulation among the different zones, the obstacles, where they stopped their carts, and the time it took them to find their items.

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Findings (Ethnography)

Upon analysing the data, it became obvious that the participant was not familiar with this grocery store, although he was familiar with the retail chain it was a part of. Through behavioural mapping, it was observed that he knew the location of some zones such as the vegetable, dairy, and the aisles, but that he had difficulties locating the meat zone and the cold veggie zone. Three different themes were found through the research and are presented below.

Speculation and verification. For the participant, the shopping journey was a constant cycle of speculation and verification. He had to constantly speculate where something might be or which direction to go, what words were on a sign, or what was in a package. This constant speculation and verification requires great concentration and is mentally exhausting. A sighted user would not need to constantly speculate and verify his location.

'I can see that it's a bright… shiny… something. Okay, I'm going to go closer to verify that I think it's a… counter.' (Participant navigating towards the deli counter.)

During the wayfinding (navigation), the participant depended significantly on his other senses for verification. An improved design would reduce the need for constant speculation and help in locating the different zones as well as the products.

Once the participant arrived at the location, the shelf labels, rather than reducing speculation, continued to contribute to speculation because of the small print and poor labelling practices. Packaging of products is so variable that even sighted users sometimes need to speculate as to the contents of a product. For a low-vision shopper, the problem is even more acute:

'I know this is some kind of relatively plain tofu because it's not over there with all the fancy stuff. But it's not the color of typical tofu, so… what is it? And I'm looking at… Whoa, there's some kind of word there, what… ah," smoked" it says. Right, so that was the hierarchy.'

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Better package and shelf label designs are needed to reduce the amount of speculation and verification necessary. Many design ideas could be developed that would help people find the right shelf and the right product; this can be done by designing a handheld device or designing the environment to be more accessible. The latter is our aim in this research.

Request for assistance and trust. During the shopping trip, there was a constant cycle of asking for assistance and trusting the helper. Our participant carried a white cane, not so much to guide him visually, but so that when asking for assistance people would be more willing and likely to help because of his low vision.

'I'm trying to figure out whether store clerks are paying attention to me… which is why it's useful to have this [white cane].'

'Excuse me, could you tell me where I would find tofu, or things related to tofu?'

In addition, the participant would have to leave his cart unattended to ask people for help.

'People who are comfortable with working with digital information should not underestimate the importance of other people in the environment. I ask people for assistance all the time and they are the most responsive machines of all!'

An improved store design would enable a low-vision user to ask for assistance and allow customer service to help customers through the all the different stages in the shopping journey in an easier way. But how can designers make a wayfinding system to be embedded in the store design without making the low-vision customer wait for human customer service?

Mistakes and apologies. As seen from the behavioural mapping of the store, the path taken by the participant was indirect with extra time needed for backtracking. To find two vegetable items took 15 minutes. The participant bumped his cart seven times during the visit and he was apologetic each time.

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'Turning left is frightful.' [Speaking of driving the cart and going left.]

An improved design would need to minimise mistakes and errors. The cart could be designed with a device that detects obstacles and alerts the driver or automatically brakes. This technology is already available in some car models to help with parking.

We are uncertain as to whether the participant made mistakes with his product choices. He may have arrived home and realised he forgot an item or chose an incorrect item. He mentioned that to minimise error he usually shops in the perimeter of the store and does not venture into the centre aisles if he can help it.

Interviews

Phone interviews were conducted with five participants. The questions were semi-structured, open-ended questions to help the participants speak freely and to reduce any bias through the research. The questions were divided into four themes: the first theme was demographic, designed to find out about the participant's age and shopping habits; the second theme concentrated on the building environment, accessibility, and customer service; the third theme focussed on the packaging and information accessibility; and the last theme dealt with the checking out process. In this paper, we will concentrate on the demographic data and building environment theme. Below are samples of the questions asked during the interviews:

1. When/where do you typically do your grocery shopping? (Speciality store, retail store)
2. How do you go grocery shopping (with a friend? by car, bus?), and did you have hard time shopping alone and finding your product?
3. What do you make sure you have with you when you go shopping (list? magnifier? white cane?)
4. Do you think an iPhone may assist you in reaching the aisles and finding the product you need?

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5. Do you think the building environment is designed to help you find the section you are looking for?
6. What can architects and designers do to reduce the barriers in a grocery store?
7. If you are familiar with a store, can you find the different zones? Can you identify the sections in the aisles?
8. Can you find the product on the shelf? How?

Findings (Interviews)

The participants stated that they go shopping at least once a week, on weekends or on their days off. They do their shopping with their family, a family member, or a friend; if necessary, visually impaired users are able to do their shopping alone if the grocery store is within walking distance. All participants stated that they use their cane because it works for them as an identification tool so staff and customer service can help them in the shopping journey. They use their iPhone or dictaphone for writing their shopping lists.

Building environment barriers. Most participants confirmed that they face great challenges in navigating a store when they visit it for the first time, but if they are used to a store, the environment is less challenging. Finding a product, customer service, and navigating between the aisles is really challenging.

'I cannot navigate the store alone. I am not going to explore the space it is not safe (for new stores). I can reach the different zones, I can access the product if it is unique. Someone has to assist me with the brand name. Random displays are an obstacle.' ***Blind Participant***

'The biggest challenge is to find a product or someone to help. Random displays in the aisles shelves is a great obstacle.' ***Visually impaired participant M***

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'The outside perimeter is more accessible than the centre of the store (aisles). No overhead signage. No audio direction.' ***Accessibility Specialist***

Conclusion & Recommendations by the participants

It is very important that we assist the aging population and people with vision impairment in creating a mental map of the built environment in grocery stores. Such a map will help them in orientation, deciding where to go, and taking action to move from one place to another; the mental map is based on information obtained from the built environment known as orientation cues. The orientation cues include spatial form, layout, signage, lighting, colour, texture, sound, information system, and tactile maps.

The participants had suggested the following solutions in order to come up with design solutions to mitigate those difficulties:

'Standardise the bag location. Use different flooring material. Signage. Put a line in the flooring in the aisles section to help know that we are heading forward and not in a zigzag direction.' ***Blind Participant***

'Standard floor layout. Different floor colours with different materials. Staff training. Remove random displays from the middle of aisles.' ***Visually impaired participant M***

'A good layout design, wider aisles, good lighting. Auditory signs.' ***Visually impaired participant N***

'Contrast in colours. Lighting. Wide aisles to accommodate a guide dog. Auditory signs to alert the person to what is in the aisle.' ***Accessibility Specialist***

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