ITERATING WITH INTENT: A RETROSPECTIVE ON ACCESSIBLE HUMAN CENTRED DESIGN PROCESSES

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ABSTRACT

Disability will affect everyone at some point in their lives. Childbirth, breaking a bone, car accidents, and aging are just a few examples of life events that force a change in daily habit or routine. Whether permanent, temporary, or situational, we will all need products and services that help us adapt to our physical and digital environments. Despite this, accessibility is often brought into the product development process only after ideas have been fully developed, leaving little room for experience innovation that serves the spectrum of end user needs.

To counter this tendency, our team studies the intersection of accessibility, user needs, and innovation to create a concept that matters to end users. The human-centred design process is never a straight line; many rounds of discovery research, design exploration, and concept evaluation go into developing a single idea. To do this, we talked directly with over 75 end users with accessibility needs, designed 8+ concepts for evaluation, and developed a functional PoC for our top conceptual direction. The goal of this paper is to reflect on this complex product design process in the accessibility space, where our team takes a conceptual idea to a PoC by working collaboratively with the visually impaired and deaf/hard of hearing communities. This paper will examine our process, lessons learned, and how to iterate with intent.

The paper will cover:

- How to frame and understand a complex problem
- Review cycles of research and design from conceptual ideas to a proof of concept
- The drafting of an accessibility innovation methodology to assess concepts
- Lessons learned in accessibility research and design

Keywords: Accessibility innovation, disability, inclusive design, process iteration

1 INTRODUCTION

The market for accessible products, services, and solutions is often considered to be niche by the companies and organisations designing consumer products. However, according to the World Health Organisation, 16% of the world's population experience a significant disability that limits their independent function, requiring the need for assistive devices and solutions [1]. Despite these statistics, individuals with accessibility needs are often considered outliers or edge cases by design and research teams, meaning that their needs are rarely thought of in the early stages of product development [2]. This is not only harmful to those specific end-users but also to the companies and organisations missing a potential target audience. In a recent publication, Greg Williams, estimates that companies could increase their target audience by more than 1 billion end-users who have a combined purchasing power over 13 trillion dollars by actively designing for individuals who identify as having a disability [3]. The following case study is an example of how our team brought users with accessibility needs into the product development process with us to create an inclusive and innovative experience. We hope that sharing our successes and failures throughout this process can be useful for other design and engineering professionals, students, or organisations who are aiming to improve product accessibility and inclusivity by providing a real-world example of accessible design in practice.

2 METHODOLOGIES

To guide the development of meaningful and inclusive accessibility solutions, our team employed a multi-stage, human-centred process that leveraged iterative conceptualisation, rigorous user testing, and the development of a strategic framework to guide decision-making. Table 1 outlines our approach.

Table 1. Approach and Development Process Outline

Research Focus	Research Activity
Building a Foundation of Understanding Utilising Discovery Research	Internal Project Audit
	Competitive Analysis
	Industry Expert Interviews
	Online Diary Study
Learning Through Experimentation by Iterative Conceptualisation and Testing	Online Concept Testing (8 Concepts)
	In-Person Concept Testing (8 Concepts)
Evaluate and Prioritise Concepts for Further Development	Accessibility Innovation Framework Development
	In-Person Concept Testing (1 Concept)
Developing a Strategic Focus through PoC Development and Testing	Narrowed Feature Testing and Refinement (2 Concept Features)

2.1 Building a Foundation of Understanding Utilising Discovery Research

To start, we created a strong foundation of understanding around how Lenovo and other companies approach accessibility innovation. We talked with Lenovo teams to learn about their work, assessed what other companies were doing in a competitive analysis, spoke with industry professionals who created accessible solutions at their organisations, and conducted an online diary study with users who identified as having a variety of disability statuses. These activities informed our opportunity area and narrowed our target user to individuals with a visual or hearing impairment. We found an opportunity to explore solutions at the intersection of accessibility, user value, and innovation. We decided to use the Lenovo Yoga Book 9i as a base for conceptualisation for its large screen and customisation potential.

2.2 Learning Through Experimentation by Iterative Conceptualisation and Testing

Our second step was to diverge and converge conceptually in order to cover a broad range of ideas representing a spectrum of accessibility needs and assistive technologies via PC interactions. To do this, we created 8 concepts, represented by low-fidelity mock-ups that simulated the desired experience on the PC but were not fully functional. We conducted in-person user testing with 10 participants who are blind/visually impaired and 10 participants who are deaf/hard of hearing. We also conducted a separate online diary study with 42 participants who are blind/visually impaired and 21 participants who are deaf/hard of hearing. For all 8 concepts, participants were given an overview of the concept, time to interact with the concept (in-person) or watch a video (online) and then provided feedback. Table 2 provides an overview of concepts tested by problems addressed, target user, and user sentiment.

Table 2. Concept Overview

Concept	Problem Addressed	Target User	In-Person Sentiment	Online Sentiment
Concept 1	Contextual Awareness	Deaf/hard of hearing	×	×
Concept 2	Contextual Awareness	Deaf/hard of hearing	✓	✓
Concept 3	Contextual Awareness	Blind/visually impaired	✓	×
Concept 4	Typing	Blind/visually impaired	✓	×
Concept 5	Typing	Both	✓	✓
Concept 6	Typing	Blind/visually impaired	×	×
Concept 7	Navigation	Blind/visually impaired	✓	✓
Concept 8	Navigation	Blind/visually impaired	×	✓

× = Negative Sentiment, ✓ = Positive Sentiment

2.3 Evaluate and Prioritise Concepts for Further Development

To organise and guide the prioritisation process, we developed the *A11y Innovation Framework* (AIF). The AIF is a strategic tool created to align diverse team perspectives as well as complement the feedback we received from user testing outlined in Table 2. Expert reviews with accessibility and technology experts informed our approach. We propose a layered prioritisation based heavily on accessibility user value and strategic fit for Lenovo. Figure 1 illustrates a high-level view of the AIF process. We wanted to supplement the user feedback because we had a smaller number of participants which is typical of most documented user studies with participants with varying ability statuses [4].

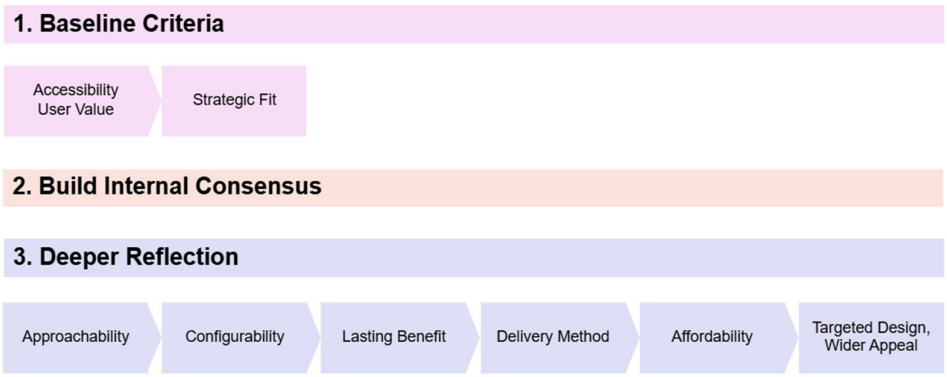

Figure 1. The Accessibility Innovation Framework Steps

After assessing each concept using the AIF, we identified Concept 5 in Table 2 as the top concept. It stood out for its strong potential to enhance user experience, particularly in terms of accessibility, usability, and customisation. Below is a quote from a user who participated in all rounds of in-person concept testing, providing feedback on Concept 5.

"As a visually impaired person, I do a lot of modifications at any given moment to whatever I'm working on whether I'm enlarging the screen or changing the brightness, I like the ability to make modifications in the midst of my workflow instead of having to go into specific, very extensive searches to change accessibility tabs." – Participant with a visual impairment.

2.4 Developing a Strategic Focus through PoC Development and Testing

We refined Concept 5 based on user feedback and alignment on the AIF, focusing on expanding customisation opportunities and minimising steps for the user. After updating the design, we conducted a second round of in-person testing with 13 participants, including 10 users with a visual impairment and 3 with alternate disabilities. The sessions were 90-minutes focusing on ensuring each participant had ample time with the PoC to get in-depth feedback. Additionally, we conducted follow-up sessions with 10 select participants to get more detailed feedback on specific features.

3 PROCESS REFLECTION

Throughout the design and research process, we experienced and overcame many challenges. The following section outlines a few of those challenges.

3.1 Scope Creep

The main challenge at the beginning of the process was narrowing our project scope. Accessibility encompasses many different users with unique needs and a variety of technical solutions. Due to that, finding the right need to solve for can seem overwhelming. This is why we relied heavily on our internal resources such as the Inclusive Product Design Office that ensures all products at Lenovo not only meet but exceed accessibility requirements to meet the needs of our customers and employees. Having mentors and experts in the field of accessibility to support our team proved critical, in accordance with recent research that interviewed UX professionals and found those who had peer support from colleagues with experience in accessibility were more likely to approach accessibility problems themselves [5].

3.2 Recruiting Participants

As we began planning our in-person testing efforts, we quickly realised that recruiting participants with accessibility needs was going to require more time, money, and organisation than expected. After three failed recruiting attempts, we partnered with ablr, a local full-service disability inclusion organisation [6]. By partnering with ablr, we were able to cover numerous sub-topics and learn from a wide array of relevant users. While recruiting and testing for accessibility can seem overwhelming, there are many paths to find participants. The A11y Collective lists several methods such as accessibility specialists, vendors who advertise accessibility pools, and reaching out to local organisations like we did [7].

3.3 Screening Criteria

Refining screening criteria to find the right participants for each study was a unique challenge of balancing breadth and depth. We knew from previous experience that recruiting participants with accessibility needs was difficult, so we could not narrow our screening criteria much further to have a pool of participants to choose from. Because of this, any additional screening criteria was quite broad and focused on PC use. However, in one instance, this resulted in recruiting a participant who was not able to fully use the prototype in testing. To resolve this, we added an additional question to our screener, to ensure the testing experience was productive and pleasant for both the participants and researchers.

3.4 Size of Sessions

Our first in-person testing session was structured with 2-3 participants per session. While participants were grouped based on their ability status, we quickly realised that we needed to have one participant per session. Because everyone's needs are unique, the research moderator needed to balance explaining and demonstrating the prototypes in a way that guarantees each individual participant had a complete understanding of how to use the prototype. This resulted in having to edit the moderator guide live in the session by cutting unnecessary questions at the end due to running over at the beginning.

4 RESULTS

Concept 5 advances PC accessibility by addressing the needs of users with moderate to severe visual impairments. Through highly customisable elements, the concept supports more intuitive interaction with the PC. This approach reflects our broader goal of creating adaptable interfaces that accommodate diverse user abilities and enhance overall digital inclusion. Our team hopes these features not only improve the user experience of PC interactions but allow users with visual impairments access to more technology as devices and form factors evolve. Technological and product innovation has the opportunity to be a huge benefit or obstacle for individuals with accessibility needs as day-to-day life becomes increasingly dependent on technology [8]. If designers and researchers focus development at the intersection of accessibility and innovation, we can create solutions that both meet user needs and progress with new technology trends.

5 KEY TAKEAWAYS

Outside of the development of Concept 5, our team uncovered many insights about designing accessible and innovative technology solutions with the visually impaired that can be applied to broader projects and teams.

Table 3. Project Insights

Broad Theme	Theme Description
Consistency	Processes, interactions, and touchpoints need to be the same in appearance and placement throughout the prototype and ideally across the device, in order for participants with mild to severe vision loss to be able to predict where they will be. This will ultimately result in more confidence for the participant when interacting with the device.
Customisation	Users want the ability to completely make their device their own by having ample opportunities for customisation. Customisation options not only allow for customisation of the device and aesthetic appeal but increase accessibility of the device as well.
Feedback	Participants with a visual impairment often prioritise audio feedback and tactility. Lack of tactility is a major roadblock for new devices and form factors. Making

	sure every physical interaction is complemented by a sound or haptic input will increase the number of users able to interact with the device.
Behaviour	We found that most participants with a visual impairment prefer to operate off of a desktop computer and/or tablets in their daily life, where large screens tend to be maximised and manoeuvrable. Participants need a screen to be 15-17 inches minimum as a starting point for functionality.

Gathering perspectives directly from people with disabilities is paramount for success. Nothing replaces the lived experience of people who use assistive technology every day [6]. Our team hopes other researchers and designers can learn from our successes and failures to improve product accessibility and inclusivity. Below are our top lessons and tips to start incorporating accessibility into research processes early. See Figure 2 for an example of some these tips in practice.

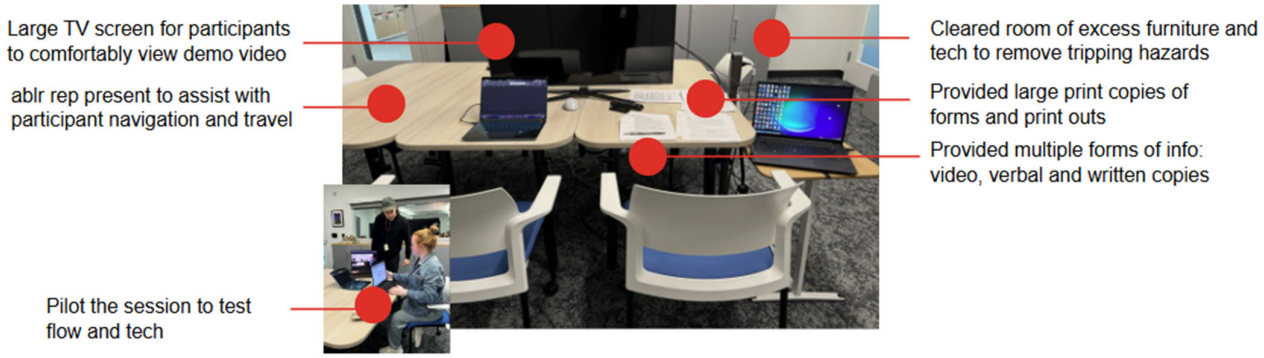

Figure 2. Usability Testing Tips Put into Practice

1. Clear the testing area of excess furniture and tech to remove tripping hazards and prevent distractions.
2. Provide digitally accessible and/or large print copies of any required forms or print outs that participants must complete during testing.
3. Provide information in multiple forms for participants so they can choose the best way to receive the information that accommodates their needs, including but not limited to video, verbal descriptions, and written copies.
4. Have an accessibility rep or specific team member available to assist with participant navigation and travel.
5. Provide detailed descriptions of what to expect upon arrival and during testing well in advance of the testing date.
6. Pilot the session to test session flow and ensure all technology and other required setup works as planned.

In addition to the above lessons learned Systems Concepts, a UX consultancy specialising in usability, accessibility, and ergonomics, emphasises the importance of communicating the intent of the study with participants, sending any forms or materials to participants ahead of time when possible, and allowing for extra time in sessions and between sessions [9].

While we have a long way to go, accessibility and inclusive design is becoming more and more intertwined into companies' and organisations' product development processes. I hope that this case study can guide other professionals to start their own accessibility journey. Please reach out to learn more about my approach to accessible human centred design and research.

6 CONCLUSIONS

The development of Concept 5 from a conceptual idea to a functional PoC exemplifies how our team took a proactive approach to research and design by bringing users with varying disabilities into the process with us. Rather than assessing the accessibility postproduction, we consider it from the initial stages. This allowed us to develop a new concept that is accessible and innovative for users who identify

as having a visual impairment. While our result focused on solving specific needs of those with visual impairments, we discovered the concept has added value for the general population as well.
It is common among reported usability studies with participants who have accessibility needs that the results end up being designed primarily for individuals with visual impairments [10]. For this reason, we will continue to refine Concept 5 by developing an improved PoC followed by another round of in-person testing, extended testing with users in their home, and testing the concept on other devices and form factor combinations which would enable broader use of the concept.
"[Making PC interactions more accessible is] going to open up a whole new world for BVI's and other populations with disabilities who do not have the ability to have that hands on, tactile experience. As the world progresses, we have to keep up with it." – Participant with a visual impairment.

ACKNOWLEDGEMENTS

The impact, scope, and learnings from this work would not be possible without the continued support and guidance from Lenovo's Inclusive Product Design Office, the hard work and dedication of Ellis Anderson and Onyx Mintah who were dedicated teammates over the course of this project, and the knowledge and outreach of ablr, a full-service disability inclusion organisation who has helped us throughout the entirety of this work [6]. I look forward to continued partnership and progress towards smarter technology for all.

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