THE DARK SIDE OF DESIGN:

PROCESSES THAT CAN LEAD TO THE EXCLUSION OF USERS

Inclusion4EU Consortium, 2024

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Inclusion4EU, an Erasmus+ project, investigates Co-Design as a method to make software development processes more inclusive, starting with the education of future Computer Science professionals. It researches co-design methodologies in European universities, develops open-access teaching resources, collaborates with marginalized groups to co-design inclusive software practices, and provides training courses for teachers. The project partners are Technological University Dublin, Mälardalen University, Télécom SudParis, Informatics Europe, and SAP.

Inclusion4EU: Co-Design for Inclusion in Software Development Design
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Introduction

The report illustrates the relationship between software development and inclusive design (which is the design of systems to ensure that they are usable by as wide a range of people as possible), and it consists of four main sections. The first section presents the interview process and outcomes that were undertaken in the Inclusion4EU project, the second section explores three key questions related to exclusion, and the third stage outlines case studies highlighting exclusion experiences. The final section contains a compilation of a series of mitigations to help to reduce exclusion in general.

In the first section, a summary of the eight interviews that took place as part of the Inclusion4EU project is presented. The interviewees consisted of a person with a disability, industry professionals with expert inclusion knowledge, industry professionals with non-expert inclusion knowledge and an assistive technology expert.

In the second section the three main questions explored are:

- What can go wrong when designing software for different end users, the related failures and exclusions (e.g. data omissions or biases, interface issues)? - *Common software design and development flaws*.
- Why does exclusion happen (how do certain groups become marginalized with respect to technology)? - *Reasons for Failures and Exclusions in Software*.
- What are the most common development design flaws that result in the exclusion of specific groups of users? - *Consequences of Failures and Exclusions in Software*.

In the third section, a collection of case studies is presented that highlights some of the ways in which both software systems and organizations can become exclusionary. It also includes some suggestions as to how these challenges can be addressed.

In the final section, a series of mitigations are presented based on research, interviews and case studies presented in this report.

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Section A – RESEARCH IN INCLUSIVE SOFTWARE

1. Introduction to Inclusive Software Research

Software and smart systems are now ubiquitous and increasingly diverse social groups use software platforms for making their lives easier in terms of work, communication, health, entertainment, education and many other activities. Furthermore, the Covid-19 pandemic has accelerated the rate of change in disruptive technologies (which are technologies that significantly alter approaches to the use of technology, such as Affordable Virtual Reality, 5G tech, Advanced Artificial Intelligence, and Smart Assistants). However, for older adults, persons will disabilities, underserved communities, and individuals with low literacy and limited digital skills, the shift to online portals and applications can pose considerable obstacles in their daily interactions with public and private service providers. Digital exclusion can happen to vulnerable citizens in a number of ways: they can be excluded because they do not have adequate access to technology, they are not well informed about technology-based products and services, they do not have the time and skills required to interact with digital products and services, or digital products and services are not designed to cater to their specific needs and requirements. In this report we are focused on the last aspect: poorly designed digital products and services that do not consider the specific requirements of users from excluded categories.

2. Interviews on Inclusive Software Research

A number of interviews took place in this project with the goal of having discussions with people who are experiencing the challenges associated with the development of software systems, and to exploring ways to better facilitate their work to make software that is more accessible and inclusive, but with an appreciation of the specific constraints and challenges that exist for them around issues such as: time, resources, communication, recruitment of diverse users, limited user involvement culture issues, knowledge and change management etc.

Eight interviews were undertaken in this research, and to put the users at the heart of this analysis, the first interviewee was a person with disabilities to help understand their challenges and needs when interacting with software systems. The next set of interviewees were three IT professionals with prior knowledge of accessibility and inclusive design from SAP, the largest European software company in the world in terms of revenue, and to ask these experts for their perspectives in terms of developing more inclusive software, and to understand some of the challenges that they face having their

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current design and development project in mind. The next set of interviewees were three IT professionals without profound prior knowledge of accessibility and inclusive design from SAP, to help explore what they know about inclusive software, and to understand some of their challenges considering their current design and development project. Finally, an Assistive Technology expert was interviewed to explore some of the technical solutions that exist to bridge any potential gap between the users with disabilities and the software systems that they may wish to use.

In terms of analyzing the interviews, three key theoretical lenses were used to reflect on the outcomes of the process, firstly using the troika of People, Process and Practice (Mieczakowski, *et al.*, 2013) to categorize the responses, secondly using existing models and processes of Inclusive Design approaches, to explore which practices are already happening, and what are the challenges present that is preventing others from being possible, and finally looking at the specific barriers that prevent inclusive design, including looking at technical and non-technical challenges.

The themes that emerged from this series of interviews are highlighted in the figure below.

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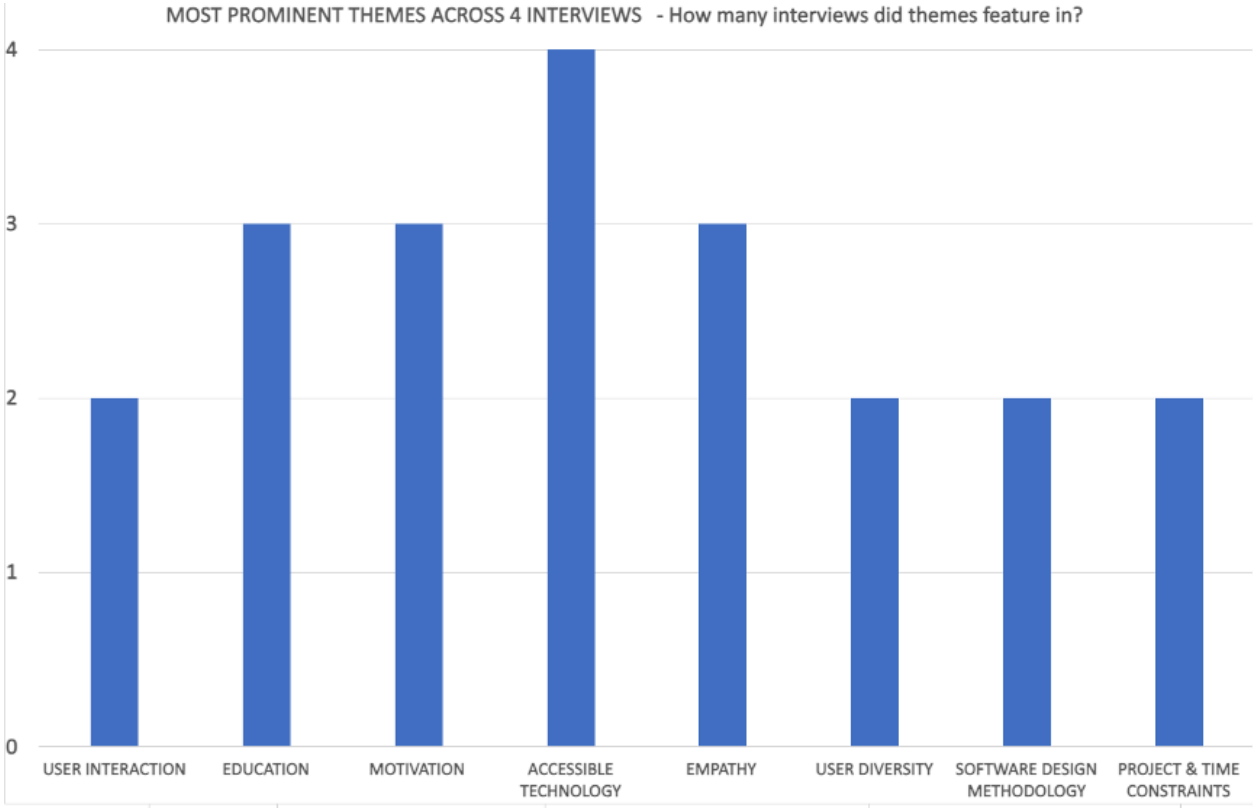

3. Key Questions in Inclusive Software Research

Inclusive design is a process where the needs of people with disabilities are specifically considered in technology products and services. Not only is inclusive design a best practice method and a very ethical approach to take when designing digital products and services, but a range of key market drivers means that designers and developers now simply cannot afford to ignore it. To explore inclusive design in detail, some background research and case studies are presented by exploring the following three key questions:

- What can go wrong when designing software for different end users, the related failures and exclusions (e.g. data omissions or biases, interface issues) - Common software design and development flaws?
- Why does exclusion happen (how do certain groups become marginalized with respect to technology)? - Reasons for Failures and Exclusions in software
- What are the most common development design flaws that result in the exclusion of specific groups of users? - Consequences of Failures and Exclusions in software

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3.1. Software Failures and Flaws

The full question is: *What can go wrong when designing software for different end users, the related failures and exclusions (e.g. data omissions or biases, interface issues) - Common software design and development flaws?*

3.1.1. Relevant Research

To explore this issue, a review of relevant research is presented below, focusing on papers that highlight the importance of diversity in software design teams to avoid system failures or exclusions.

Bennett, *et al.*, (2021) explored this issue from the perspective of how we label and categorize end users. They discuss the challenges associated with potentially excluding users when labelling (and mislabeling) them based on their race, gender, and disability. So, for example, in the context of making content accessible, images are typically augmented with an associated textual description, but the guidelines that exist for creating these descriptions lack specific guidance on how to write about people's appearance. Therefore, this paper includes interviews with computer users who use screen reading software, and who are also Indigenous, People of Color, Non-binary, and/or Transgender. The interviews discuss their current image description practices and preferences and experiences negotiating their and others' appearances in a non-visual context. The key finding of the interviews is that labeling and categorization of end users is a challenging activity, and different users will use different terms to describe the same category (depending on their activist stance), and to further complicate things, the same individual will use different terms to describe the same category (depending on the context, and the person that they are speaking to); thus, the key recommendation of the research is to try to create software that does not exclude people, and try to develop it in such a way that it provides the users with flexibility in terms of the ways in which they (and their avatars) can be labelled.

Eisma, *et al.* (2004) explore the importance of involving diverse users as soon as possible in the development process, and their focus, in particular, is looking at people aged 60 and over. In their research they develop a series of tools to assist in the development of technology products for older people, who may also have a range of disabilities. To achieve this, they contacted a number of organizations to recruit their participant groups (including community organisations, social clubs, day centres and charity organisations). They elicited information from the participants using a variety of techniques (depending on the individual's motivations, abilities and knowledge) including questionnaires, interviews and focus groups. This process uncovered some key lessons: (1) Technology use declines with age (in general), but better-designed

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technology reduces the rate of decline, (2) If there are clear benefits to using the technology, it is more likely to be used consistently, (3) Terminology used to describe the technology (and the development process) needs to be clear, and (4) Participants need to be encouraged to communicate with each other and the technology providers. The researchers also note that a vital aspect of their methodology is to build a diverse user base by forming long-lasting partnerships with older people who have different perspectives on technologies.

Rodríguez-Pérez, Nadri and Nagappan (2021) undertook a systematic literature review of perceived diversity in software engineering. In this case, perceived diversity is defined as the diversity factors that individuals are born with. According to this research, perceived diversity is becoming increasingly recognized as an essential consideration in the success of software development processes, and a growing number of organisations are increasing their efforts to create more diverse work teams. To explore the true impact of diverse teams, the researchers used a systematic literature review to identify (1) What issues have been studied and what results have been reported; (2) What methods, tools, models, and processes have been proposed to help perceived diversity issues; and (3) What limitations have been reported when studying perceived diversity in Software Engineering. Their research highlighted that there is a significant body of literature showing that gender diversity in software teams has a range of significant benefits for the team and the software that they develop, but diversity in terms of race, age, and disability needs to be further analyzed.

Stary (2001) explored the importance of user diversity and design representation in the context of the “Design for All” approach. The goal of the “Design for All” approach is to develop technologies that can easily interact with a variety of users and user groups, and these researchers suggest that a lack of appropriate commercially available “Design for All” techniques and tools prevents designers from developing more universal interfaces in a straightforward way. They developed a symbolic design representation scheme to support modelling of functional roles and individual characteristics, which is designed to avoid UX failures in software systems. The researchers feel that this approach has helped develop highly adaptive software – as required for multi-modality, context-sensitivity, and dynamics of situations and contents.

3.1.2. Key Findings

Inclusive design considers different ages, genders, languages, skills, and cultures during the software design process. An inclusive design revolves around diversity and encompasses different perspectives of people, in order to meet diverse user experiences. An accessible design can highlight that a product or service is made for a

specific need and can open up the product or service experience to all. Although it is not always the case, accessible design can be a part of inclusive design. Accessibility and diversity ensure the usability of products and services by a wider set of end users. Designing products that can be used by people with a wide range of abilities and disabilities is called "inclusive design." In contrast, many software producers focus on the characteristics of the "average" user.

The findings from the eight interviews are summarized below.

INTERVIEW 1 -Student with disability

In terms of general failures and flaws in software and hardware, this interviewee highlighted the following areas:

- **ASSISTIVE SOFTWARE**: This interviewee described how he and some of the lecturing and technical team spent an entire semester exploring accessible technology alternatives as the software required for one of the student's taught modules (Android Studio), was not compatible with his screenreader (NVDA).
- **OPERATING SYSTEM CONFIGURATION**: An issue occurred with an assessment that was taking place on a particular lab machine. While the learning material was accessible the lab machines did not have appropriate assistive technology installed.
- **WEBSITE DESIGN**: In terms of general failures and flaws in software and online content this interviewee highlighted the lack of consideration of accessibility requirements for end users particularly as a screen reader user.

INTERVIEWS 2-4: Three IT professionals with prior knowledge of accessibility and inclusive design-from SAP

In terms of general failures and flaws in software and hardware, this interview group highlighted the following areas considering their current design and development project:

- **LACK OF USER DIVERSITY REPRESENTATION:** During the testing phase, this team focused on visually impaired users. This can lead to a limited inclusion of other design needs.
- **LACK OF DIVERSITY WITHIN THE TEAM:** The inclusion of a neurodiverse team member brought awareness to their co-workers on specific accessibility needs this employee has when accessing applications.
- **ACCESSIBILITY X INCLUSION:** There is a major focus on making the products accessible, meaning that more people should be able to interact with the content. However, participants identified a limitation on making the products inclusive since aspects such as different cultural backgrounds or a

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wider variety of disabilities, e.g., neurodiversity weren't considered in this specific research project.

INTERVIEWS 5-7: Three IT professionals without profound prior knowledge of accessibility and inclusive design from SAP

In terms of general failures and flaws in software and hardware, this interview group highlighted the following areas considering their current design and development project:

- L**ACK OF USER INTERACTION THROUGH THE LIFECYCLE:** As this team only had limited interaction with users **throughout** the development process, the final product may not be catering for the desired users.
- **LACK OF USER DIVERSITY REPRESENTATION:** The products/apps can be designed for a narrow user base as users were selected according to their availability rather than their abilities.
- **ASSUMPTIONS & STEREOTYPES:** As developers do not have interactions with the users, stereotypes and assumptions evolve. A central team deals with reviewing accessibility and issues are forwarded on to the development teams. Developers form pre-conceived ideas on who the user is and is not.
- **INSUFFICIENT USER RESEARCH & TESTING**: User research and testing is not always carried out with the end-–user. This depends on whether there is suitable user available at the time.

INTERVIEW 8: Assistive Technology Facilitator

In terms of general failures and flaws in software and hardware, this interviewee highlighted the following areas:

- **TECHNOLOGY NEEDS**: Designers and developers need to understand that there are issues beyond individual disabilities, there are technology needs that need to be addressed, including access to Wi-Fi, access to the latest software and hardware, and access to support and maintenance.
- **LACK OF CLARITY**: The interviewee noted that a key reason that software systems fail to live up to the necessary accessibility and inclusion standards is because of a lack of clarity about the exact nature of those standards.
- **ROLE MANAGEMENT**: The interviewee noted that when roles and responsibilities are not defined at the start of the project and different needs conflict with the requirements, this will make it harder to manage expectations.
- **LANGUAGE CHALLENGES**: The interviewee noted that people with disabilities may experience literacy challenges in the sense that other people may use

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jargon (both technical and otherwise), and this can create a barrier when some groups rely on plain language.

- **ACCESSIBILITY STANDARDS**: When designers and developers fail to adopt basic accessibility requirements (alt text, colour contrast, font, layout, animations, and navigation), they exclude a range of users. They need to ensure that the needs of diverse users are addressed by ensuring that a range of people are involved in the design process who understand accessibility.

Designing software for the 'average user can result in a range of exclusions, and design flaws, as outlined in Table 1 below:

Cause of Exclusion	Design Flaw
Lack of User Diversity Representation	Design for a narrow user base
Assumptions and Stereotypes	Assuming uniformity in behavior or preferences among users.
Insufficient User Research and Testing	Failing to involve a diverse group of users in the testing phase
Language and Cultural Sensitivity	Inadequate consideration of diverse linguistic and cultural aspects such as different languages, idioms, symbols or cultural norms in the design
Accessibility Challenges	Neglecting accessibility standards, a lack of accessibility features or failing to provide options for customization.
User Interfaces	Complex, unintuitive or confusing interface design
Lack of consideration of end-user devices	Non-Responsive Design, Limited Device Compatibility
Overly complex software design	Cognitive Overload
Lack of consideration of privacy and Security aspect	Neglecting to prioritize privacy and security features
Unconscious Bias in Algorithmic Decision-Making	Not ensuring high-quality training data
Inadequate Consideration of Socioeconomic Factors	Not considering the socioeconomic diversity of end-users
Lack of User Interaction	Users have limited involvement in the design process outside of research and testing.

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Technology Needs	Designers and developers need to understand there are issues beyond individual disabilities - technology needs.
Language Challenges	People with disabilities may experience literacy challenges.

Table 1: Design Flaws based on Van Maele (2023)

To mitigate these issues, it's crucial to conduct thorough user research, involve diverse stakeholders, test the software extensively with a broad user base, adhere to accessibility guidelines, and continually iterate the design based on feedback. Additionally, raising awareness about biases and fostering a culture of inclusivity within the organization (including research teams, design teams, engineering teams, support teams, etc.) and this is essential to create software that caters to the diverse needs of all end users.

3.2. Reasons for Exclusion

The full question is: *Why does exclusion happen (how do certain groups become marginalized with respect to technology)? - Reasons for Failures and Exclusions in software*

3.2.1. Relevant Research

To explore this issue, a review of relevant research is presented below, focusing on papers that highlight the importance of including users at the design stage of a development process.

Clarkson, Waller and Cardoso (2015) discuss the reasons for technology exclusion for people with disabilities, and they suggest that reasons for it include: poorly designed interfaces that are not usable, a lack of credible competition, and a lack of information (and promotion) of more accessible alternatives. The researchers undertook a range of approaches to assess the degree of exclusion of different technologies, including qualitative observation of individuals and groups undertaking specific tasks. They found

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that exclusion does not occur as a single point on a continuum, but it is rather a progression with regard to a user population, which can be approximately divided into three-thirds, one-third of the people finding technologies relatively easy to use, one-third experiencing some degree of frustration, and one-third experiencing significant difficulties or full exclusion. They recommend including excluded users at all stages of the design process.

Coleman, *et al*. (2010) discuss the design of software systems, and also discuss the reasons why some technologies tend to exclude older adults They highlight that the most commonly stated reason for older adults' non-adoption of digital technologies is "*a lack of interest, rather than affordability or difficulty*". The research highlights that older adults need to be part of the design process for technology, but to do that it is important to explore some of the reasons why they are deterred from using technology (the key "pain points") and identify potential solutions to these issues. Some key suggestions include the following: highlighting the specific benefits of using technology, understanding that they are already using a lot of complex technology (e.g. Digital TVs), and making sure that they listen to their family members and friends who encourage their use of technology, and combining their existing hobbies with technology. Finally, the researchers argue that it is essential that these users are involved in the very early stages of design activity, before solutions have been explored or proposed through traditional user-centered design approaches.

Matthiesen, Bjørn and Trillingsgaard (2023) discuss how implicit bias about different cultures can negatively impact the success of software projects. Their research indicates that there may be a problematic tendency to implicitly assume that peoples' character, proficiency, and behavior are on the basis of ethnicity and national cultural heritage and this risks essential aspects of work being rendered invisible through racialized stereotypical narratives. They suggest that this implicit bias may be a result of models of cultural differences categorized by different cultural dimensions, such as hierarchical power structures and inequality (power distance). However, when "culture," is used as an explanatory fact, it risks closing down any further evaluations and reflections on how to organize work and deal with the issues met, therefore, these models need to be a first step, and from there to consider models of social psychology, such as implicit bias as an analytical instrument, as a pathway that can identify, discuss, and move beyond the use of binary interpretations of what nationalities do, by doing novel empirical research to move towards more concrete, structural, and practice-oriented issues.

Czaja and Urbaniec (2019) take a different perspective on this topic and look at exclusion from the perspective of the users and why they don't engage with technology.

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To do this, they look at the reasons for digital exclusion in European countries and highlight the changing nature of the labour market in Europe, as well as globally, as a key issue. They note that the changing labour market may be increasing the number of people who are excluded. Some of the reasons why people are excluded include:

- Users can't afford to access technology at home
- Lack of access to technology at work or Public Access Points
- The cost of Internet connections
- The complexity of the technology and lack of skills
- Lack of awareness
- Lack of time
- Language barriers
- Unavailability of readily useful content.
-

Thus, exclusion is not just an issue for technology companies, but instead a society-wide issue that needs to be addressed with training and funding for those who are being excluded.

3.2.2. Key Findings

In 2022, more than one-fifth (21.1%) of the EU population was aged 65 and over. An estimated 135 million people in Europe live with a disability. With population ageing and the rising prevalence of chronic health conditions due to non-communicable diseases and injuries, this number is set to increase. Already, a quarter of the EU working population already reports having a chronic disease[1]. Workplace adaptation including technology adaption is fundamental to ensure that workers with limiting chronic disease are engaged in quality and sustainable work.

The European Union has recognized the importance of inclusion and accessibility in the digital domain and is in the process of implementing a digital strategy via projects such as the Digital Inclusion Strategy (which is also associated with the European Disability Strategy) and through legislation such as the EU Web Accessibility Directive of 2016 and the European Accessibility Directive of 2019. What is more, the EU Commission has recently proposed the adoption of a European Declaration on Digital Rights and Principles as part of the EU Digital Decade strategy. For example, the Digital Markets Act aims to ensure fair and open digital markets and the Digital Services

[1] https://www.eurofound.europa.eu/news/news-articles/just-one-in-three-workers-with-limiting-chronic-disease-in-adapted-workplace

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Act, whose goal is to better protect consumers and their fundamental rights online, establishes transparency and accountability for online platforms.

Finally, the EU vision for digital transformation (the European Declaration on Digital Rights and Principles for the Digital Decade, January 2022) puts people at the centre, empowers individuals and fosters innovative business. This vision encompasses digital sovereignty, inclusion, equality, sustainability, improving quality of life, and respect for people's rights and aspirations.

The findings from the eight interviews are summarized below.

INTERVIEW 1: Student with disability

In terms of reasons for exclusions, this interviewee highlighted the following areas:

- **ACCESSIBILITY TRAINING**: SP1 expressed that he feels accessibility is seen as an optional feature but when it is mandatory both students and professionals take it more seriously. He believes that accessibility should be a mandatory part of academic programmes and that this could be achieved by giving students marks for inclusive/accessible design across various modules.
- **ACCESSIBILITY MYTHS**: He also highlighted certain myths or misconceptions that can exist around accessibility. People can assume that doing something accessible is hard when sometimes it takes seconds and it is not difficult.

INTERVIEWS 2-4: Three IT professionals with prior knowledge of accessibility and inclusive design from SAP

In terms of reasons for exclusions, this interview group highlighted the following areas having their current design and development project in mind:

- **TIME CONSTRAINT:** Due to the limited amount of time for designing and testing, the process mainly focused on visually impaired users and their challenges in accessing the applications.
- **STEREOTYPING:** The design process focuses on making the products accessible. This includes measurable inputs, such as when the designer tests the impact of the font size or the colour contrast. When it comes to including people from different cultures or a wider range of people with disabilities e.g., neurodiverse users, and if the designers are not exposed to these users' needs and preferences, the products tend to be developed based on assumptions that do not reflect the reality and are stereotypes.
- **LACK OF SUITABLE GUIDELINES FOR NEURO-DIVERSE:** Guidelines are difficult to create for people who are neuro-diverse. Current applications are

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lacking or this user group. One interviewee stated that it is a goal in the future to do more research on these users.

INTERVIEWS 5-7: Three IT professionals without profound prior knowledge of accessibility and inclusive design from SAP

In terms of reasons for exclusions, this interview group highlighted the following areas considering their current design and development project:

- **STEREOTYPING:** Stereotyping involves making assumptions about individuals based on their membership in a particular group. These stereotypes can blind individuals to the unique experiences and challenges faced by others, making it difficult to recognize exclusion. When not exposed to users or without education in the area, developers can have incorrect assumptions on who their user is.
- **EMPATHY GAP:** An empathy gap occurs when individuals find it challenging to understand or relate to experiences and challenges faced by others, especially if they belong to different demographics. This gap can hinder the recognition of exclusionary experiences. The interviewees suggested that they would like to have more interaction with users to have more empathy with the user's experience.
- **TIME CONSTRAINTS:** Employees are under pressure to get their own targets. The time required for adequate inclusion processes is very difficult to come by. Significant time is also required for education and training. Unless this is incentivised, incorporation of inclusion process will be limited.

INTERVIEW 8: Assistive Technology Facilitator

In terms of reasons for exclusions, this interviewee highlighted the following areas:

- **INCENTIVISATION**: Organizations need to award and reward the inclusion of diverse testing groups, especially the upskilling of people with lived experience to become accessibility experts and strong self-advocates.
- **LEADERSHIP**: The interviewee noted that when there is little or no support from the team leader of a diverse group it can lead to failure in communications and logistics, as well as language challenges and unrealistic expectations.
- **POLICY CHALLENGES**: The interviewee noted that policies can sometimes result in hindering marginalized groups due to them being either paternalistic or risk-averse in their model of care.
- **EQUITY**: The interviewee noted that all the co-designers must be partners. Until participants in co-design believe and live the value of equality, it's hard to understand empathy or interpret the problem.

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Failure to identify exclusion is usually caused by one of the biases outlined in Table 2 below.

Bias	Explanation	Possible examples from software design
Confirmation Bias	This bias involves favoring information that confirms our existing beliefs or values. In the context of exclusion, if individuals have preconceived notions that a particular group is not excluded, they may disregard evidence or experiences that suggest otherwise.	The software designers hold a strong belief that users primarily want advanced features. They conduct user surveys and interviews with a specific target audience that aligns with this belief. During the user research phase, participants are primarily asked questions that reinforce the assumption that advanced features are crucial. Questions are framed to elicit responses that validate the designers' beliefs. Ultimately the software development process heavily emphasizes and prioritizes advanced features and the software might lack simpler or introductory features that cater to a broader audience.
In-Group Bias	In-group bias occurs when we favor those belonging to our social, cultural, or professional group over those from outside that group. This bias can prevent individuals from recognizing the exclusion faced by individuals from different or marginalized groups.	The design team, influenced by their preferences and habits, decides to prioritize features and design elements that cater to the tech-savvy, young, and socially active demographic—their in-group. The software may end up with features that might not be intuitive or appealing to older users, individuals less familiar with technology, or those who have different social networking preferences. The interface might assume a certain level of tech proficiency and use language, icons, or functionalities that align with the design team's preferences but alienate a broader, more diverse user base.
Availability Heuristic	This bias involves relying on readily available information or examples that come to mind easily. If instances of exclusion are not prominent or well-known	The design team, influenced by their familiarity with blindness, focuses primarily on developing features and functionalities catering to individuals who are blind, such as screen reader compatibility and high contrast interfaces.

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	within a specific environment, individuals may underestimate the prevalence of exclusion.	As a result, the application may lack adequate features catering to individuals with other impairments. Users with these specific needs might find the app less inclusive and less usable, leading to their exclusion.
Stereotyping	Stereotyping involves making assumptions about individuals based on their membership in a particular group. These stereotypes can blind individuals to the unique experiences and challenges faced by others, making it difficult to recognize exclusion.	The design team is developing software for older adults and holds a stereotype that older adults are not tech-savvy and prefer simpler, less feature-rich interfaces. Based on this assumption the design team decided to create an overly simplified, minimalistic interface assuming it would cater to the perceived preferences of older adults. As a result, the app may lack advanced features and customization options that could be useful for some older adults who are tech-savvy or prefer a more comprehensive experience.
Normalcy Bias	This bias leads individuals to underestimate the likelihood of a negative event occurring, assuming that things will function as they normally have. In the context of exclusion, assuming that exclusion is uncommon or isolated can prevent individuals from recognizing its presence.	The design team assumes that older adults have consistent, unchanging needs and preferences. This can result in overlooking the potential for a diverse range of tech-savviness, interests, and capacities within the older adult population.
Status Quo Bias	Status quo bias refers to a preference for the current state of affairs, even if it may not be equitable or inclusive. Individuals may fail to identify exclusionary practices because they	Suppose a design team is working on an accessibility feature for a piece of software. The current version has basic accessibility features, such as screen reader compatibility and keyboard navigation. The design team is hesitant to invest time and resources in enhancing the accessibility features further, believing that the existing features are

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	are accustomed to the current way of doing things.	sufficient and that major changes may disrupt the current user base or development workflow. As a result, the software's accessibility features remain basic and fail to address the diverse needs of users with disabilities. This exclusion affects individuals who could benefit from more advanced features like voice recognition, improved screen reading, or better integration with assistive technologies.
Anchoring Bias	Anchoring bias occurs when individuals rely too heavily on the first piece of information encountered when making decisions. If the initial information does not suggest or highlight exclusion, subsequent assessments may also overlook it.	The design team becomes anchored to this initial color scheme and layout, without considering if it is the most inclusive choice for all users, including those with visual impairments or color blindness. The fixation on the initial design choice has inadvertently excluded a group of potential users.
Empathy Gap	An empathy gap occurs when individuals find it challenging to understand or relate to experiences and challenges faced by others, especially if they belong to different demographics. This gap can hinder the recognition of exclusionary experiences.	Suppose a design team is creating a navigation app to help users find nearby facilities. The team, without direct input from wheelchair users or a solid understanding of their needs, might overlook crucial features like accessibility information for venues. The design team, lacking direct experience or understanding of wheelchair users' challenges, may fail to consider essential features such as accessible entrance details, interior layout, and availability of ramps or elevators. As a result, the navigation app may lack critical accessibility information, making it challenging for wheelchair users to plan their visits and potentially excluding them from accessing and enjoying various venues.

Table 2: Exclusion Biases

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Awareness of these biases is crucial to foster a more inclusive and equitable software design and development environment. Addressing biases and promoting unbiased perspectives can aid in identifying and mitigating exclusion effectively.

Other reasons for exclusions were highlighted throughout the interview process and are detailed in the Table 3 below.

Other Reasons for Exclusion	Explanation
Lack of knowledge due to lack of training	All interviewees cited or discussed training as one of the most important aspects of an inclusive organization.
Time Constraints	Both groups from SAP stated that whilst they would like to have much more interactions with users, time and project pressures are the bigger inhibitors.
Accessibility Myths	There are misconceptions that it is very difficult to incorporate accessibility in software development. In many cases, this is untrue.
Lack of Suitable Guidelines	According to the SAP interview groups, there are comprehensive guidelines and tools available for some user groups. However, there are other groups e.g., neurodiverse, that there is less understanding of and tools available to developers and designers.
Culture/Leadership	When there is little or no support from the team leader of a diverse group it can lead to failure in communications and logistics, as well as language challenges and unrealistic expectations.
Incentivization	Motivation was a strong theme in the interview process. The question on why a designer or developer will buy into inclusive development. Organizations need to reward or incentivize employees.
Policy Changes	Policies can sometimes result in hindering marginalized groups due to them being either paternalistic or risk-averse in their model of care.

Table 3: Other reasons for exclusion

3.3. Consequences of Exclusion

The full question is: *What are the most common development design flaws that result in the exclusion of specific groups of users? - Consequences of Failures and Exclusions in Software*

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3.3.1. Relevant Research

To explore this issue, a review of relevant research is presented below, focusing on papers that highlight the importance of embracing diversity to avoid design flaws.

Alshammari, *et al*. (2020) present the development of a Health Information System for people with Mild Intellectual and Developmental Disability, and document some of the barriers that their users experience. The researchers used focus groups of men with mild intellectual and developmental disabilities aged between 18 and 35 years. The key barriers that they identified that were causing exclusion for them were:

- A lack of training available on the use of IT systems
- The IT systems use terminology that is unfamiliar
- The IT interface is confusing
- The IT systems aren't flexible enough to accommodate a range of disabilities
- There are no good alternatives on the market

Overall, the researchers highlight the importance of stakeholder involvement in all stages of the development of information systems.

Newman, *et al*. (2017) investigated the reasons for digital exclusion, using a critical theory model from social science called Bourdieuian analysis. The specific target group of their analysis was looking at online social networking among young people with disabilities. Using a case study approach with 18 participants, with 12 boys and 6 girls aged 10–18 years. The key barriers that they identified were:

- Inability to use the technology
- Inability to understand the instructions
- Lack of online helplines and technical support
- Attitudes to technology
- Have sufficient technical support
- Lack of financial support from the government

The researchers conclude that it is important to remember that there are inequalities in IT use within groups with different disabilities and of different ages, and there is a need for specific resources to help increase digital inclusion for young people with disabilities.

Mieczakowski, Hessey and Clarkson (2013) investigated the nature of inclusive design, and how to demonstrate its value to decision-makers in organisations. They point out that historically the failure to create inclusive products has been seen as the fault of the product designers, but it is now more frequently recognized that these failures are not (solely) their fault, and it is not necessarily their lack of knowledge, awareness, or

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willingness. Instead, there are complex and multi-faceted organisational factors at play that seldom provide an adequate environment in which inclusive products can be designed. To address these challenges, the authors of this paper suggest the following steps:

1. Include diverse users in the design process, and allow them to participate in design decisions.
2. Create accessibility champions at all levels of the organization, particularly at management levels.
3. Ensure that there are processes in place to adequately support all aspects of the design process.
4. Create evolving business practices that encourage ongoing training and skills development.
5. Develop sophisticated models of profitability that take into account the long-term benefits of creating more inclusive products and services.

The researchers highlight that when technology products are designed to embrace the needs and capabilities of heterogeneous users it leads to increased customer satisfaction and enhanced corporate social responsibility, as well as better market penetration.

Croft and Fraser (2022) found that the COVID-19 pandemic acted as a magnifying lens in identifying the barriers to technological participation for people with a disability (PWD). They did a structured literature review using the search terms “disability” and “COVID-19” in four research databases: CINAHL, Medline (Ovid), EMBASE and Web of Science. The search identified 465 peer-reviewed articles. Exclusion criteria included: disability as a symptom or result of COVID-19, the health outcomes when PWD acquired COVID-19, disability leave for someone who is sick and the risk of acquiring the disease for PWD. 74 articles met the inclusion criteria and were analyzed. The barriers that emerged included the following:

- Increased lack of easy access to important information, and training
- Increased lack of ease of communication, with complex online tools,
- Significant financial impacts, to purchase assistive technologies,
- Increased lack of access to essential services,
- Increased lack of access to educational resources.

The researchers found that COVID-19 exacerbated existing challenges in the lives of PWD and raised new quality of life concerns.

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3.3.2. Key Findings

The following table has been created based on research, case studies and interviews for this project:

Design Flaw	Potential Failures of the Exclusion
Design for a narrow user base	The exclusion of diverse user groups can cause the software to be less accessible or unusable for those with different needs and backgrounds.
Assuming uniformity in behavior or preferences among users.	A failure to understand the nuanced requirements of different user segments.
Failing to involve a diverse group of users in the testing phase	Overlooking specific needs or preferences of underrepresented user groups.
Inadequate consideration of diverse linguistic and cultural aspect such as different languages, idioms, symbols or cultural norms in the design	Alienate users from different linguistic and cultural backgrounds. Neglecting to offer the software in multiple languages can exclude non-English-speaking users, limiting their ability to use the software effectively and understand its functionalities. A failure to effectively communicate the software's features and functionalities.
Neglecting accessibility standards, a lack of accessibility features or failing to provide options for customization.	Neglecting accessibility standards can exclude users with disabilities, making the software difficult or impossible for them to use. Failing to design software with accessibility features (e.g., screen readers, keyboard navigation, color contrast) excludes users with disabilities, such as visual or motor impairments, making it difficult or impossible for them to use the software. Relying heavily on visual cues without providing alternative text or descriptions can marginalize users with visual impairments or those using screen readers, excluding them from understanding the content.

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	Failing to provide options for customization (e.g., font size, color schemes) may deter users with specific accessibility needs, resulting in a suboptimal user experience.
Complex, unintuitive or confusing interface design	Alienate users who are less tech-savvy or have limited digital literacy, leading to exclusion from utilizing the software effectively or leading to a failure in user adoption and satisfaction.
Non-Responsive Design, Limited Device Compatibility	Designing software that is not responsive across various devices (e.g., mobile, tablets, desktops) excludes users who primarily access the software through certain devices, limiting their engagement and experience. Designing software that only works optimally on high-end or specific devices may exclude users who cannot afford or do not have access to such devices, particularly individuals from lower socioeconomic backgrounds.
Cognitive Overload	Designing software with excessive complexity, jargon, or cognitive load can overwhelm users, especially those with cognitive disabilities or learning challenges, leading to exclusion from meaningful interaction with the software.
Neglecting to prioritize privacy and security features	Neglecting to prioritize privacy and security features can deter users concerned about their data safety, potentially excluding them from using the software due to trust and safety concerns.
Not ensuing high quality training data	If the training data used by an algorithm is biased, the software may exclude or disadvantage individuals based on factors like gender, race, or socioeconomic background.
Not considering the socioeconomic diversity of end-users	Failing to account for socioeconomic diversity may lead to software designs that are unaffordable or impractical for certain user segments.
Users have limited involvement in the design process outside of research and testing.	If there is limited interaction with users throughout the development process, the final product may not be catering to the desired users.
Designers and developers need to understand there are issues beyond individual	Technology needs that need to be addressed, include access to Wi-Fi, access to the latest software and hardware, and access to support and maintenance.

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disabilities - technology needs.	
People with disabilities may experience literacy challenges.	An example of literacy challenges is that other people may use jargon (both technical and otherwise), and this can create a barrier when some groups rely on plain language.

Table 4: Consequences of exclusion

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Section B – CASE STUDIES IN EXCLUSION

This section details case studies, where excluded populations review systems, and identify barriers that exist within the design of those systems. These case studies are focused on asking those excluded populations what they see as exclusionary in a given system. I Based on their insights, it is clear that the designers should have asked them these questions as part of a co-design process in developing their systems.

4.1. Case Study: The Supports and Barriers to Facilities at the University of Mauritius

Participants

Students at the University of Mauritius

Description

Students with disabilities typically have a much lower retention rate in universities, and the principal reason for this is that the university staff (in all departments) are inadvertently designing institutional and educational barriers that are challenging for all students, but are compounded for students with disabilities. In the context of institutional barriers that the students encounter, these can include things such as: having buildings or rooms that are inaccessible to people with mobility issues; lacking specialist software for students with sight and dyslexic disabilities; and not creating support group structures for students with disabilities. In the context of the educational experience that the students encounter, these educational barriers are created when educators are doing things such as: developing poorly organized educational materials and learning environments; producing multimedia that is uncaptioned or doesn't have subtitles; creating educational materials that cannot be read by a screen reader or accessed without a mouse.

The University of Mauritius wanted to find out some of the sources of exclusion that exist within their institution (both at an institutional level and at an educational level), and they did so by developing an online, self-administered survey that asked students two key questions:

1. Which facilities have insufficient support for students with disabilities?
2. Are the students aware of the existing supporting facilities that are currently provided?

To explore this issue, the university sent this survey to 500 students (which is 4% of the overall student population), and they obtained 122 responses (which is a 24.4% response rate).

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Findings

The findings of the survey were mixed, with the library facilities, sports and recreational facilities, and departmental facilities scoring low on the accessibility scale, but the IT facilities scoring much better. Students did recognize a number of accommodations that are currently being made, including ensuring that students with mobility issues are scheduled in classrooms that are easily accessible, and the creation of bespoke exam papers (including using a large font, changing the colour layout, and even producing a braille-based papers). The majority of students embraced the wider use of Blended Learning practices by the university, citing the flexibility it engenders, however some students with disabilities felt that there was a potential for ghettoization of the students with mobilities issues, where they would miss out of the “real” university experience if they were relegated to the online alternative. In terms of the students’ awareness of the institutional approaches that the university was undertaking to accommodate a wider range of students, almost two-thirds of the students (65.6%) were unaware the significant financial investments in the physical environment of the university to make it more accessible, and were unaware of the university disability advisors that they can contact to discuss their requirements and problems. Crucially this research indicates that it is not only important to provide a range of accommodations for students with disabilities, but it is as important to advertise and promote these resources, to ensure that everyone who can benefit from these resources, actually do benefit from them. Additionally, the students all agreed that it was essential that the university provide a service for students with disabilities to report any barriers to their educational experience.

Citation

Singh, U., Pudaruth, S. and Gunputh, R. (2017) "Forgotten, excluded or included? Students with disabilities: A case study at the University of Mauritius”. *African Journal of Disability*, 6(1), pp.1-12.

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4.2. Case Study: Digital exclusion in later life: A Maltese case study

Participants

The Older Adults of Malta

Description

The widespread use of IT systems has resulted in profound changes in the way in which individuals, organizations, and governments interact. However, this means that the manner in which these IT systems are designed can create potentially insurmountable barriers for some people in their use, resulting in a digital divide between the 'have' and the 'have nots'. One area of society where this divide is extremely pronounced is in the demographic of older people, which may result in significant forms of social exclusion, and their quality of life. There are numerous reasons why this digital divide exists, including factors such as:

- Lack of exposure to IT systems over their lifetimes
- Lack of exposure to IT systems in their careers
- Their current income levels
- Lack of access to affordable IT training
- Acquired disabilities over their lifetimes

To explore whether these are the only factors of exclusion, a qualitative study using a series of semi-structured interviews was undertaken by the University of Malta, targeting older non-users of IT systems, to identify what leads to, and the effects of, digital exclusion in later life. The findings showed that, in this case, neither access to IT systems, nor costs were significant factors in their non-engagement in IT systems. In fact, a continuum of overlapping barriers contribute in this study to older people's non-use of IT systems, including the following: believing that they were 'too old' to use new technologies; a lack of relevance or 'life-fit' of computers; perceived non-usefulness and difficulty to use; anxiety about computer usage; concern about security and privacy issues; and facing disability issues.

Findings

Although these factors focus on the individuals themselves, it is possible to infer design changes that should be made to IT systems (and the messaging around them) to make them less exclusionary. Some specific fears that need to be addressed to make systems more usable include:

- A fear expressed that they are too complex to use (this suggests UX improvements are needed).
- A feeling that they are not relevant to older people's lives (this suggests that more relevant resources to these people need to be made easier to find).

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- A fear expressed by many that pressing the wrong key may break the systems (this suggests that the robustness of modern IT systems needs to be promoted and even embodied in the interface of these systems).
- A concern about security and privacy issues (this suggests that better, more secure services should be made more prominent).
- A series of challenges for people with disabilities (this suggests that interfaces need to be improved to be more flexible and eliminate the need for fine motor control and high visual acuity).

Citation

Formosa, M. (2013) “Digital exclusion in later life: A Maltese case-study", *Humanities and Social Sciences*; 1(1): pp. 21-27.

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4.3. Case Study: Exclusion in Digital Libraries: A comparison of four different sites

Participants

Participants in Digital Libraries

Description

This study highlights an essential aspect of the design process, which is the importance of understanding the environment and social context in which IT systems are going to be used. It does this by exploring the introduction and use of digital libraries in four different settings (three clinical and one academic). These settings were studied over a 4-year period and involved 144 users – including end-users, librarians, designers, and management, and their views were gathered, compared, and contrasted to identify relevant issues, using Grounded Theory, and the critical lens of "communities of practice" in its analysis.

The notion of "communities of practice" suggests that learning is not simply the formal acquisition of knowledge, but it also has a social element that should not be ignored. Learning is through participation in a community, and new members are brought into knowledge communities, and they can improve and transform those communities.

The digital libraries were implemented in three different ways across those four settings:

- *The Traditional Approach*: Making the digital library available on existing computer systems (in their offices and the library).
- *The Shared Space Approach*: Making the digital library available via computer systems in shared spaces (e.g. hospital wards).
- *The Information Intermediaries Approach*: Making the digital library available via information intermediaries who liaise with users as a community.

Findings

Interestingly, the different approaches, in their different contexts, resulted in different perceptions of the technology, as follows:

- The *Traditional Approach* made the users feel the digital library was not relevant to the current needs of the individuals and community.
- The *Shared Space Approach* had an even worse impact, where there were poor design, support, and implementation procedures; this resulted in the perception that it was a threat to current organizational structures.
- The *Information Intermediaries Approach* was the most successful, where it could adapt and change practices according to individual and group needs, was seen as empowering to both the community and the individual.

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Ultimately this research shows that if IT systems are designed and implemented on untested assumptions, they will result in exclusion. The three different approaches in this work showed that if the systems are designed on the assumption of individual use of digital libraries, they will be unsuccessful, whereas if the community is part of the design of the system, and it is structured and presented well, there will be less exclusion.
Citation Adams, A., Blandford, A. and Lunt, P. (2005) “Social empowerment and exclusion: a case study on digital libraries”. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 12(2), pp.174-200.

4.4. Case Study: The Exclusion Calculator: A Demographics-Based Approach to Design

Participants

The Engineering Design Centre, University of Cambridge

Description

This study concerns the redevelopment of an exclusion calculator, a software tool that provides designers with a realistic appreciation of the number of people with disabilities that will be excluded, depending on their design choices. The exclusion calculator is generally used as part of an exclusion audit, based on the principle that an individual is excluded from using a product if their capabilities are less than the abilities demanded by the product, given the environmental context. For example, if a mobile telephone has small buttons requiring a certain level of dexterity to use them, then a user with low dexterity capability may be unable to use the device correctly, particularly depending on environmental conditions, such as cold weather.

The exclusion calculator is based on a dataset from the UK Disability Follow-up Survey (DFS), and participants in that survey were asked up to 300 questions about their ability to perform a range of everyday tasks, such as reading newspaper print and picking up small items. Their answers were then grouped into 13 ability categories, seven of which are most relevant for product design: “Seeing‟, “Hearing‟, “Intellectual Function‟, “Communication‟, “Locomotion‟, “Reach & Stretch‟, and “Dexterity‟. Additionally, each activity was given a “severity score”, since different tasks have a different level of impact on an individual’s quality of life.

The original version of the exclusion calculator only considered the activity aspects of the survey, however, there is additional answers that was incorporated into the redesign of the exclusion calculator which better determined the impact of each individual’s capabilities on quality of their life. These new answers also allowed the redesign to further refine the seven categories above into subscales in each category, which researchers called “demand types”. The main experiment in this research examined the division of capabilities into these demand types, and, in particular, it investigated whether participants are able to consistently determine the demand type of a given task, within the context of an exclusion audit. Forty people took part in the experiment, 20 men and 20 women, aged between 20 and 60.

Findings

The participants were able to accurately and consistently determine the demand type of a given activity with a high level of accuracy, therefore these are good data points to use in the exclusion calculator. It is also worth mentioning that although the

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exclusion calculator is focused on measuring a single task, it is possible to measure the exclusion in an entire task sequence, such as making a phone call, by using the same exclusion calculator and treating this as a sequence of tasks, and therefore, setting the demand for each capability to the maximum demand for that capability over the whole set of tasks. It is worth noting that this type of calculator can be used to promote inclusion, but can also be used to make judgments as to how many people an organization is happy to exclude for a given cost/benefit analysis scenario, and it is also worth noting that such tools only consider individual capabilities rather than how communities can support each other in doing their tasks. Thus, tools like these are helpful as part of a design process, but should not replace designers working directly with individuals with disabilities as part of a co-design process.
Citation Goodman-Deane, J., Waller, S., Williams, E., Langdon, P. and Clarkson, J. (2011) "Estimating exclusion: a tool to help designers". *Session 1A–Civic and Social,* p.107.

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4.5. Case Study: The Exclusion of Persons with Disabilities Online in China

Participants

112 Internet Users in China with a range of Disabilities

Description

Although many researchers suggest that the online world provides a very good remedy to the types of exclusion that people with disabilities experience in the real world. The researchers in this work content that this is an overly optimistic perspective, and does not take into account the fact that the online world may very well deepen the digital divide and social exclusion of people with disabilities in many ways, as they ignore the power structure that results in the social and digital exclusion of disability. There is also a concern that they may be more vulnerable to exposure to harmful, manipulative, and exploitative content; they may engage with, or be engaged by others, in antisocial behavior; and they may get negative online contacts.

The research employed an ethnographic participant observation approach and in-depth interviews. They used purposive sampling and snowball sampling to recruit participants. Initially, they targeted specific online forums, including the biggest online forum for people with disabilities on Baidu Tieba, namely, caijiren ba (Forum of people with disabilities) and the biggest online platform for online jobs available to people with disabilities, namely, hubangwang (Website for Helping Each Other). In addition to these online fields, the researchers identified three rehabilitation hospitals for people with disabilities in Guangzhou. From 1 October 2016 to 1 November 2017, the authors conducted 13 months of fieldwork in the above fields. The fieldwork produced field notes of more than 100,000 words, and in addition to participant observations, the authors conducted 82 in-depth interviews. Following this, based on the snowball sampling approach, they conducted another 40 in-depth interviews.

Findings

Some participants with disabilities indicated that they lived in poverty because they were unable to find employment, and the process of obtaining financial support from the government is extremely complicated, therefore, they had limited access to online content. Those who are able to regularly access the Internet have commented how the forums specifically aimed at people with disabilities do somewhat address the exclusion they find in their day-to-day lives, in a few different ways, not only does it alleviate boredom, but it also allows them to access disability and medical information, and it also allows them to find people with similar disabilities and share their stories, and learn from each other. Additionally, access to the Internet provides potential new means of employment, undertaking work in an online context.

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However, in addition to the significant benefits outlined above, many participants raised issues and challenges that they have faced because of their Internet usage. A significant majority of the participants indicated that they are using the Internet to hide from their real-world problems, and many are addicted to online games. Additionally, when they see images of people with no obvious disabilities online, they sometimes feel sad and hurt about their conditions. The researchers also found that some disability forums had become very negative spaces where people were constantly sharing their pain and misery to such an extent that it was negatively impacting the mental health of others on those forums.

Citation

Lin, Z., Yang, L., & Zhang, Z. A. (2018) “To include, or not to include, that is the question: Disability digital inclusion and exclusion in China”, *New Media & Society*, 20(12), 4436-4452.

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4.6. Case Study: Google's AI Skincare tool

Participants

Google's AI Skincare tool users with dark skin

Description

In 2020 Google released an AI-powered dermatology tool as a web-based application that could help to diagnose skin conditions. In order to use the tool users need to upload three photos of a problem area to the tool from different angles. According to Google "You'll then be asked questions about your skin type, how long you've had the issue and other symptoms that help the tool narrow down the possibilities. The AI model analyzes this information and draws from its knowledge of 288 conditions to give you a list of possible matching conditions that you can then research further."

Google researchers published the data and model that the Skincare tool was built on in the journal Nature Medicine (2020). According to the authors the tool was developed using a set of around 65,000 anonymised images and case data of diagnosed conditions, taken from a total of 16,114 individual cases.

Following the publication in Nature Medicine (Liu, Y., Jain, A., Eng, C. *et al.*, 2020), a number of researchers highlighted issues with Google's data for the skincare tool. Dr Roxana Daneshjou tweeted her concerns that Google's study data appeared not to include many patients with darker skin types.

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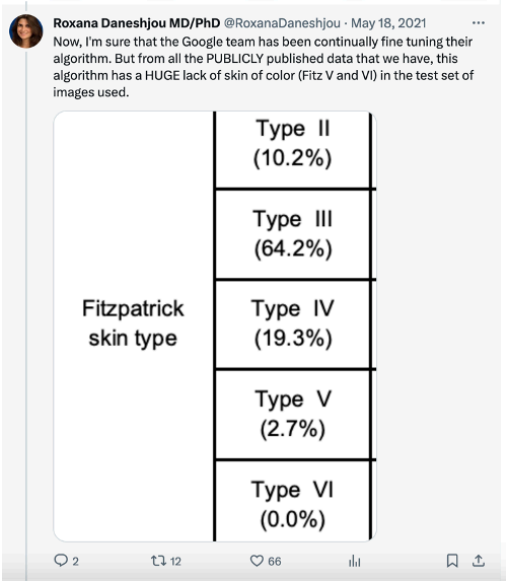

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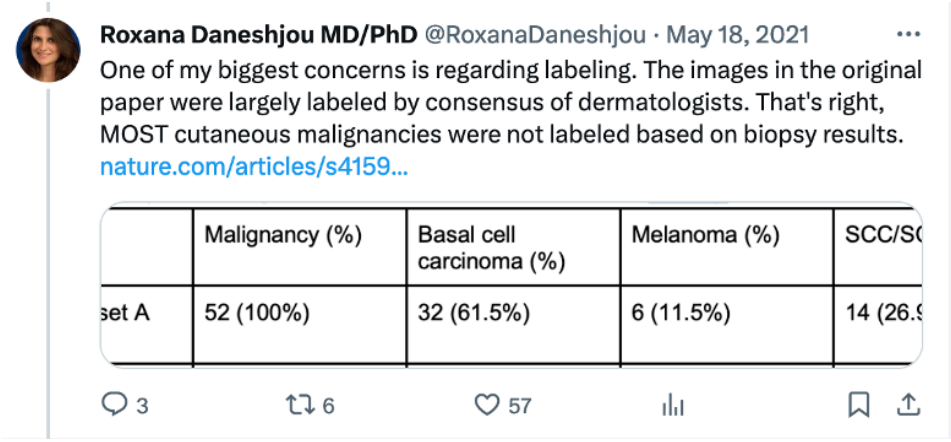
The lack of diversity of skin colour would make the skincare tool unreliable and usable for people with darker skintones. Dr Daneshjou also highlighted issues with labelling in the model published by Google:



Dr Tereza Hendle highlights that the “EU legal system prohibits discrimination also on the grounds of race and ethnicity, hence, medical tools should not discriminate against patients with brown or black skin tones” (Euronews, 2021).

Citations:

Bui, P., Lui, Y. (2021) Using AI to help find answers to common skin conditions. https://blog.google/technology/health/ai-dermatology-preview-io-2021/

Liu, Y., Jain, A., Eng, C. *et al.* A deep learning system for differential diagnosis of skin diseases. *Nat Med* **26**, 900–908 (2020). https://doi.org/10.1038/s41591-020-0842-3

Euronews (2021) Google’s New AI Skincare tool may not work on patients with darker skin tones. https://www.euronews.com/next/2021/05/26/google-s-new-ai-skincare-tool-may-not-work-on-patients-with-darker-skin-tones

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Section C – MITIGATIONS FOR INCLUSIVE SOFTWARE

5. Inclusive Software Mitigations

We propose the following table of mitigations to prevent exclusion, and promote better inclusivity in the software design and development process. The table is based on the themes identified by the research for this report, including interviews and case studies:

Theme	Mitigation	Explanation
EDUCATION	**Continuous Learning and Improvement**	**Knowledge Sharing:** Encourage knowledge sharing within the team and organize regular workshops or seminars to stay updated on the latest advancements in bias identification and mitigation.
		Post-Project Evaluation: Conduct post-project evaluations to analyze the software's impact, identify any biases that may have been missed, and apply lessons learned to future projects.
EMPATHY	**Education and Awareness**	**Training**: Educate the design team about various types of biases as outlined above, their implications, and how they can manifest in software design.
		Case Studies: Share real-world examples and case studies illustrating biases in software design and their impacts on users.
SOFTWARE DESIGN METHODOLOGIES	**Design Thinking and User Research**	**Empathetic User Research:** Emphasize empathy for users by conducting user interviews, observations, and surveys to understand their diverse needs and preferences.
		Empathetic Design: translate user research into empathetic designs using tools such as empathy maps, personas, and scenarios representing a diverse range of users to guide design decisions.
	Iterative Design Process	**Feedback Loops:** Establish regular feedback loops and design reviews to encourage team members to critique designs and raise concerns about potential biases.

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		Prototype Testing: Conduct user testing with a diverse group of individuals to gather feedback on potential biases and areas for improvement.
USER DIVERSITY	**Diverse and Inclusive Team**	**Team Composition:** Ensure a diverse team with varied backgrounds, perspectives, and experiences to reduce the risk of biases related to homogeneity.
		Inclusive Culture: Foster an inclusive culture where team members feel comfortable addressing biases and discussing potential issues openly.
USER INTERACTION	**Bias Identification Tools**	**Bias Checklists:** Develop checklists that designers can use to systematically identify biases at various design stages, such as problem framing, ideation, prototyping, and testing.
		Bias Detection Algorithms: Integrate automated tools or algorithms that scan design elements for potential biases, such as biased language, imagery, or user flows.
MOTIVATION	**Transparency and Accountability**	**Documentation:** Document design decisions, rationale, and considerations related to biases to maintain transparency and enable reflection.
		Accountability Measures: Implement mechanisms to hold designers accountable for addressing biases and adhering to ethical guidelines.
ACCESSIBLE TECHNOLOGY	**Compliance and User engagement**	**Guidelines and Compliance**: Ensure compliance with WCAG and other inclusive design guidelines
		User Participation and Testing: Continuous engagement with users with disabilities through feedback and user testing
PROJECT & TIME CONSTRAINTS	**Prioritize**	**Prioritize User Engagement**: If co-design is beyond resources, consults with users in a limited way, use experts, existing resources
		Revisit Project Schedule: In Agile programming, the Scrum Master will decide on the schedule of tasks, therefore, they must make inclusion a key priority in all of software. Over time they will build

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		up a collection of inclusion approaches to address the time constraints.
ETHICS	**Ethical Guidelines and Principles**	**Ethics Framework:** Develop a set of ethical guidelines and principles that designers must follow, explicitly addressing potential biases and discrimination in software design.
		Ethics Review: Integrate an ethics review process for design proposals, ensuring alignment with established ethical guidelines.
	Expert Consultation	**Diversity of Expertise:** Seek consultation from external experts or consultants with expertise in ethics, diversity, and inclusion to provide insights and recommendations during the design process.

Table 5: Inclusive software mitigations

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References

Alshammari, M., Doody, O., and Richardson, I. (2020) “Software Engineering Issues: An exploratory study into the development of Health Information Systems for people with Mild Intellectual and Developmental Disability”. In *2020 IEEE First International Workshop on Requirements Engineering for Well-Being, Aging, and Health (REWBAH)* (pp. 67-76). IEEE.

Bennett, C.L., Gleason, C., Scheuerman, M.K., Bigham, J.P., Guo, A. and To, A., 2021, May. “It’s complicated: Negotiating accessibility and (mis) representation in image descriptions of race, gender, and disability”. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1-19).

Clarkson, P.J., Waller, S. and Cardoso, C. (2015) “Approaches to estimating user exclusion”. *Applied ergonomics*, 46, pp.304-310.

Croft, S. and Fraser, S. (2022) “A scoping review of barriers and facilitators affecting the lives of people with disabilities during COVID-19". *Frontiers in Rehabilitation Sciences*, 2, p.784450.

Czaja, I. and Urbaniec, M. (2019) “Digital exclusion in the labour market in European countries: Causes and consequences”. *European Journal of Sustainable Development*, 8(5), pp.324-324.

Coleman, G.W., Gibson, L., Hanson, V.L., Bobrowicz, A. and McKay, A. (2010) "Engaging the disengaged: How do we design technology for digitally excluded older adults?” In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (pp. 175-178).

Eisma, R., Dickinson, A., Goodman, J., Syme, A., Tiwari, L. and Newell, A.F., 2004. Early user involvement in the development of information technology-related products for older people. Universal Access in the Information Society, 3, pp.131-140.

Matthiesen, S., Bjørn, P. and Trillingsgaard, C. (2023) “Implicit bias and negative stereotyping in global software development and why it is time to move on!”. *Journal of Software: Evolution and Process*, 35(5), p.e2435.

Mieczakowski, A., Hessey, S., and Clarkson, P.J. (2013) "Inclusive design and the bottom line: how can its value be proven to decision makers?." In *Universal Access in Human-Computer Interaction. Design Methods, Tools, and Interaction Techniques for eInclusion: 7th International Conference*, UAHCI 2013 Proceedings, Part I 7, pp. 67-76. Springer Berlin Heidelberg.

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Newman, L., Browne-Yung, K., Raghavendra, P., Wood, D. and Grace, E. (2017) “Applying a critical approach to investigate barriers to digital inclusion and online social networking among young people with disabilities”. *Information Systems Journal*, 27(5), pp.559-588.

Rodríguez-Pérez, G., Nadri, R. and Nagappan, M. (2021) “Perceived diversity in software engineering: a systematic literature review”. *Empirical Software Engineering*, 26, pp.1-38.

Stary, C. (2001) “User diversity and design representation: Towards increased effectiveness in Design for All”. *Universal Access in the Information Society*, 1, pp.16-30.

Van Maele, M., 2023. Consumer problems due to non-inclusive design: a study of brand reactions (Doctoral dissertation, Ghent University).

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