CHALMERS
UNIVERSITY OF TECHNOLOGY

UNIVERSITY OF GOTHENBURG

Accessible Artist Archives

Supporting web professionals in creating accessible navigation for online artist archives

Master of Science Thesis in Interaction Design & Technologies

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Gothenburg, Sweden 2019

Master's Thesis 2019

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Master's Thesis 2019
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Typeset in LaTeX
Gothenburg, Sweden 2019

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Abstract

This thesis explores which factors are preventing web professionals from creating accessible website navigation. To answer this, interviews with six web designers and developers were conducted, the results of which (in accordance with previous research) indicate two primary factors: 1. Client demand is low, leading to deprioritization and a lack of time and/or money for considering accessibility; 2. Accessibility does not have a natural place in the design/development process. In addition, an analysis of the navigational accessibility of an existing web archive of the Swedish painter Ivar Arosenius was performed, identifying three main issues: 1. Lack of context, causing disorientation; 2. Keyboard operation not being optimally implemented; and 3. Search functionality issues, such as being inconsistent in displayed results and not providing correction suggestions for misspelled search terms. Finally, as a way to address the factors preventing accessibility, four concrete concepts were developed. Of these, two were further advanced: an accessibility business value calculator, to aid clients in recognizing the business value of accessibility; and an accessibility design linter, to make it easier for web designers to identify accessibility problems in their designs at an early stage.

Keywords: web accessibility, inclusive design, navigation.

Acknowledgements

I would like to thank my supervisor, Sara Ljungblad, who has been a huge support and incredibly helpful in navigating the winding paths of writing a master's thesis. I would also like to thank the people involved in the Arosenius project, for letting me get involved. Finally, a big thank you to all the participants who took time to be my interview subjects, without whom there would have been no thesis.

David Hallberg Jönsson, Gothenburg, June 2019

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Introduction

In the article "Introduction to Web Accessibility", the World Wide Web Consortium Web Accessibility Initiative writes:

> The Web is an increasingly important resource in many aspects of life: education, employment, government, commerce, health care, recreation, and more. It is essential that the Web be accessible in order to provide equal access and equal opportunity to people with disabilities. An accessible Web can also help people with disabilities more actively participate in society. [1]

There is not a lot of data on the extent of accessibility of existing websites, but there are some studies that can give an indication: In 2010, a review of UK e-government sites found that only seven of the 130 tested sites where free of accessibility errors. [2] A 2014 study of Italian public administration web pages [3] found that all of the 976 web pages surveyed contained accessibility errors (despite accessibility of Italian government websites being regulated by law since 2004 [4]). In a 2014 study of US web-based emergency alert sign-ups, 21 of the 26 sign-up forms reviewed contained accessibility errors. [5]. A 2017 evaluation of 697 Iberian eHealth websites found that all of them were "definitely not accessible" [6, p. 1].

Seen through this lens, the fact that a number of museums and other archival organizations now are increasing digitization efforts and expanding their presence on the web [7] [8] [9] raises some questions. For whom are these efforts made? How can access to these websites and the materials on them be ensured for people with special needs? How much are these perspectives taken into account as these websites are being developed?

1.1 Aim and Research Questions

This thesis will attempt to explore the attitudes of web professionals toward accessibility and attempt to find ways of increasing the accessibility of websites being created, especially the navigation. As a focus, online archives—specifically of digitized artist material—has been selected. In an attempt to capture these aspects, the following research questions have been defined:

1. *Which major factors are preventing web professionals from creating accessible website navigation?*
2. *What types of solutions could address factors that prevent accessibility?*

3. *What specific issues regarding accessible navigation does the Arosenius website, as a digital archive of artist material, display?*

1.2 Deliverables

What form the final artifact of this thesis will take is highly dependent on the findings from the research phase (see chapter 4 for more information regarding this). The goal is to deliver two things:

- A collection of factors influencing whether web professionals create accessible websites or not.
- An number of prototyped design solutions for addressing the factors that prevent accessibility.
- A collection of navigational accessibility issues on the Arosenius archive website.

What form the prototyped solutions take (if possible design solutions are found) will be dependent on the result of the research. Some potential forms they could take are guidelines, method(s), design patterns, or evaluation tools. It may also be the case that a single solution warrants multiple artifacts that may be different in form and function.

1.3 Delimitations

This thesis will predominantly consider the navigation—finding and getting to the desired content—of artist archives, and will not primarily consider other actions (see section 2.3) taken on the archive. However, if the research were to show that navigation is unproblematic and that there are other actions that are more relevant to consider, the aim and research questions will be re-evaluated. While the question might be incidentally raised, this thesis will not deal heavily with the user experience of alternative ways of experiencing art, e.g. how a visually impaired person might experience having a visual painting explained by audio, or how a color blind user might experience a color adjusted painting. The focus will be on high-level navigation, and generally not on the exploration of particular artworks. Finally, while solutions might be considered from a long term perspective, long term archive upkeep will not be a primary concern.

1.4 Stakeholders

1.4.1 Web Professionals

The main target group of this project is web professionals (specifically those with experience working on digitized artist archives, but results will likely be more widely applicable), who hopefully will be able to use the results of this project in their own work to more quickly and easily make it accessible. From their perspective, the most

important aspect of any results of this project is that they can easily use it to create value for users, and thereby in the end making themselves more valuable.

1.4.2 End Users

In the end, all web users benefit from the web being simpler, clearer, and easier to use. The primary benefactors of a more accessible web, however, are the people that require that increased accessibility in order to make use of it—people with some kind of special needs, like visual or auditory impairments (more on special needs in section 2.5). For these people, the desired outcome of this project would be that it actually succeeds in enabling web professionals in creating accessible websites, resulting in a web that is more accessible.

1.4.3 Museums and Arosenius Project

In collaborating with the Arosenius project, while contact will mainly be had with the designer and developer of the project the project group as a whole may be affected. Results of this project may influence further development of the project, specifically the archive website. Through the collaboration with the project, this thesis will also touch on the work of museums, who might be affected by or interested in building and expanding on the Arosenius project's work to create their own online archives. Both for the Arosenius project group and for possible museums, the primary concern is that the project results can assist them in creating valuable solutions, allowing them to reach more people.

1.4.4 Chalmers University of Technology

Finally Chalmers University of Technology, as the university at which this thesis is written, has an interest in the work and will be affected by the result. The main consideration for Chalmers is that the thesis contributes some research of value and is produced in an academically honest way.

1.5 Ethical Considerations

In general, the project will strive to adhere to the five principles for research ethics set out by Gajjar [10]:

1. Discuss intellectual property frankly.
2. Be conscious of multiple roles.
3. Follow informed-consent rules.
4. Respect confidentiality and privacy.
5. Tap into ethics resources.

Specifically regarding interviews conducted as part of this project, effort will be taken to make sure these are handled in an ethical way. Informed consent will be

gathered for every interview, and subjects will be made to feel comfortable. No monetary compensation will be given for interviews and all collected data—although it is not likely that the data collected would be considered sensitive—will be anonymized.

Finally, as the end result of this project is intended to empower people with disabilities and special needs, a special mention is warranted. This is a group that is in many regards more vulnerable than the general public, and failing to take proper consideration means a project might end up hurting these people more than it helps them. Therefore, throughout this project effort will be taken to thoroughly consider this group's interests before making any decision, as well as considering each decision's impact on this group.

2

Background

Like all projects, this one exists in a context. This section will attempt to outline that context; providing some detail about the research project that will be used as a case study, then go on to look at research and problems regarding navigation on the web. After that, some user groups for archive projects will be detailed, including explaining some disabilities that will be relevant to consider. Finally, the chapter will end with a presentation of related work, both regarding museums' work with accessibility, and developer resources regarding accessibility.

2.1 Interaction Design

Interaction design (IxD) can be defined as "the practice of designing interactive digital products, environments, systems, and services" [11], or, in the slightly more specific form proposed by Rogers, Sharp, and Preece, "designing interactive products to support the way people communicate and interact in their everyday and working lives" [12, p. 9]. The field is related to a number of fields, such as user experience (UX) design and Human-computer Interaction (HCI). Rogers, Sharp, and Preece consider the difference IxD and HCI to be one of scope, with IxD having "cast its net much wider, being concerned with the theory, research, and practice of designing user experiences for all manner of technologies, systems, and products, whereas HCI has traditionally had a narrower focus" [12, p. 10]. Cooper et al. describe UX design as consisting of three overlapping concerns: form, behavior, and content, with interaction design focusing on the design of the behavior. [11] Alben implies a slightly closer connection to UX, writing that

> By "experience" we mean all the aspects of how people use a product: the way it feels in their hands, how well they understand how it works, how they feel about it while they're using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it. If these experiences are engaging and productive, then people value them. We call this "quality of experience." [13]

She describes interaction design as the way to reach this "quality of experience", presenting nine criteria that, taken together, "define successful interaction design, design that leads to quality experiences" [13]. The criteria are: understanding of users, effective design process, needed/desired, learnable and usable, appropriate, aesthetic experience, mutable, and manageable; these eight criteria come together in the central ninth criterion, quality of experience. [13]

2.2 Museums and Accessibility

Museums have attempted to deal with the issue of disability for many years. [14] Since 1984, the Tactile Museum of Greece—a museum established specifically for this purpose—has allowed blind people to experience ancient Greek art. [15] Wojton, Heimlich, and Shaheen observed educational sessions for blind youth in museum spaces—designed by the National Federation of the Blind—distilled their observations into a number of lessons for museums, concluding that "[b]y using methods that accommodate the blind, museum educators create stronger museum education programs for everyone" [16, p. 63]. Martins [17] describes a successful attempt at a Portuguese art museum to engage deaf audiences in their tours, arguing that the use of sign language is a critical component in doing so. Finally, Eardley et al. studied two Portuguese museums that experimented with an "access for all" approach. While success differed, the authors concluded that

> multisensory presentation of information should not be a minority issue aimed at providing access for a few visitors; rather it should be at the centre of a museum experience, enabling understanding for all visitors [18, p. 284].

Thereby, they agree with Wojton, Heimlich, and Shaheen that attempts to provide a valuable museum experience for disabled people ultimately enhances the experience for all visitors, disabled or able.

(a) Home page. **(b)** Gallery view.

Figure 2.1: The Arosenius archive website.

2.2.1 Conjuring up the Artist from the Archives: Ivar Arosenius

As a part of the thesis, a case study of the research project "Conjuring up the Artist from the Archives: Ivar Arosenius" will be performed. The three year project aims to develop a "digital archive that collects the digitized material from several sources into a central repository" [19], using the Swedish artist Ivar Arosenius as an example. For this project an Arosenius archive microsite [20] has been developed, with an archive of primarily graphical material (e.g. pictures of paintings and scanned letters) and methods of searching and filtering this material. The project faces a number of accessibility challenges that make it relevant to this thesis. For example, the target group is very heterogeneous, ranging from young children to art experts

and researchers, resulting in differing wants, needs, and preconditions for assimilating the presented material. Additionally, an interesting aspect is the fact that the material is primarily graphics based, which may present issues for users with visual impairments and raises questions on how such ordinarily visual material can be presented in alternative ways. Figures 2.1a and 2.1b show the start page and the gallery view of the archive website, respectively. Navigation of the archive currently consists primarily of searching or "click and scroll" navigation.

2.3 Website Navigation

As mentioned in section 1.3, the focus of this thesis will be on navigation. The reason for this is that navigation is one of the most important aspect of the usability of websites [21], and is something that can be difficult for many users [22]. Some underlying theory concerning website navigation is presented in section 3.5, but in practice, navigation can take many forms and be performed in many different way. Some common ways of finding content are searching for it and looking at menus, and the usual way of getting to content is through clicking links in menus or in the content of web pages. In a way, it can be said to be one of the most important aspects of a website: users will not be able to appreciate the content on it, if they have no way of finding and getting to that content. In fact, Palmer found that “navigation and content are significantly associated with Web site success” [23, p. 161].

2.3.1 Arosenius Archive Navigation

The specific act of navigating an online artist archive can be divided into several tasks that the user performs. Some tasks a user might try to perform on a web archive include searching for a known artwork (knowing the title or what the artwork looks like); exploring artworks by an artist; filtering artworks based on color, year of creation, or something else; compare two or more artworks; or learn information about the artist or specific artworks. Searching for an artwork on the Arosenius archive could consist of the following steps:

1. Decide which artwork one wants to find and a likely search term to identify it.
2. Scan the current web page to find a search field.
3. Enter the decided search term in the search field and click the “search” button.
4. Scan the current web page to find where search results are presented.
5. Scan the results to find the desired artwork.
6. Click the link to more information about this specific artwork.

Of course, the exact flow will differ depending on the specific user and their conditions for and goal with visiting the archive. Some examples of various user groups and critical aspects for each are presented in section 2.4.

2.4 End User Groups

The target group for this thesis work is web professionals, that is individuals who work with designing and developing content for the web. However, these web professionals will in turn have user groups of their own. In order to create effective solutions for these designers and developers, therefore, it is important to consider the end user groups. Public museums in Sweden are required by law to be accessible to all [24]. As such, the final target audience is extremely diverse, in theory encompassing all of Sweden's population (although this may not be the case in practice). In order to narrow it down for, the following three end user groups have been selected to serve as perspective when exploring museum websites, though more may be added during the project. Since all groups are heterogeneous and diverse, and no formal user study will be conducted, a lot of assumptions will be made.

2.4.1 Children

A child does not possess a lot of advanced pre-existing knowledge about art or artists. They are more likely to be visiting the website in order to gather information for a school assignment or to explore works of an artist they have learned about, rather than to look for particular artworks. Children do not have a lot of patience for reading through long and dense texts or navigating complex user interfaces. [25] When searching for information, they tend to have a "loopy" navigation style, revisiting visited web pages and remaking searches previously made [26], meaning the flow of navigation might be tangled and less straightforward than the one described in subsection 2.3.1. They also misspell search terms "significantly more" than adults [27], something one needs to take into account when designing a search function for children.

2.4.2 Senior Citizens

This group includes people with limited computer experience, as well as limited eyesight and/or hearing. The level of prior knowledge about artists can vary greatly within the group and between artists. Their reasons for visiting the web archive could be to find specific artworks they like, or explore the work of their favorite artists. Older people need clear navigation and simple language, with extensive time to read it. [28] They need help keeping track of where they are and where they have been [29], and links need to be obviously and consistently styled, and explicit about what they do [30].

2.4.3 Art Researchers

This target group varies from the other two, in that it's not primarily delimited by age, but rather by profession. Individuals from this group possess a lot of knowledge about the art and the artists of the websites. Functions they are interested in include searching and filtering, comparing artworks, and looking for trends and connections in the works. As professionals, they have experience using various digital

art archives, and might expect and/or desire other archives to be similar in terms of functions and interface. Expert users typically desire customization and support for simplifying repeated operations. [31] They need navigation tools that let them freely find specific information, such as index tools, content lists, and search tools. [32] When searching, experts in a specific domain (for example art) tend to use a significantly shorter queries, with fewer errors, and spend a lot less time with search results, being quicker than non-experts to read documents and decide the next move. [33]

2.5 Special Needs

Apart from the differences between the groups discussed above, there exists in all three groups—indeed, in all user groups—users with special needs. Sometimes these needs arise because of a permanent disability, and sometimes they come from temporary or situational impairments. Figure 2.2, from Microsoft's inclusive design toolkit [34], illustrates these temporal aspects. It shows, for example, that problems with hearing can arise from being deaf or hard of hearing, from a temporary ear infection, or from simply being in a noisy environment. In all these cases, the consequence is the same—the user has a hard time hearing—and to a web designer or developer targeting this user, the exact reason is irrelevant. This relates to the view held in inclusive design that "people are disabled by designs and environments" [35, p. 127], something discussed more in section 3.2. This section will begin by presenting some information on Swedish disability legislation, and go on to detail some examples of special needs that will be relevant to consider for this thesis.

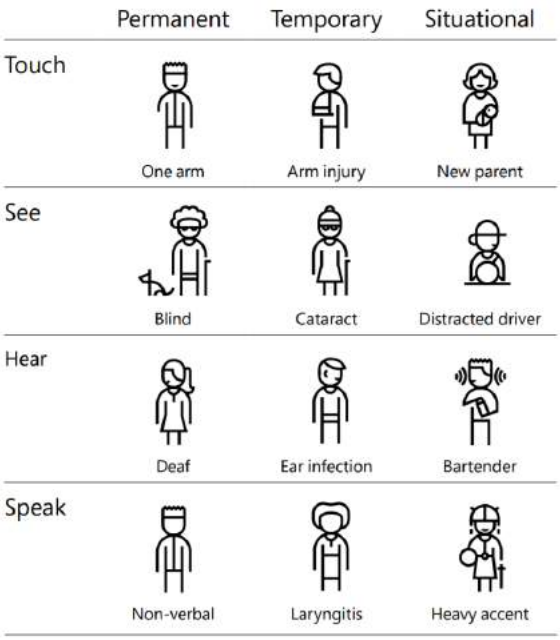

Figure 2.2: Microsoft's persona spectrum detailing temporal spectra of special needs. [34]

2.5.1 Disability Legislation in Sweden

The Swedish Discrimination Act defines a disability as a

> permanent physical, mental or intellectual limitation of a person's functional capacity that as a consequence of injury or illness existed at birth, has arisen since then or can be expected to arise [36, p. 3].

It further provides a level of protection for disabled people, including characterizing inadequate accessibility, defined as

> a person with disability [being] disadvantaged through a failure to take measures for accessibility to enable the person to come into a situation comparable with that of persons without this disability where such measures are reasonable on the basis of accessibility requirements in laws and other statutes, and with consideration to
>
> - the financial and practical conditions,
> - the duration and nature of the relationship or contact between the operator and the individual, and
> - other circumstances of relevance.
>
> [36, p. 3]

as a form of discrimination, thus making it illegal to (in certain cases) not provide adequate accessibility. While the web is not mentioned specifically the law extends to websites, meaning that an employer could be found guilty of discrimination if, for example, the work requires the use of website with a design that excludes visually impaired employees from using it.

2.5.2 Visual Impairments

Visual impairment refers not only to blindness, but all forms of low vision. About 100 000 people in Sweden are visually impaired, i.e. have difficulties reading printed text or navigating using sight. [37] There are many different causes for visual impairments, but some of the more common ones are cataracts, glaucomas, age-related macular degeneration, and strabismus. [37] Since the web in many ways is a visual medium, visually impaired people are often prevented from using the web in the same ways as people with regular eyesight. One common method of using the web is using a screen reader, a software program that converts the text of websites into speech, which is played to the user. [38] There are also screen readers that convert text into braille characters on a special device, for users who are both visually impaired and hard of hearing.

2.5.3 Auditory Impairments

In Sweden, over one million people have difficulties hearing what is said in a conversation between multiple people. [37] The most common reasons for hearing impairments are age-related hearing loss and noise-induced hearing loss. [37] Auditory impairments primarily influences the use of websites with some form of multimedia content, for example videos might need to be equipped with captions for speech.

2.5.4 Mobility Impairments

Roughly 300 000 people in Sweden have some form of mobility impairment. [39] This includes impaired arm and leg function, myalgia, rheumatism, and MS. There are a number of assistive technologies aimed to help with using computers and the web. [40] Some examples are mouth sticks and head wands, which offer ways of interacting with keyboards and touch screens without using one's arms, and eye-tracking and voice recognition software, which lets a user interact with their computer without the need to move more than the eyes or the mouth respectively.

2.5.5 Intellectual Disabilities

About 100 000 people in Sweden are cognitively impaired, characterized by an IQ of less than 70. [41] Of these, two thirds have a mild intellectual disability, meaning an IQ between 50 and 69. People with intellectual disabilities might have difficulties comprehending text, meaning that it is important (even more so than otherwise) to structure and format documents clearly. [42] Illustrations, icons, video, and audio also can also help greatly in aiding comprehension for this group. [42]

2.6 Web Designer Resources

There are a number of projects attempting to aid web designers in their work to improve accessibility. Here is presented three such projects, related to web accessibility. Although none of these projects deal directly with archives, they can provide valuable insights into how one should try to think when designing for designers.

2.6.1 Official Guidelines for Web Development

Webbriktlinjer [43] is the official set of guidelines web development in the public sector in Sweden, maintained by the Swedish Post and Telecom Authority (PTS). The main focus of the guidelines are accessibility and usability, and the guidelines are largely based on the Web Content Accessibility Guidelines (more information about them in subsection 3.3.1). Apart from the guidelines themselves, the website contains user personas, to help designers keep accessibility in mind throughout the design process, and a "wizard" for accessibility testing, giving designers a step-by-step guide to follow for manually evaluating the accessibility of a website.

2.6.2 WebAIM

WebAIM [44] is a non-profit organization from the Center for Persons with Disabilities at Utah State University. Its mission is to

> expand the potential of the web for people with disabilities by providing the knowledge, technical skills, tools, organizational leadership strategies, and vision that empower organizations to make their own content accessible to people with disabilities. [45]

To this end, they offer accessibility certifications, do research and take part in discussions about policy. [45] They also provide tools for evaluating website accessibility, for example WAVE [46], which can be used to analyze a cite and identify accessibility issues.

2.6.2.1 Inclusive Components

Inclusive Components [47] is a project attempting to support web designers in creating accessible interface. It does this through providing a library of modular interface components, each created with accessibility in mind. For example, the Pickering demonstrates how to design a "true menu", a navigation menu designed to be usable, semantically correct, and work for screen readers. The code for this "true menu" is also provided, letting web developers reuse it and—in theory—simply copy and paste the code into their own project, in order to implement a more accessible menu.

2.6.3 Turretcss

Turretcss [48] is a Cascading Style Sheets (CSS) framework aimed at web designers. While it is not an accessibility centered project, the stated ease of using it to design accessible websites is one of its main selling points. The framework provides a number of predefined styles and user interface elements, like buttons and menus, that designers can include in their own projects. The elements are described as "semantic HTML elements with accessible color combinations, and screen reader utility classes to create accessible web interfaces" [48], with the idea being that since the elements are already accessible, the designer does not need to consider implementing accessibility features.

3

Theory

This chapter will present the theoretical framework of the project, introducing the concepts of interaction design, inclusive design, and web accessibility (focusing on the Web Content Accessibility Guidelines (WCAG). It will also detail theory of navigation on websites and present some existing research regarding web developers' and designers' knowledge about and attitude toward web accessibility.

3.1 The Interaction Design Process

In 1992, John Chris Jones proposed a model of design as a three-stage process: divergence, transformation, and divergence [49] In the divergence stage, the designer seeks to extend "the boundary of a design situation so as to have a large enough, and fruitful enough, search space in which to seek a solution." [49, p. 64] This is primarily a research phase, where the objectives of the design are still vaguely defined and changeable, and time is spent trying to understand the problem. [50] For the transformation phase, Jones writes:

> The main objective is to impose, upon the results of a divergent search, a pattern that is precise enough to permit convergence to the single design that must eventually be decided upon and fixed in every detail. [49, p. 66]

Here, attempts are made to structure the identified problem into smaller subproblems, which can be solved one by one, until "objectives, brief, and problem boundaries are fixed." [49, p. 67] Finally, in the convergence phase, the goal is to arrive at a final design, by eliminating alternatives "until only one of many possible alternative designs is left." [49, p. 68]

Two decades later, Rogers, Sharp, and Preece [12] described the interaction design process as containing four basic activities:
"

1. Establishing requirements
2. Designing alternatives
3. Prototyping
4. Evaluating

" [12, p. 15]
These can be seen as mapping onto Jones' model, with "establishing requirements" corresponding to "divergence", "designing alternatives" correlating to "transformation", and "evaluation" concerning "convergence", with "prototyping" being a part

of both the "transformation" and "convergence" phases. The four activities are meant to be repeated, the results of each influencing the others. Evaluation is held up as especially important, with the authors claiming that "[e]valuating what has been built is very much at the heart of interaction design." [12, p. 15] The purpose of evaluation is to understand what users do and want, so as to be able to determine if the design is appropriate, and should preferably involve actual users in some capacity. [12]

3.2 Inclusive Design

Inclusive design is a design philosophy with the intended goal of "developing products and services that can meet the needs of the whole population within the context of a consumer society." [51, p. 10] Universal design, a closely related concept, has been defined as "the design of products and environments that can be used and experienced by people of all ages and abilities, to the greatest extent possible, without adaptation." [52, p. 4] Both of these design philosophies arose from a movement in the 1990s that aimed to

> replace the view that people are disabled by physical and mental impediments with the more radical proposal that people are disabled by designs and environments that do not take account of the full range of human capabilities. [35, p. 127]

Inclusive design acknowledges the fact that it is sometimes not possible for a single design to address the needs of everyone, and that sometimes specialist products are required to satisfy the needs and wants of users. [53] In Figure 3.1 the target market for inclusive design is detailed.

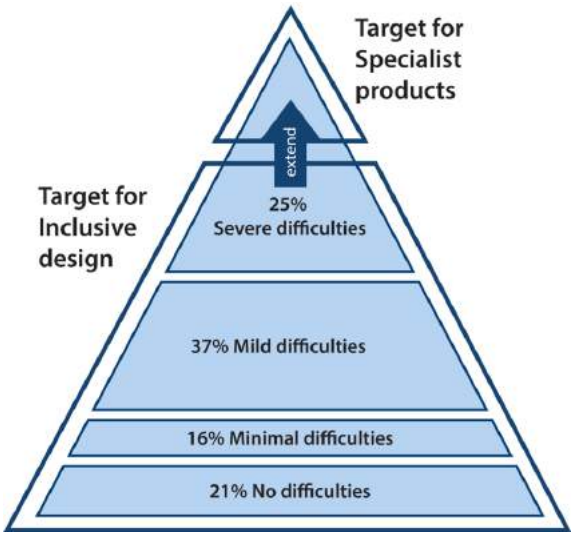

Figure 3.1: A pyramid model detailing the target market of inclusive design. [53]

Related to inclusive design but taking a broader view, Ben Shneiderman [31] in 2000 introduced the concept of "universal usability", defined as "having more than 90% of all households as successful users of information and communications services at

least once a week." [31, p. 85] He described three challenges in attaining this [31, pp. 85–86]:

- **Technology variety:** Supporting a broad range of hardware, software, and network access;
- **User diversity:** Accommodating users with different skills, knowledge, age, gender, disabilities, disabling conditions (mobility, sunlight, noise), literacy, culture, income, and so forth; and
- **Gaps in user knowledge:** Bridging the gap between what users know and what they need to know.

To address these challenges, he proposes an agenda including a committment to lowering costs, research in human-computer interaction, and usability engineering. [31] Doing this, Shneiderman contends, could "could pave the way for broad citizen participation in quality online services and novel social, economic, and political programs." [31, p. 91]

3.2.1 The Inclusive Design Process

To Keates and Clarkson [54], inclusive design is tightly related to user-centered design, something that influences how one should treat the inclusive design process:

> [E]nabling inclusive design requires the successful capture of information about the end-user and representing that information in a form that is accessible for the designer. The designer then needs to have the necessary tools and techniques available to translate the end-user information into a concept, which can then be tested against the end-user needs and wants. [54, p. 440]

They propose a three-stage design process (building on a model described by Blessing [55]) that correlates to the process presented by Rogers, Sharp, and Preece, but takes explicit steps to "include a broader range of user capabilities" [54, p. 446]:

> 1. define the problem: the problem definition should explicitly include reference to the intended target users;
> 2. develop a solution: an appropriate design approach should be adopted for the target users;
> 3. evaluate the solution: the target users should be included in the evaluation process
>
> [54, p. 446]

Building on this model, they present a 7-level inclusive design framework, designed to be applicable to a wide range of products [54, p 447]:

1. Identify the complete problem to be solved.
2. Specify the functionality to be provided.
3. Develop a minimal, but sufficient representation of the system status and verify user perception.
4. Structure the interaction to match the user's expectations and verify user understanding.
5. Develop quality of control and user input and verify user comfort.
6. Evaluate system functionality, usability and accessibility.
7. Evaluate social acceptability and match to user wants.

3.2.2 Attitudes Toward Inclusive Design

In the paper "Four reasons not to teach inclusive design" [56], De Cauwer et al. report on reasons given for resisting teaching inclusive design in six university programs in Flanders. The study was of architecture programs, but the authors believe the results to be transferable to other contexts as well. The study identified four common arguments against teaching it:

1. The concept of inclusive/universal design is viewed skeptically, and is not seen as the obvious solution to accessibility issues.
2. The nature of university education is taken to require a focus on a broad scientific education, and inclusive/universal design is too particular to warrant inclusion in the learning process.
3. There is not enough time to cover inclusive/universal design in the programs.
4. Accessibility is seen as a problem for society at large rather than universities, as long as accessibility is not explicitly rewarded, there is no use in investing in it. [56]

However, in a study by Basnak, Tauke, and Weidemann [57] the majority of the asked faculty members showed a positive attitude toward inclusive design. Furthermore, Heylighen has confronted these skeptical attitudes [58], relating inclusive design to the nature of design (as studied in design research) and through this arguing for a different perception. For example, she concludes that the difficulty in actually designing for everybody, that the subjects of the Flanders study alluded to, "is inherent to design rather than characteristic of universal design." [58, p. 8]

Finally, in the paper "How does inclusive design relate to good design? Designing as a deliberative enterprise" [59], Heylighen and Bianchin explore the relation of inclusive design to good design, trying to reconcile inclusivity and normative objectivity. In analyzing these questions, they argue for conceiving design as a "deliberative enterprise", that involves both the designers and the people they design for, and conclude that

> [T]he competence to judge what is good design is not an exclusive possession of anyone, but arises by deliberative cooperation of designers and people about the issues at stake. [...] A design is excellent not when it is appreciated by both the designers and the users, but when it is produced by exploiting the information and competences at the disposal of the designer and the people she designs for in qualified circumstances. [59, pp. 106-107]

3.3 Accessibility

There are a number of definitions of the term accessibility, as discussed by Persson et al. [60] They suggest employing the definition given in ISO 9241-171, defining accessibility as:

> the extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of character-

> istics and capabilities to achieve a specified goal in a specified context of us. [61]

This definition, they argue, avoids the problems that comes with focusing on individuals with certain disabilities, instead being applicable to the wider group of people that experience difficulties using a certain product. [60]

For web accessibility specifically, the primary definition is the one offered by the Web Accessibility Initiative (WAI), an effort launched by the World Wide Web Consortium (W3C). They define web accessibility as meaning that "websites, tools, and technologies are designed and developed so that people with disabilities can use them." [1] They further specify that it means means that people can "perceive, understand, navigate, and interact with the Web" [1] as well as "contribute to the Web." [1]

3.3.1 Web Content Accessibility Guidelines (WCAG)

The foremost authority on web accessibility are the Web Content Accessibility Guidelines (WCAG) [62], developed by the W3C. The current version, 2.0 (a new and updated version, WCAG 2.1, is being developed, but as of this date does not hold status of an official recommendation from W3C), consists of 12 guidelines, with each guideline being divided into a number of success criteria. These criteria, in turn, belongs to one of three successive levels: A, AA, or AAA. Each guideline is also categorized into one of four principles:

1. Principle 1: Perceivable - Information and user interface components must be presentable to users in ways they can perceive.
2. Principle 2: Operable - User interface components and navigation must be operable.
3. Principle 3: Understandable - Information and the operation of user interface must be understandable.
4. Principle 4: Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. [62]

[62]

3.3.1.1 Status of WCAG

Although the W3C is not an official body of any state, WCAG enjoys a high status in many countries. In 2017, a United States federal court acknowledged WCAG as an "industry standard" and determined that failure to comply with it may constitute a violation of the American with Disabilities Act. [63] In the European Union, the European Parliament adopted WCAG in legislation in 2016, requiring that websites of public sector bodies conform to WCAG 2.0 [64] This is also set to be added to Swedish legislation in 2018. [65]

3.3.1.2 Criticism of WCAG

The WCAG have received criticism on a number of different aspects. Kelly et al. [66] argue for the limitations of accessibility guidelines in general—contrasting guidelines to user evaluation—as well as criticize the WCAG specifically on a number of challenges in implementing them, such as their theoretical nature, their complexity, and logical flaws in their formulation, among others. Clark, in an article commenting on the last draft of the 2.0 guidelines [67], criticizes mainly the comprehensibility of the guidelines, the lack of connection to existing web standards, the guidelines' (perceived) fixation with automated testing.

Regarding testing, Alonso et al. [68] ran an experiment where 17 students of a web accessibility course manually evaluated a website against 25 selected criteria from WCAG. As an "answer key", the same evaluation was also performed by two experts. The result of the experiment highlighted two issues: first, that for 9 of the success criteria a majority of students gave an incorrect answer, second, that only 8 (32%) of success criteria where reliably evaluated at an agreement threshold of 80%. This led the authors to conclude that "WCAG 2.0 is far from testable for beginners" [68], something that is supported by similar findings by Brajnik, Yesilada, and Harper [69], who found that 50% of the success criteria in WCAG failed to meet an 80% agreement threshold in the experiments they ran.

3.3.1.3 WCAG and Navigation

WCAG specifically refers to navigation in guideline 2.4, "Navigable: Provide ways to help users navigate, find content, and determine where they are." [62] The intent is to "help users find the content they need and allow them to keep track of their location." [70] The success criteria for this guideline include bypassing blocks of content, describing link purpose, providing accurate and useful headings and labels, and providing information about the user's location. [62] The W3C also provides a set of recommendations for addressing this guideline that do not fall under any of the success criteria, such as limiting the number of links on each page and highlighting search terms. [70]

3.4 Web Professionals' Perceptions of Web Accessibility

In 2004, Lazar, Dudley-Sponaugle, and Greenidge investigated web developers' and designers' perceptions of web accessibility in the paper "Improving web accessibility: a study of webmaster perceptions" [71] To do this, they developed a survey targeted at webmasters that asked questions about their knowledge and perceptions of web accessibility. In total, 175 webmasters responded. The results showed that some webmasters objected to the very idea of accessibility interfering in their design work, and claimed that they would only make sites accessible if forced to by law. Most respondents, however, supported web accessibility as a concept, but experienced obstacles "such as lack of time, lack of training, lack of managerial support,

lack of client support, inadequate software tools, and confusing accessibility guidelines." [71, p. 284] This is similar to later findings by Putnam et al. [72], who in 2012 conducted a survey showing that user experience and human-computer interaction professionals experienced a lack of control over how accessibility was considered.

Another survey was conducted in Brazil in 2008 by Freire, Russo, and Fortes [73], asking 613 people involved in web development projects about their knowledge and perception of web accessibility. Their results showed that few of the participants were "really aware of accessibility issues in Web development" [73, p. 95], and that "few of the participants have ever had any kind of training regarding accessibility." [73, p. 95] It also showed that the 2004 legislation regarding web accessibility had not been effective in raising awareness, and that in fact few of the participants even knew the legislation. The main reasons given by participants for not considering accessibility in their projects were the the lack of formal requirements from the organization, lack of customer requirements, and lack of training and, to a smaller extent, the time and cost involved. [73]

In 2012, Yesilada et al. [74] conducted a survey asking 300 people with an interest in accessibility about their perceptions of the field, and its relations to that of usability. The results showed that the concept of accessibility was seen as tightly related to the concepts of both usability and user experience, and that the majority of respondents viewed accessibility as benefiting all users, not only users with disabilities. Regarding evaluation and guidelines, respondents "strongly agreed" that "accessibility evaluation is more than just inspecting source code; however, they are divided as to whether training in WCAG is necessary or not to assess accessibility." [74, p. 131] However, experts and respondents with a technical background were more inclined to agree that WCAG training is necessary.

In summary, the research seems to imply that the knowledge of accessibility varies among web developers and designers, but that the majority is generally positive toward the concept of accessibility. The main reasons accessibility is not considered in projects seems to be the perceived added cost in time and money, as well as lack of support from management and customers.

3.5 Website Navigation

Navigation in the context of computer mediums was defined by Watts-Perotti and Woods as "the decisions and actions that contribute to a person's ability to find and examine data organized in the computer medium" [75, p. 271]. This (along with other definitions of navigation) was later expanded on by Webster and Ahuja to define web navigation as "a system that is designed to aid users in the creation and interpretation of an internal mental model that helps them find and examine data on a Web site." [76, p. 663] Jakob Nielsen described three fundamental questions that the navigation needs to answer for a user [77, p. 188]:

1. Where am I?
2. Where have I been?

3. Where can I go?

Failure to answer these questions, according to Danielson [78], will lead to *disorientation*, "the tendency to lose one's sense of location and direction in a nonlinear document" [79, p. 40], a state which can lead to users missing sections of a site [80] and cause them to be frustrated and lose interest [76].

Website navigation systems can be classified into two types: global or simple. Simple navigation systems consist of pages having links to other pages in the site, whereas in global systems each page presents an overview of the whole site. [76] In a study by Webster and Ahuja, "those interacting with the enhanced global navigation system reported the lowest disorientation" [76, p. 670]—however, the authors concluded that "simple navigation systems can be better than some global navigation systems." [76, p. 671]

In 2006, Tan and Wei [81] ran an empirical study on the behavior of web browsing, and identified the processes and components involved in the task. As seen in Figure 3.2, the basic process consists of constructing a cognitive map, making a decision based on this, and executing this decision. [81]
Thomas [82] identified two web browsing behaviors that signal trouble with the navigation. They were *swapping*, in which "a user browses our website, exits to a search engine, performs a search, then returns to our site" [82, p. 32] and the weaker *circling*, where "a user views a number of pages, then retraces their steps and reviews an earlier page" [82, p. 32] (it is weaker because, in certain circumstances, circling is expected [82]). If either of these behaviors occur it is an indication that the user is having problems navigating the site.

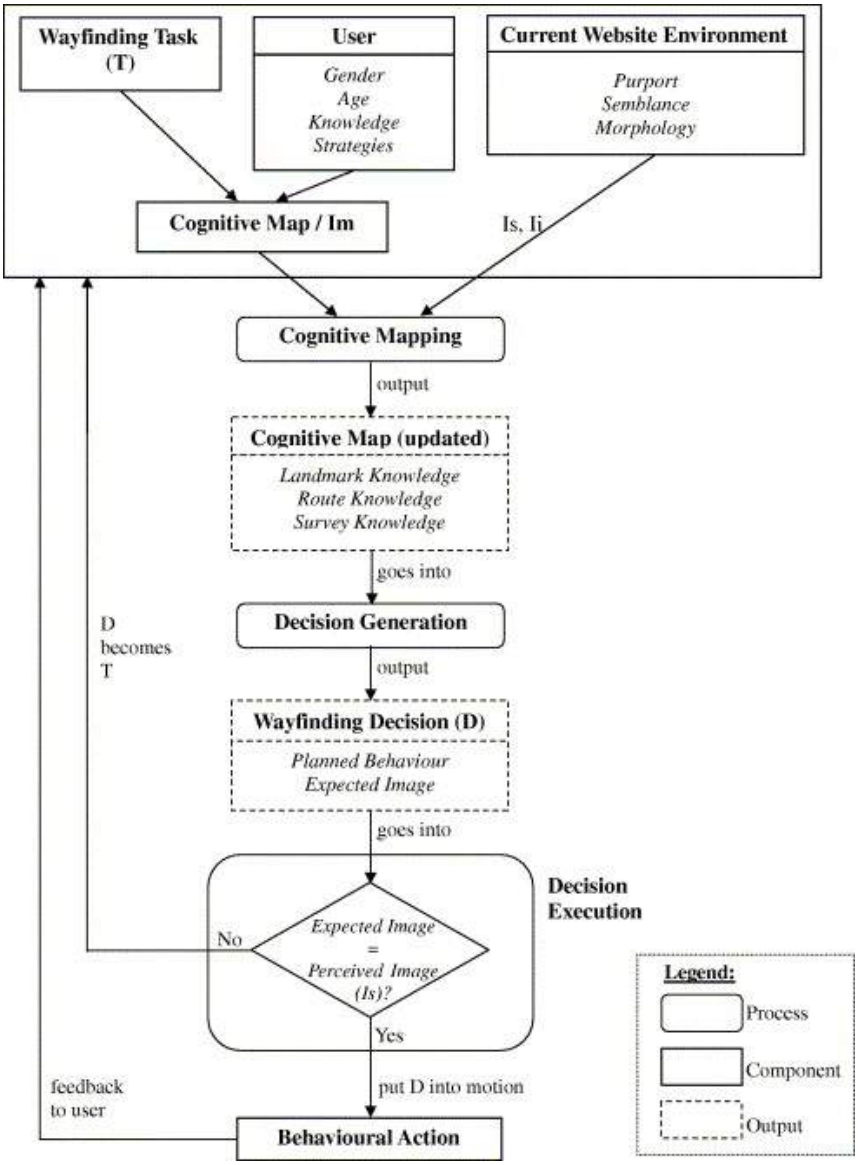

Figure 3.2: Wayfinding diagram of a web browsing task. The user constructs a cognitive map, makes a decision based on this, and executes this decision. The result of the execution feeds back to the user, who utilizes this information for the next web browsing task. [81]

4
Methodology

This chapter will introduce the concept of Research through Design, as well as present a number of methods that might be used throughout this project for research, prototyping, and evaluation, divided into the main phases described in chapter 5.

4.1 Research Through Design

The work on this thesis can be seen as a form of Research through Design (RtD), as described by Stappers and Giaccardi:

> [D]esign activities that play a formative role in the generation of knowledge [...] such as gaining actionable understanding of a complex situation, framing and reframing it, and iteratively developing prototypes that address it. [83]

When doing RtD, Zimmerman, Stolterman, and Forlizzi [84] argue that an important aspect is creating and building theory, as well as critiquing existing theoretical proposals. The traditional way of doing this is creating formalized written or diagrammatic theoretical accounts, but Gaver [85] suggests that annotated portfolios can be a valuable alternative to this. The defining feature of annotated portfolios, Gaver writes, is not the presentation of materials, but rather that they achieve a balance

> between descriptions of specific, detailed examples of design practice, and articulations of the issues, values and themes which characterise the relations among the collection, and to which the examples suggest answers. [85, p. 944]

Finally, Gaver notes that annotated portfolios are not intended to abstract design patterns from repeated design instances, but rather they "maintain the particularity of individual examples, while articulating the ideas and issues that join and differentiate them" [85, p. 945].

4.2 User Research

Research, in the words of Wadsworth, "a process that begins with people having reasons to ask questions, then setting about getting answers to them that will adequately address their initial reasons." [86, p. 9] User research specifically, as defined by Kuniavsky, is "the process of understanding the impact of design on an audience." [87, p. 3] To reach this understanding, a number of various methods are used, of which both Wadsworth and Kuniavsaky offer a number of examples. This section

will present a number of methods, their strengths and weaknesses, and how they might be used.

4.2.1 Individual Interviews

Individual interviews are conducted with one person at a time. When doing qualitative research, it is common that interviews take a semi-structured form [88], since these are more open and allow for new ideas to be raised during the interview [88]. This opens for the exploration of topics not considered beforehand, letting the interview subjects contribute the maximum amount of their individual knowledge. [86] This is valuable, but sometimes it is necessary with a more guided approach, in order to get answers to the relevant questions. A variation of interviews that might be useful is showing subjects videos of for example web navigation scenarios and ask questions about the videos, in order to stimulate discussion.

4.2.2 Group Interviews

An alternative form of interviewing is that of group interviews, where several people are interviewed at the same time in a form of group discussion. According to Wadsworth, group interviews are

> most valuable and exciting when you are utilising the group dynamics to generate new ideas, collect a wider range of perceptions and experiences, or find innovative solutions to persistent problems [86, p. 76].

However, they run the risk of groupthink, as well as losing the points of view of quieter people. [86]

4.2.3 Surveys

Another method that may be used to gather information is that of surveys, in particular online surveys [88]. A quick and cheap survey method is that of web-based surveys [89] For this, services such as Google Forms [90] or SurveyMonkey [91] can be used. To design effective web-based surveys, Lazar and Preece [89] have set out a process and a number of guidelines to follow, such as “make the survey error-proof” and “test the survey with different monitor sizes.” [89]

4.2.4 Field Visits

One user research method that can be very powerful is that of field visits. A field visit consists of going to meet people in their regular environment (for this case, that would be e.g. web designers at the design studio’s office) and observing them there. [87] This can generate huge amounts of data [86] and help generate concrete requirements for projects [87]. However, it requires a lot of time and effort to be done. [87] [86]

4.3 Data Analysis

After data has been gathered a content analysis of it will be performed. Content analysis is a method of analysis where the content is divided into categories and the number of occurrences in each category is systematically quantified. [88] Kuniavsky presents a process for qualitative analysis where the gathered data is processed so that it can be sorted and searched for patterns and themes. [87] For sorting and organizing fieldwork data, the AEIOIU framework, created by Wasson [92], can be very useful in getting started to organize and categorize observations that are made [87]. In this framework, data is organized into one of five categories:

1. Activities are goal directed sets of actions-things which people want to accomplish
2. Environments include the entire arena where activities take place
3. Interactions are between a person and someone or something else, and are the building blocks of activities
4. Objects are building blocks of the environment, key elements sometimes put to complex or unintended uses, changing their function, meaning and context
5. Users are the consumers, the people providing the behaviors, preferences and needs.

[92, p. 382]

4.4 Prototyping and Evaluation

The prototyping step is highly dependent on the result of the user research. The form of the prototypes created and the methods used to create them will depend on the result of the research, so as to target them specifically toward the problems identified. Likewise, the forms of evaluation chosen depends on the forms of the prototype. In chapter 1, four possible forms of solutions where mentioned: guidelines, method(s), design patterns, and evaluation tools. This section will present a (non-exhaustive) number of methods that may be used for prototyping and evaluating these.

Before that, however, two notes on the prototyping process. First, regardless of the forms of prototypes that are to be created or the methods used for this, the prototyping phase will adhere to the concept of parallel prototyping, i.e. creating multiple prototypes in parallel. The reason for this is that parallel prototyping was found by Dow et al. [93], to produce more diverse work that was of a higher quality than working on a single alternative at a time. Second, when developing methods or guidelines, traditional prototyping methods might not be suitable. Experience prototyping refers to prototypes that are designed to explore the experience of interacting with a product or system. [94]

4.4.1 Personas

Personas, developed by Cooper, are “hypothetical archetypes of actual users” [95] that “are defined by their goals” [95]. They can help designers in focusing on the users and making assumptions about the target group explicit, as well as enable communication with other designers, testers, and others. [96] To construct and utilize personas successfully, Pruitt and Grudin [96] recommend having personas be informed by existing market and user research.

4.4.2 Card Sorting

Card sorting is a method that can be used to understand people’s perceptions of concepts and categories and can help in organizing content. [97] Spencer describes how it is performed:

> You give people a set of cards (often paper index cards) that have example content written on them. You ask people to sort the cards into piles according to what’s similar and describe the groups they make (this is called an *open card sort*, as illustrated in Figure 1.1). Or you can give people a set of content cards plus a set of categories and ask them to sort the cards into the predetermined categories (this is called a *closed card sort*, as illustrated in Figure 1.2). Either way, you record the results, analyze them, and apply what you learned to your project. [97, pp. 6-7]

Card sorting is mainly used for information architecture projects [97], such as the structure of tools, grouping guidelines, or identifying important steps in methods.

4.4.3 Paper Prototyping

Paper prototyping is defined by Snyder as

> a variation of usability testing where representative users perform realistic tasks by interacting with a paper version of the interface that is manipulated by a person "playing computer", who doesn’t explain how the interface is intended to work. [98, p. 4]

Even though test subjects generally prefer computer prototypes over paper prototypes [99], paper prototyping holds a lot of benefits: it is quick, it provides a useful feedback early in the development, and it allows for iterative development. [98]

4.4.4 Think-aloud Protocol

Having a think-aloud protocol refers to having users think out loud while performing specific tasks which lets one record their reactions, for example when evaluating. [100] This can also be done retrospectively, where participants are silent when performing tasks, but then get to watch a recording of their performance and asked to describe what they did and why. [101] In order to teach and remind participants to think out loud, they can be given practice problems and asking questions throughout the test. [100]

4.4.5 Heuristic Evaluation

Nielsen defines heuristic evaluation as

> a method for finding usability problems in a user interface design by having a small set of evaluators examine the interface and judge its compliance with recognized usability principles (the "heuristics"). [102, p. 373]

The expertise of the evaluators influence the effectiveness of the method, with an experiment by Nielsen [102] showing that experts performed almost twice as well as non-experts. This can be an obstacle for using this method, as recruiting experts can be costly in time and money. On the other hand, in Nielsen's experiment, even novice evaluators were able to find usability issues, and since the actual performance of the method is relatively cheap and fast [103], it can still be a valuable method for identifying minor usability mistakes early on.

5
Planning

The work on this thesis will be divided into four overlapping phases: Planning and research, interviews, data analysis, and prototyping and evaluating. Here follows an elaboration of each of the phases, including the tasks constituting each phase.

5.1 Planning and Research

The purpose of this phase is to gain a solid theoretical grounding for the thesis, as well as find suitable methods for conducting interviews, analysis, prototyping, and evaluation. To achieve this, a literature study in two parts will be conducted: focusing first on methods for user research, prototyping, and evaluation; then on web accessibility and web developers' relation to the concept. For methods, Wadsworth's "Do it yourself social research" [86], together with Kuniavsky's "Observing the user experience" [87] will be used as a base; relevant methods found in these sources will be researched more thoroughly. Regarding web accessibility, the focus will be on literature related to the Web Content Accessibility Guidelines (see subsection 3.3.1).

5.2 Interviews

In this phase the aim is to gather data from web developers on their experience of and opinions toward web accessibility. It is divided into two subphases: preparing interviews (finding interview subjects, gathering questions and putting together an interview script) and conducting the interviews (including compiling the results). The focus will be on gathering qualitative data, through the use of semi-structured [86], [88] individual interviews. Therefore, the questions in the script will be kept open-ended. Interview subjects will be recruited through direct contact with web studios and through professional affinity groups on Facebook. In total, the plan is to conduct eight interviews.

5.3 Data Analysis

Analysis of the interview results will begin as soon as there are results, but the bulk of the analysis work will take place after the interviews themselves are finished. Interview data will be analyzed through content analysis, using the methods set out by Wadsworth [86]. To aid in this, audio recordings of the interviews will be transcribed.

5.4 Prototyping and Evaluation

This phase will be spent prototyping design solutions to the problems identified in the earlier phases, as well as evaluating these prototypes. For creating the prototypes, card sorting [97] and paper prototyping [98] will be used. For evaluating, some form of heuristic evaluation [104] and user testing, using a think-aloud protocol [100]. Finally, an annotated portfolio (as proposed by Gaver [85]) of the prototypes will be created.

5.5 Intended Results

The intended outcome of the thesis project is twofold. First, a collection of the identified factors that influence whether accessible websites are created or not, for use by future research and application by web professionals who wish to increase the amount of accessibility work conducted. Secondly, an annotated portfolio (as described by Gaver [85]) of prototyped solutions to any identified problems, that can support web professionals in creating accessible solutions for navigating online archives of digitized artist material.

6
Process

My process throughout the project followed the general structure outlined in chapter 5, although the execution of several phases differed from the plan, including adding an entire subphase, subsection 6.3.2.

6.1 Literature Study

The literature study was conducted in two parts; concerning methods for user research, and regarding web accessibility and related topics. Apart from Wadsworth [86] and Kuniavsky [87], Hanington and Martin's "Universal methods of design" [105] was used as a base for finding suitable methods. These three sources were searched or relevant methods, those found were further researched through searching the databases Google Scholar [106] and the Chalmers online library [107]. This allowed for quickly finding a number of methods which could be used.

When researching web accessibility, my starting point was the Web Content Accessibility Guidelines (WCAG), as these are one of the biggest resources for web accessibility (see more in subsection 3.3.1). Apart from WCAG and web developers' relation to them, I also researched Inclusive Design and the discourse surrounding it (drawing strongly on Heylighen [58], [59]), as web accessibility can be viewed as a subset of the larger Inclusive Design discipline. Finally, as I had decided to focus the project on accessibility in website navigation specifically, the theory surrounding website navigation was studied. In this, Tan and Wei's paper on the behavior of web browsing [81] was very helpful.

6.2 Interviews

This phase can be divided into two subphases: preparing the interviews, and conducting them. After the interviews were conducted, I analyzed the data and attempted to draw conclusions based on the findings. The result of the analysis is presented in subsection 6.3.1, and the conclusions can be found in section 7.1.

6.2.1 Preparing Interviews

This first subphase consisted of preparing interview questions and finding interview subjects. For the former, I used the methods laid out by Wadsworth [86] and Elliot [88] as a guide. The questions primarily considered the subjects' knowledge of and

attitude toward web accessibility. A subset of the questions had the subjects consider specific past projects, based around navigation on websites with large amounts of images (or, if the subjects had no experience of such projects, large amounts of content in general). Questions were consciously kept open-ended, so as to allow new ideas and points of view to arise during the interviews. Finally, I created a form to gather informed consent from the interview subjects.

For recruiting subjects I began by contacting museums in Gothenburg, asking what web design studios had been involved in creating their websites. The idea was to be able to directly contact developers and designers who had been involved in creating the kind of website being investigated in the thesis. In practice, this proved difficult. Most museums did not answer and of those that did, none were able to help. Instead, interview subjects were reached in two ways: direct contact with the two developers of the Arosenius project, and through contact seeking posts in the Facebook groups "Kodapor", "UX Sverige", and "Webbdesign & Utveckling", three groups seeking to gather professionals in the fields of development and user experience. Through these two methods, six interview subjects were found.

6.2.2 Interview Subjects

This section will present the findings from the conducted interviews. For context, a short introduction of each of the six interview subjects will be given. All names have been changed.

Erik has a background in interaction design, but works as a research assistant at a university, doing research on digitalization. The interview mainly concerned his work on an image archive website, for which he was both the main designer and, as a part of the research group, the client.

Maria is a software developer consultant working at a large customer experience agency. She has worked as a developer for ten years, has primarily worked with Content Management Systems, connecting interfaces to the underlying data. She has studied a two-year vocational education in web development.

Lars has worked as a software developer for ten years, working a lot with “data, and what can be done with it,” inquiring into how data can be utilized in interfaces. His technical education consists of two years of multimedia design studies. He has worked mainly in academia, and is currently involved in work on an image archive website, for which he is both developer and, as part of the research group, the client.

Karl is a web developer consultant. Having worked with web and front-end development for four years, he currently works for a large company in the aviation business where his primary work consists of receiving designs from the company’s designers and implementing these in code. He is educated in software engineering and interaction design.

Anders is a senior UX designer at a medium-sized company in the banking industry. His responsibilities include the user experience of their website, as well as the overall user experience of all aspects of the company. With an education in interaction design, he has worked with user experience for ten years.

Johan currently works as an agile coach, but has previous experience working as front-end developer at a large company, where he mainly worked with disability adjusting (a section of) the company's website, focusing mostly on the technical sides of the process. He has an education in computer science.

6.2.3 Conducting Interviews

The interviews were conducted over a span of two weeks. Most interviews were conducted at the subjects' respective places of work. The interviews lasted between 20 and 40 minutes and were documented through audio recordings and notes. The discussions mainly revolved around the questions I had prepared; although certain sidetracks were explored, this was not very common.

6.3 Data Analysis

I began preliminary analysis of the interview data began as soon as the first interview was conducted. The main work, however, began when all interviews were finished, and consisted of going through the audio recordings and searching for trends and categories, as detailed by Wadsworth [86], drawing also on Kuniavsky [87] for inspiration. Although the original intention was to transcribe each interview, I abandoned this relatively quickly as I realized that while it might be useful to have the full content of all interviews available as text, it would simply take too much time to be efficient.

Upon realizing that the interview findings did not contain much information about specifically navigation (more on why this might be in subsection 8.2.1), I decided to perform an analysis of the state of navigational accessibility of the Arosenius project website, in order to concretely demonstrate what accessibility in navigation refers to and what might have supported accessibility throughout the work on that particular website. The results of this analysis can be found in subsection 6.3.2.

6.3.1 Interview Findings

As a part of the analysis of the findings, a number of themes and sub-themes were identified in the answers given by the interview subjects. Here they are presented together with exemplifying quotes from the interviews, along with observations and analyses of them. In discussing the findings, comparisons will be made with the studies introduced in section 3.4.

6.3.1.1 Accessibility

The six interview subjects had differing but overlapping views of what accessibility entailed. Four main ways of thinking were identified, however most interview subjects raised more than one way of viewing accessibility. All of the views can be said to conform to the definition of accessibility given in ISO 9241-171, which defines accessibility as:

> the extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of us. [61]

Disability Adjustments

"The first thing you think about are these alt tags on images, and making it possible to read [the website] in screen readers." — Johan

The first and most common way of thinking about accessibility was as the act of making special adjustments to a design in order to accommodate the needs of disabled users. Specifically, adjusting websites to be usable by people with vision impairments (such as designing for screen readers) seemed to be the first thing to appear in many of the interview subjects' minds when considering this aspect of accessibility.

For Maria, the accessibility work at her workplace "regards making sure that [websites are] readable by having it read out", as well as making sure that websites are "readable even if you have a somewhat impaired vision," but she notes that she may not be totally familiar with their practices due to not primarily working with the front-end (which she sees as the domain in which accessibility exists). Lars started by talking about technical accessibility (see subsubsection 6.3.1.1 below) but was quick to add that "it is also quite important that it is accessible to those who cannot see and such." Anders reports that to him, accessibility used to mean "coding correctly so that a screen reader can read it," but he now felt that he had moved to a broader, more holistic (see subsubsection 6.3.1.1 view. Erik mentioned disability adjustments, but specified that this had not been the main focus in his current project, where they had rather focused on the holistic aspect. Karl also focused more on technical and holistic accessibility, but mentioned that accessibility could pertain to disability adjustments such as "coloring buttons so that there are no problems with color blindness, or having clear, large text, high contrast, or very clear navigation."

In the mindset expressed here users with special needs are viewed as a single (if diverse) group, one that differs from the primary group and is in need of particular consideration. Constructing this dichotomy—even if it is not done consciously—between a (larger) "primary" and a (smaller) "secondary" group, implicitly characterizes the secondary group as non-essential, opening up for the possibility of exclusion. This perspective can be juxtaposed with that of inclusive design, where "people are disabled by designs" [35, p. 127] and ability is seen as a spectrum, where

special needs are dynamic and temporally bound rather than static and permanent. From this point of view, providing for special needs is seen as critical, as failing to do so could potentially mean excluding one's entire target audience (at one point or other). This mindset can also be contrasted by that found by Yesilada et al. [74], who noted that "the fact that accessibility benefits all types of people regardless their abilities and situations is very strongly supported by all." [74, p. 129] This disparity might be caused by Yesilada et al.'s study being targeted specifically toward people with an interest in accessibility, but this could be interesting to investigate further.

Technical Accessibility

"When talking about accessibility, perhaps it would be fruitful to broaden the term to, so to speak, the technical tools users use to take part of the content." — Karl

The second accessibility aspect that was raised was that of technical accessibility; that is, being able to access a website no matter what kind of equipment is used. Karl contrasted this to the previous aspect, noting that "it is not just disabilities, it could also be that someone wants to read their content on a certain kind of device." To Lars, accessibility primarily meant that "It does not matter if you are on iPhone or Android, mobile phone or old Internet Explore or Google Chrome on Linux, you can always see the content, you can do the same thing but in slightly different ways." Erik noted that one specific way of achieving technical accessibility and preventing the problem "that it does not work on a large section of people's devices" was through adhering to web standards.

Technical accessibility is one aspect of the Web Content Accessibility Guidelines (WCAG) [62], which includes sections related to it, such as success "Guideline 4.1 Compatible: Maximize compatibility with current and future user agents, including assistive technologies." In Yesilada et al.'s study [74], respondents were "divided as to whether training in WCAG is necessary or not" [74, p. 131], with respondents coming from a technical background more inclined to agree that it was. Since WCAG relates to other aspects of accessibility as well, a one-to-one comparison is likely to be misleading, but it could be interesting to note that the interview subjects who raised the question of technical accessibility all have technical backgrounds as well.

Language

"It can also be like, the language of a website or an app." — Lars

One aspect that arose that rather surprised the author was that of accessible language. For example, Erik noted that there are certain websites that are "not accessible because of the language being used", something they were trying specifically to counteract in one project he was currently involved in. Anders mentioned that for his employer, there are certain target groups that are naturally excluded, but that "disregarding target groups who for example [...] do not understand Swedish very well [...], that is less OK." Johan recalls one specific job where he was involved

in making a website more accessible, in which they "worked quite a lot with the language on the pages."

Of the studies presented in section 3.4, only Putnam et al. [72] mentioned relationship between language and accessibility, and then only briefly (one of the participants mentioned using plain language in order to accommodate users with cognitive disabilities), which could imply that language and accessibility are usually not seen as related. However, WCAG includes a guideline ("Guideline 3.1 Readable: Make text content readable and understandable." [62]) specifically related to language, with success criteria pertaining to text complexity (success criterion 3.1.5 Reading Level) and unusual words (success criterion 3.1.3 Unusual Words), so it might simply be coincidental that is was not brought up more in the studies.

Holistic Accessibility

"Having an accessible website means that users who have certain needs or certain desires or demands on how they want to be able to use your website should be able to do that without having problems." — Karl

Finally, the last accessibility aspect is more difficult to define than the others, and regards accessibility as more than a single or a number of discrete aspects; rather, it is seen as a holistic perspective. To Karl, accessibility primarily means that "everyone in the target group, and users outside the target group, should be able to take part of the content to be displayed," without specifying more what this entailed. Lars related accessibility to usability, saying that what they had considered mostly in his current project was "making the website simple for the user." Erik related it to user experience in general, saying that part of accessibility was that the user should "feel some sort of pleasure as they are searching." Finally, Anders noted that, even if he could not specify exactly what it is, for him accessibility "has become something bigger compared to when I began [working with] the web ten years ago, back then it was mostly 'w3C accessibility'", referring to strictly making sure that produced code follows accessibility guidelines.

These findings are consistent with those of Yesilada et al., whose respondents agreed that "accessibility evaluation is more than just inspecting source code" [74, p. 131]. None of the other studies regarded specifically what participants considered accessibility to be, making comparisons difficult.

6.3.1.2 What Good Design Is

"Good design satisfies some form of need, both for a would-be user and for a company." — Anders

All interview subjects had their own view of what good design entails, but for most of them it relates to satisfying needs while being easy to use. One of Lars' examples of good design was "an interface that you arrive at and you do not have to think that much, you just start clicking and you find things." For Karl, good

design means predictability. “If I arrive at a new website it is usually the matter that I want to perform a task that I have done before, but somewhere else.” In his view, applications usually fall into certain categories, with a number of suitable “design recipes” existing for each such category, and “not following that recipe for that specific application is a big design error.” Johan follows Anders in relating good design to customer needs, mentioning that “you need to do a customer analysis to understand what it is the customers need.”

All the responses given can be seen as more concrete and practical than the one presented by Heylighen and Bianchin [59]. However, the various definitions should not be seen as standing in opposition to neither each other nor Heylighen and Bianchin’s definition—which concerns more the way a design is created rather than potential appreciation of the finished result. A design can easily fulfill each of the given criteria at the same time, while also conforming to Heylighen and Bianchin’s qualification.

The Relation Between Good Design and Accessibility

“If the people who are supposed to access something cannot access it it cannot possibly be good design.” — Anders

All interview subjects claimed that there is a relation between accessibility and good design. Most clear was Karl, who instantly noted that “Accessibility is definitely a part of good design.” Lars “would say that it is connected”, but did not further specify the manner of connection. Erik mentioned that he regards many accessibility aspects as “common design manners,” and that it is usually “is better for everyone” when these are considered. This sentiment is shared by Johan, who says that “if you create a good design overall where you have considered [accessibility], I feel that it becomes better even for those who do not need a screen reader or high contrasts.”

These results correspond to those of Yesilada et al. [74], who showed that accessibility was tightly related to both usability and user experience in the minds of their respondents.

6.3.1.3 Current State

For interview subjects’ thoughts regarding accessibility in the “web development community of Sweden”, three main tracks can be noted: accessibility concerns in web design and development education, the expertise in and demand for accessibility, and the (lack of) accessibility requirements specified by clients or internally in design teams.

Accessibility in Education

“I think [accessibility] was one of those things thing that was quickly passed by.” — Anders (educated in Interaction Design)

Most interview subjects could not recall accessibility being a large part of their education. Maria, for example, could not recall "that [accessibility] was spoken of much at all," and Lars could not remember if it had been mentioned, but did "not think it was very much," noting that in a relatively short education with a relatively broad focus, there was not a lot of time to delve deep in many subjects. Karl did mention that he had "quite a lot of exercises where the point was to find tools for considering various types of disabilities," and Johan, noted that "we included [accessibility] aspects in our reports when we wrote them"—but reflected that he had had supervisors with an interest in accessibility, and that it might not have been a part otherwise.

Both Freire, Russo, and Fortes [73] and Lazar, Dudley-Sponaugle, and Greenidge [71] noted "lack of training" as an obstacle to accessibility, something that would agree with the interview subjects' views. However, both Karl and Johan mention accessibility mention accessibility as a part, however small, of their education. Interesting to note may be that Karl and Johan have a more design focused education than some of the other interview subjects, and are the most recently educated, both of which may be part of the explanation as to why their experiences differ somewhat.

Accessibility Expertise and Demand

"There is absolutely a demand [for accessibility]." — Johan

Maria agrees with Johan, saying that "[accessibility is] an issue that is often raised." Johan goes on to mention, however, that he finds "that there is quite a lot of competence missing." This is something Karl agrees with, thinking about the role of education in this and noting that in his experience, "among those who have not studied a design focused education [...] the idea of accessibility is somewhat peripheral." Lars thought the question hard to answer, due to not having worked a lot in the industry, but notes that "[in academia] there have been quite a big problem that [accessibility expertise and demand] is missing." In Johans experience, clients that are required by law to consider accessibility, such as municipalities, typically have higher demands for accessibility than other clients.

Johan's note that legal requirements increase the priority of accessibility is interesting in relation to the study by Lazar, Dudley-Sponaugle, and Greenidge [71], which showed that legislation had not been effective in raising awareness about the issue. One explanation for this discrepancy is that the study looked at webmaster perceptions, whereas Johan's comment relates to specific clients. It might also be related to cultural differences between Brazil and Sweden.

Accessibility as Requirements

"We do not see it as a problem that we have to solve on our website." — Erik

Regarding requirements raised for accessibility, the general consensus was that when

these exist, they usually come from "above" in the organization and, ultimately, from the clients—and that clients are far from always keen on requiring accessibility (more on that in subsubsection 6.3.1.4). Maria notes about a specific case that accessibility was "not that important to the client, because their customers [did] not have those demands." Anders has similar experiences with customers not prioritizing accessibility, noting that "if it is not enforced [...] it has been omitted." Karl noted that even if clients had accessibility requirements, he would not consider making sure these are met his responsibility, but rather that of the designers earlier in the chain: "I work in such large organizations that I do not need to engage in design anymore, therefore [accessibility] is not my job." A similar sentiment was expressed by Maria, who notes that the front-end developers at her company may have more experience working with accessibility. Johan mentions a somewhat unique case where requirements "did not come from above", but rather arose as a result of the design team's user research ("the customers requested [accessibility]") in conjunction with there being "[a person with] expertise in-house somewhere who started the job." Finally Erik, occupying the role of both client and designer, noted that accessibility does not always need to be a requirement, saying about the current prototypes "are not meant for the crowd" and therefore "does not need to be accessible to everyone." Similarly, he mentions that accessibility need not necessarily be a task for the designers of a specific website, noting specifically about color blindness that "people who have this kind of color vision probably have add-ons for that for their operating systems", implying that adapting a website to be accessible specifically to color blind people would be a wasted effort.

Here the results are in accordance with the studies by Lazar, Dudley-Sponaugle, and Greenidge [71] and Freire, Russo, and Fortes [73], and Putnam et al. [72], as all studies point to lack of client priority as a reason accessibility is not concerned. One interesting aspect to consider is Maria's and Karl's comments about where the responsibility for accessibility falls: Maria points to front-end developers while Karl, a front-end developer points to the designers. This can of course vary depending on organization, but it might be interesting as a further area of inquiry to explore if organizations generally have a specific group of people who are in charge, or whether the responsibility is always seen as lying "somewhere else."

6.3.1.4 What Would Make Accessibility Work Easier?

When asked what would make working with accessibility easier from their specific point of view, there was no uniform answer. Four main areas were identified in the answers given: support regarding information on users, technical tools, inclusion of accessibility in design processes, and stricter requirements from both clients and the companies themselves. Apart from on the subject of technical tools, no concrete concepts for how to facilitate accessibility work were raised. Of all the interview subjects, Lars was the only one who had no answer to this question.

Information on Users

"In general I feel that it helps to gain insight into what the demands on the end user are." — Maria

Maria notes that "information about the end user is central, not just with regards to accessibility but in general", and requests easier methods of gaining this information. For Erik, information is wanted specifically on what kind of disabilities and needs users might have, noting that "there are an extreme amount of [disabilities] that you almost certainly miss", and that his knowledge in this area is mainly coincidental, coming from having acquaintances with certain disabilities and from noticing accessibility tools in existing software.

These concerns can be seen as related to the findings by Freire, Russo, and Fortes [73], who noted that developers were not really "aware of accsessibility issues" [73, p. 95]. In Lazar, Dudley-Sponaugle, and Greenidge [71], as well, observed lack of training as one reason accessibility was not more considered. The question also relates to the discussion in subsubsection 6.3.1.1, about adjustments for special needs, and special needs users as a separate and distinct group.

Technical Tools

"What would happen if the idea of accessibility was baked into the languages used in development, number one being perhaps CSS, and applications used in design, like Sketch?" — Karl

Both Karl and Johan request automatic validation tools that can be used throughout the design process. Johan would "want it to become a more natural part of the toolkit", drawing a parallel to coding work, where for coders there are tools for "automatic parsing, that is, it verifies that the code looks good, and many such things," but that this does "not [exist] for accessibility." Karl has a similar notion, expanding on the idea and mentions that some aspects that could be verified are "choice of colors, for example, and font sizes and distance between lines."

In Lazar, Dudley-Sponaugle, and Greenidge's study [71], conducted in 2004, "inadequate software tools" [71, p. 284] was raised as an obstacle to accessibility. If this is still an issue 14 years later, that might be indicative something about the condition of accessibility. On the other hand, only two of the six interview subjects raised this issue, with none of the others mentioning it at all. An interesting observation here might be that both Karl and Johan have engineering backgrounds, and have worked more with the technical side of development.

Processes

"[Accessibility] comes a bit in hindsight. [...] It's a mistake you often do if you do not have these routines in place from the beginning." — Maria

This sentiment by Maria is shared by Anders, who observes that "if you do not have a process to always include [accessibility], you do not do it." Johan also agrees and sees this as an issue that needs to be raised on multiple fronts, saying that "there is a need for development, that is, understanding of this, in education and [...] companies."

In both Freire, Russo, and Fortes' [73] and Lazar, Dudley-Sponaugle, and Greenidge's [71] studies, lack of time and lack of training are suggested as reasons for absent accessibility practices. The absence of accessibility in design processes can be seen as both a cause and an effect of this: since it has no formal place in the process, it is considered and neither taught nor learned; and since designers do not possess skill in the area or time to consider it, it is never included in the natural process.

Requirements

"Unfortunately it is always an economic consideration when you get into the working life." — Karl

As mentioned in subsubsection 6.3.1.3, there was a general feeling among the interview subjects that clients do not prioritize accessibility highly, and that because of this accessibility requirements are often not formulated. As Maria notes, echoing, Karl's sentiment, "the clients decide what they want to pay for, so how much emphasis we put on [accessibility] is up to the client." Johan agrees that this is the situation, noting that when propagating for accessibility, one should always ask the question "what is the impact on our business?," since this means that "there is suddenly money involved, and then you can motivate why you should do it."

As mentioned in the discussion for subsubsection 6.3.1.3, it might be interesting to further explore the question of where in an organization the responsibility for accessibility falls. Especially fruitful might be investigating the opinions of clients and organization management, to discover their relationship to the concept and their thoughts on requirements.

6.3.2 Analysis of Navigational Accessibility on the Arosenius Archive

This section will present various concrete examples of accessibility (of all four variations mentioned in subsubsection 6.3.1.1) with regards to navigation, using the Arosenius archive website [20] as a case. For context, the examples will relate to the end user groups outlined in section 2.4 and the various special needs presented in section 2.5.

The goal from the start was to investigate accessibility specifically with regard to navigation. However, this aspect was not featured prominently in the interviews, making it difficult to answer the research questions. In order to gather more data, I decided to perform an analysis of an existing archive website, the Arosenius archive

[20]. While WCAG guidelines were a factor considered during the analysis, I decided to to a manual analysis rather than use any automated tools, in order to capture the various aspects of accessibility raised in subsubsection 6.3.1.1. Rather, the analysis consisted of walking through two navigational cases I created (see subsubsection 6.3.2.1), attempting throughout to consider each step from the point of view of each of the user groups outlined in section 2.4 and the special needs presented in section 2.5. A more general discussion of the relation between accessibility and navigation can be found in subsection 8.2.3.

As a complement to my analysis, I looked at data gathered by a group of students as part of an exercise in a course in human-computer interaction given at Chalmers University of Technology in the spring of 2018. In the exercise, they evaluated the Arosenius archive using heuristic evaluation, cognitive walkthrough, and user testing; for all evaluation methods, the students simulated users belonging to one of three groups: children ages 7-9, art researchers, or senior citizens aged 75+. The student report can be found in Appendix A.

6.3.2.1 Navigational Cases

Throughout the analysis, the user groups outlined in section 2.4 and the various special needs presented in section 2.5 were utilized as a basis. In particular, I devised and used two specific navigational cases:

The first case was *find paintings similar to the painting "Flickan och ljuset"*. There are several reasons a user would want to find similar paintings—a child is perhaps interested in one of Arosenius' most famous work and wondering what other paintings he has done; a senior citizen might be fond of it, and curious to discover other works of art they might like; an art researcher could be comparing similar paintings to find themes or influences. The case tests a number of accessibility aspects: how will users attempt to find a specific painting? Will they find the search function, and if so be able to use it effectively? If they find the specific painting, how do they go on to find similar ones; how does the archive attempt to lead them on?

The second case, *browse pictures related to the topic of death*, was chosen as an example for when users are not looking for a specific painting, rather attempting to experience art in the same way they might at a traditional art exhibition. For a child, it might be the case of a homework assignment, where they are tasked with investigating Arosenius' paintings on this topic; a senior citizen is perhaps simply interested in viewing paintings and chose the topic on a whim; an art researcher is perhaps investigating many different artists' relationship to this topic, now looking at Arosenius. The case investigates how users go about (and if they are able) to find a certain topic and how they browse when there is not a single target in mind.

6.3.2.2 Cognitive Mapping and Decision Generation

Cognitive mapping, as described by Tan and Wei [81], refers to the user creating a mental representation of the website, which is then used by by the user to decide

which action to take in order to reach their goal. Upon first visiting the Arosenius archive website, the user is presented (as shown in Figure 6.1 by a background image of an Ivar Arosenius artwork, the main search button, and a small menu with three links: one for more information about the project, one for information on how to contribute, and one to open and scroll to the filter section of the search (discussed in subsubsection 6.3.2.3). In the case that a user arrives at the archive with little or no prior knowledge about Ivar Arosenius or the contents of the archive the experience might be confusing. There is no information on the homepage about who Ivar Arosenius is, what kind of content the archive contains, or what its purpose is, although there is a link immediately available to a page detailing the research project and the website. This lack of immediate information might inhibit the user's cognitive mapping. A more experienced user, however, like an art researcher familiar with Ivar Arosenius and with experience using other art archives, might not be as impacted by this aspect as other user groups might be. To catch this potential accessibility issue, user testing—with a diverse group of users—could have been helpful, seeing which, if any, users would have regarded this as an issue.

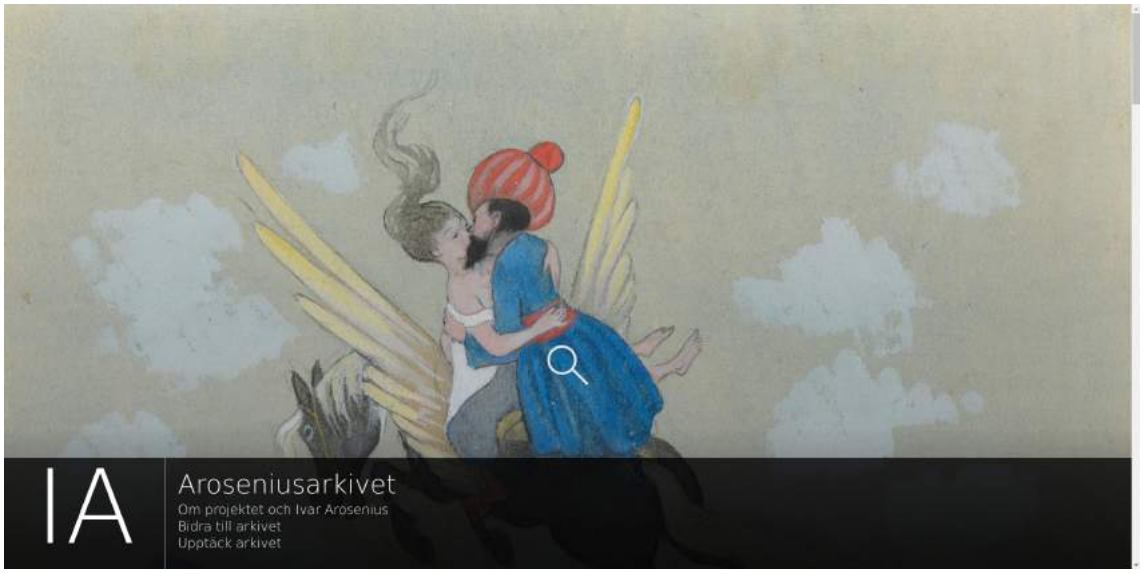

Figure 6.1: The Arosenius archive homepage.

Users from different user groups might also be interested in different kinds of content, or different ways of engaging with the same content. A child might wish to immerse themselves in a story (such as one that Arosenius wrote) while being completely uninterested in any of Arosenius' correspondence; a senior citizen perhaps wants to browse art of an artist they know and like, while also being open to learning more about Arosenius himself; and an art researcher might be trying to identify phases in Arosenius' painting career, comparing paintings and reading letters from the same time period. These are very different ways of engaging with the existing material, and they might require different paths to reach the material. Here, as well, user studies could have been valuable, to investigate what users would find interesting about digitized artist content and how they would like to engage with the material.

6.3.2.3 Decision Execution

There are two main methods of interacting with the archive:

- Scrolling through and clicking displayed content.
- Searching using the search function.

Having multiple ways to reach one's goal is positive, and in accordance with WCAG success criterion 2.4.5, which requires that "More than one way is available to locate a Web page within a set of Web pages except where the Web Page is the result of, or a step in, a process." [62] The two modes are of course not mutually exclusive: searching requires scrolling through and clicking the results, and the user can switch between both methods freely and use both during a single session. The primary method of interaction is implied to be searching, since the search button is prominently featured and one of the first things the users sees upon entering the website. This can make it difficult to progress for a user who does not know specifically what they are looking for, such as a senior citizen familiar with Arosenius who is visiting the archive to browse the paintings, rather than looking for a specific piece of content. This user might believe they have to search for something specific and be deterred; however, this is likely not a huge issue, because of the way the search function presents forward paths (as described in Figure 6.3.2.3) and because simply scrolling a short way will display content.

The archive can be navigated using only the keyboard—in accordance with WCAG guideline 2.1, "Make all functionality available from a keyboard." [62]—but it is not very clearly indicated which element is currently targeted, potentially making keyboard only navigation difficult for visually impaired users and directly violating WCAG success criterion 2.4.7, which requires that "[a]ny keyboard operable user interface has a mode of operation where the keyboard focus indicator is visible." [62] This could be alleviated by clearly highlighting the currently selected element, such as surrounding it with a colorful border. If this behavior is not wanted during regular navigation, this behavior could be turned on only when keyboard only navigation is identified. If accessibility had been more a part of the design process the designers might have included more testing—performing it themselves and simulating visual impairments, or conducting formal user evaluation and including users with visual impairments—and this particular difficulty might have been caught.

Click and Scroll Navigation

If the user does not click anything on the homepage and instead scrolls down, they are presented with an overview of existing content. The default view (shown in Figure 6.2) is called the "gallery", and the user is presented with the choice of two other views: "timeline", which displays content in the sequence, ordered by when each piece of content was created; and "catalog", which is intended to be more similar to a traditional art archive view, and targeted more toward art researchers. Regardless of view, the content displayed is clickable, and clicking takes the user to a view with more detailed information about the selected content (Figure 6.3), along

Figure 6.2: The gallery view of the Arosenius Archive.

with links to other, related, content. This detailed content view does a good job of leading the user on to related content, making the user feel like there are always ways of progressing and delving further into the archive.

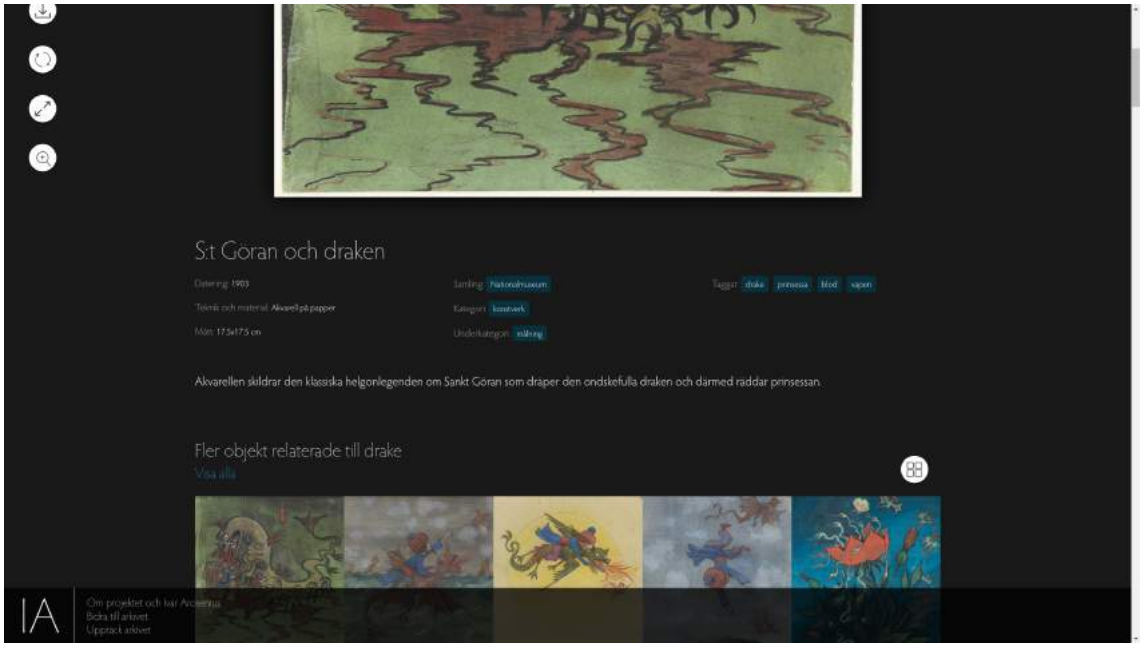

Figure 6.3: The view for a specific content on the Arosenius archive.

Searching

The button for searching is the first thing the user is presented by upon entering the Arosenius archive. Clicking on the button reveals the search field, shown in Figure 6.4, with a placeholder text prompting the user to write something. The

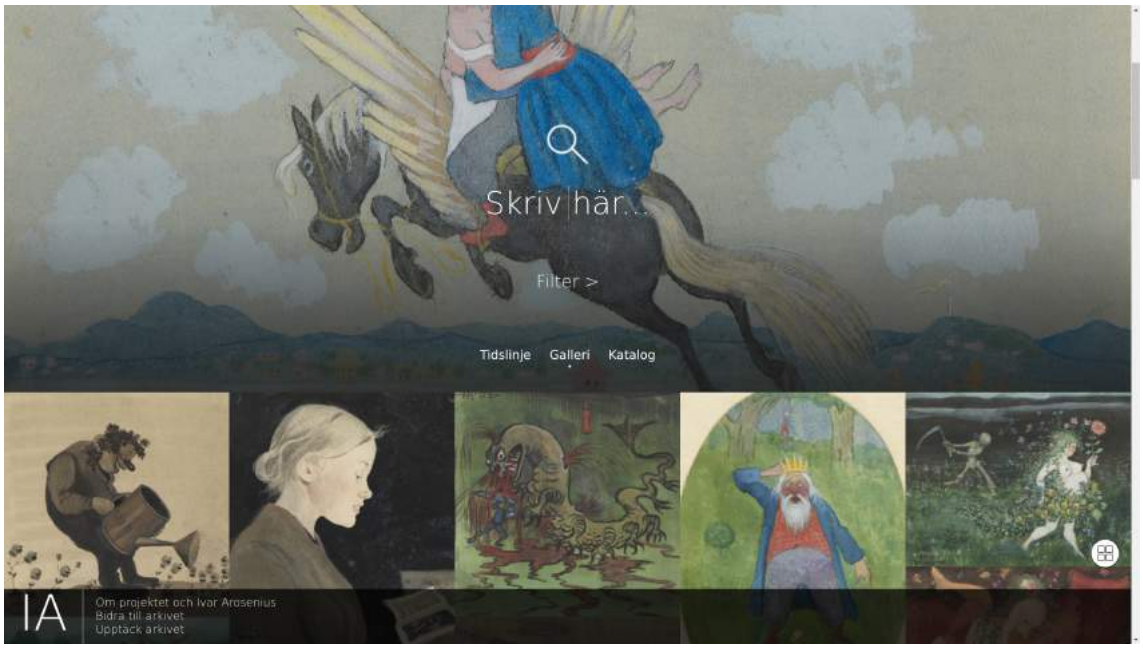

Figure 6.4: The active search field on the Arosenius archive.

search field is not active until text is entered; pressing "enter" with a blank search field yields no results. This is good, a senior citizen for example might have shaky hands and accidentally hit enter before having entered text; if they are then taken to another context this might be jarring. Along with the search field, a "filter" button is displayed; clicking on this allows the user to choose a predefined filter based on a person or on various keywords (see Figure 6.5). Related keywords also show as the user is writing (Figure 6.6). Showing suggestions is positive; a child, for example, might enter the site knowing little about Ivar Arosenius or the archive, thus not knowing what kind of content to expect to find, having suggestions presented saves the user from feeling that they have no idea what they are doing on the site and where they are to go. It can also stimulate a user into exploring things other than they had originally planned; the user might enter to look at a specific artwork, for example, but upon seeing the various categories that exist they might feel enticed to start examining one or more of them.

If the user misspells a search term (for example, a researcher might remember a name slightly wrong, or a child might have trouble with spelling in general), there are two outcomes, displayed in Figures 6.7 and 6.8. In Figure 6.7, no results are shown, despite the second half of the search term being spelled correctly. In Figure 6.8, the same results are shown as if the word at been correctly spelled. This is likely due to the technical implementation of the search function (in the first case a letter is missing in the middle of the search term, in the second case the letter is missing from the very end), but the difference in treatment might make users feel uncertain. One way to make the search function more accessible would be to present suggestions for what the user might have meant when misspelling a certain search term—identifying that "ivr arosenius" is similar to "ivar arosenius" and asking the user if that was their intention—allowing them a clear way to quickly progress. This is expressed in WCAG success criterion 3.3.3:

> If an input error is automatically detected and suggestions for correction are known, then the suggestions are provided to the user, unless it would jeopardize the security or purpose of the content. [62]

In order to recognize this potential source of errors, testing the website with users more likely to misspell (such as children or users with intellectual disabilities) would have been helpful. Apart from that, simply keeping accessibility in mind throughout the design process and being aware of this as a potential issue might have been enough to avoid it.
Apart from the case of misspelled search terms, one student group noticed in their report for the exercise mentioned in subsection 6.3.2 that search results for the search term "Paris" included results not included in the results for the search term "Frankrike" (France) (see Figure 6.9)—even though one would naturally assume that content related to Paris necessarily are related to France. This, according to the students, "makes the entire search function unreliable since you can't be sure you've found all the relevant images after a search." This is a big a problem, as it might cause users to distrust the archive. Even in if does not, it might lead to a user missing content that they might be interested in, which is certainly bad.

(a) The Arosenius archive, showing results for the search term "frankrike".

(b) The Arosenius archive, showing results for the search term "paris".

Figure 6.9: The Arosenius archive, showing different results for search terms "paris" and "frankrike".

6.4 Prototyping and Evaluation

Using the interview findings as a basis, I developed four solution concepts over several brainstorming sessions: an accessibility business value calculator, an accessibility design linter, accessibility-as-a-process, and a service for easily finding out about (special) user needs. I made the decision to further expand on the first two concepts, the accessibility business value calculator and the accessibility design linter, based on a combination of feasibility of prototyping and perceived usefulness. Although I originally intended to develop at least one of these concepts into at least a low fidelity prototype, due to time constraints this was not done; rather the concepts are presented as-is, to be used as starting points or inspiration for further development. The concepts are described more in detail in section 7.2.

Partly due to the fact that the interview findings were appearing as more interesting in and of themselves than I had thought they would be, and partly because awareness of how the time constraints would affect the prototyping process, the decision was made to present the interview results as the main result of the thesis, with the concepts and the results of the navigational accessibility analysis serving as complements. In addition to this, I decided not to present the results in an annotated portfolio, as I had originally intended, reasoning that the concepts were not developed enough to make sense in such a way of presentation.

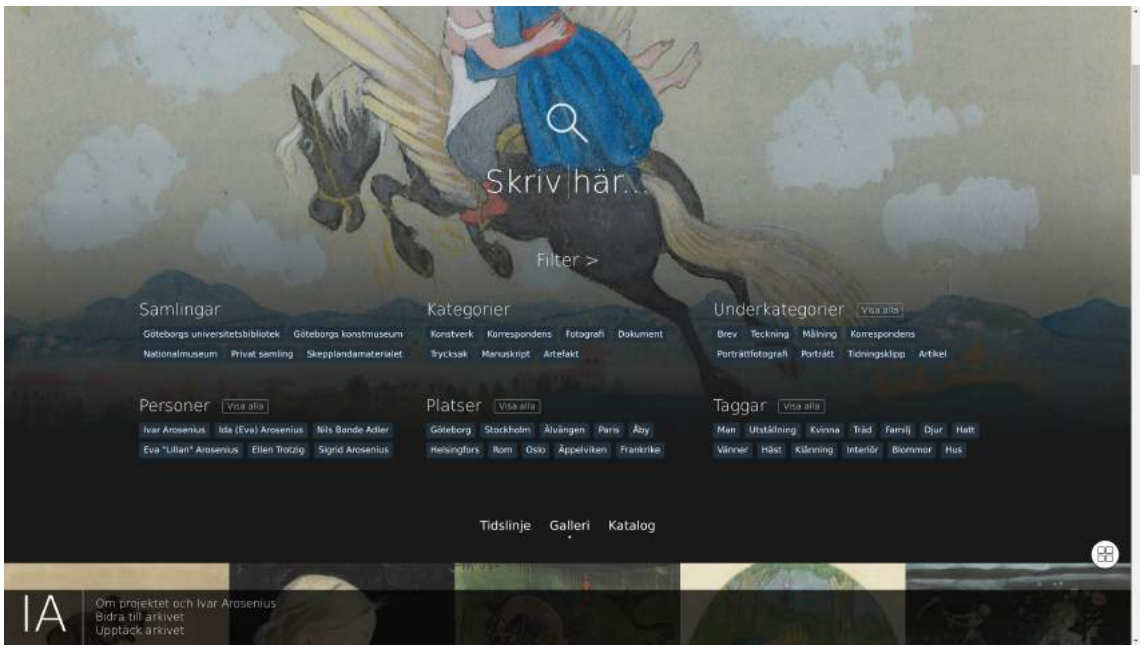

Figure 6.5: The keyword filter function of the Arosenius archive.

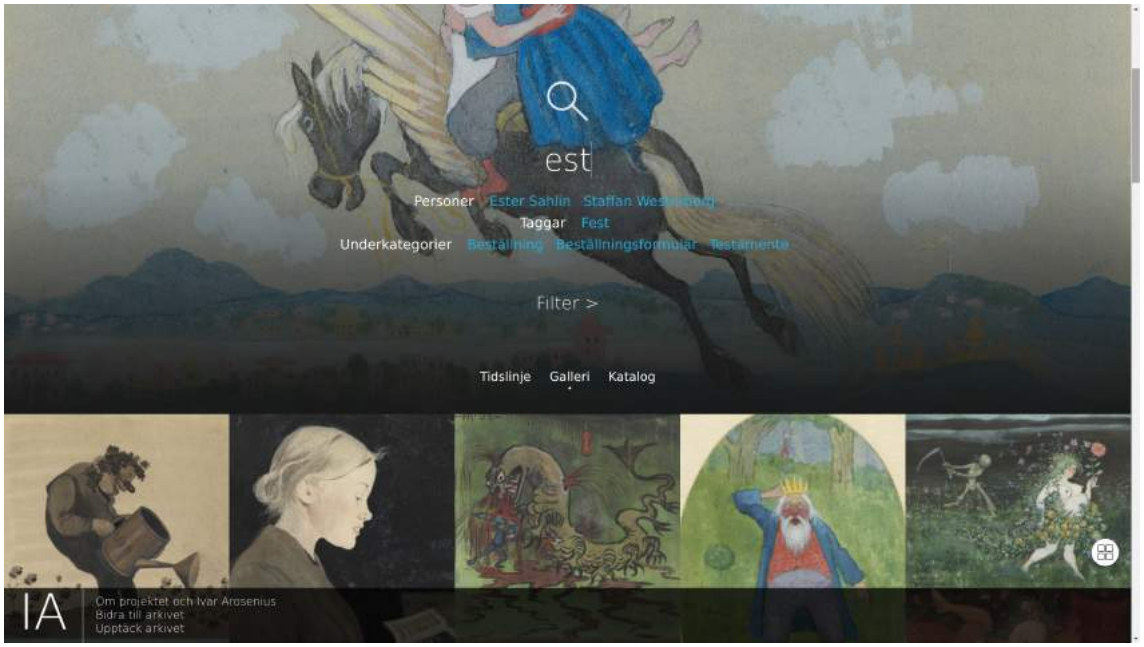

Figure 6.6: The active search field on the Arosenius archive, showing suggestions as the user writes.

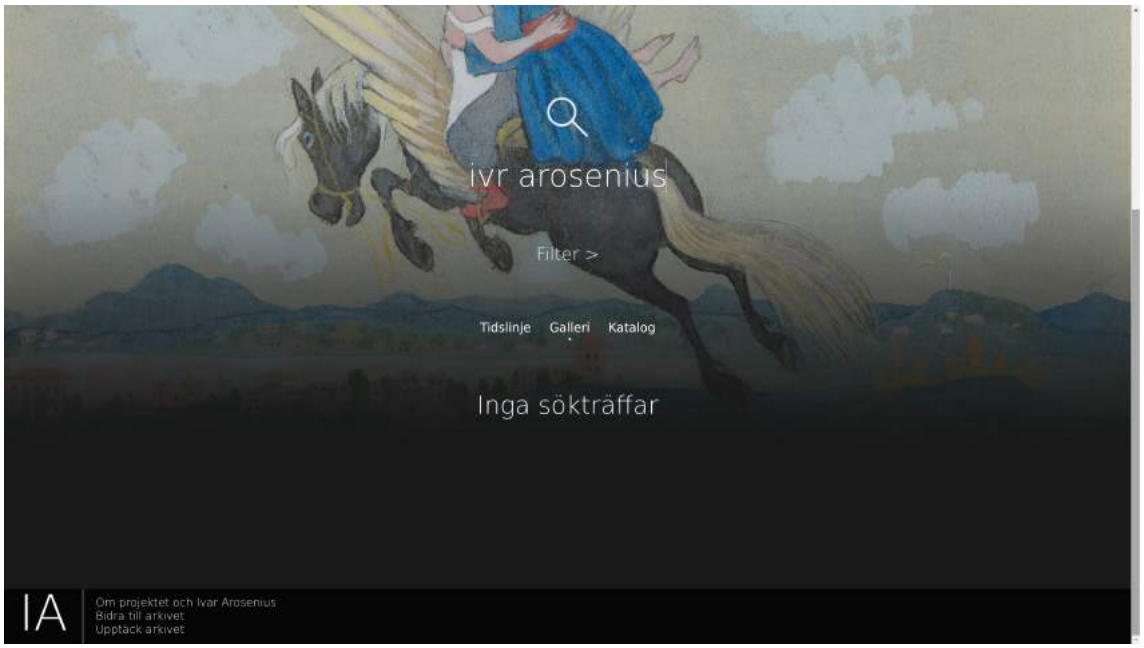

Figure 6.7: The Arosenius archive, showing no search results for a misspelled search term.

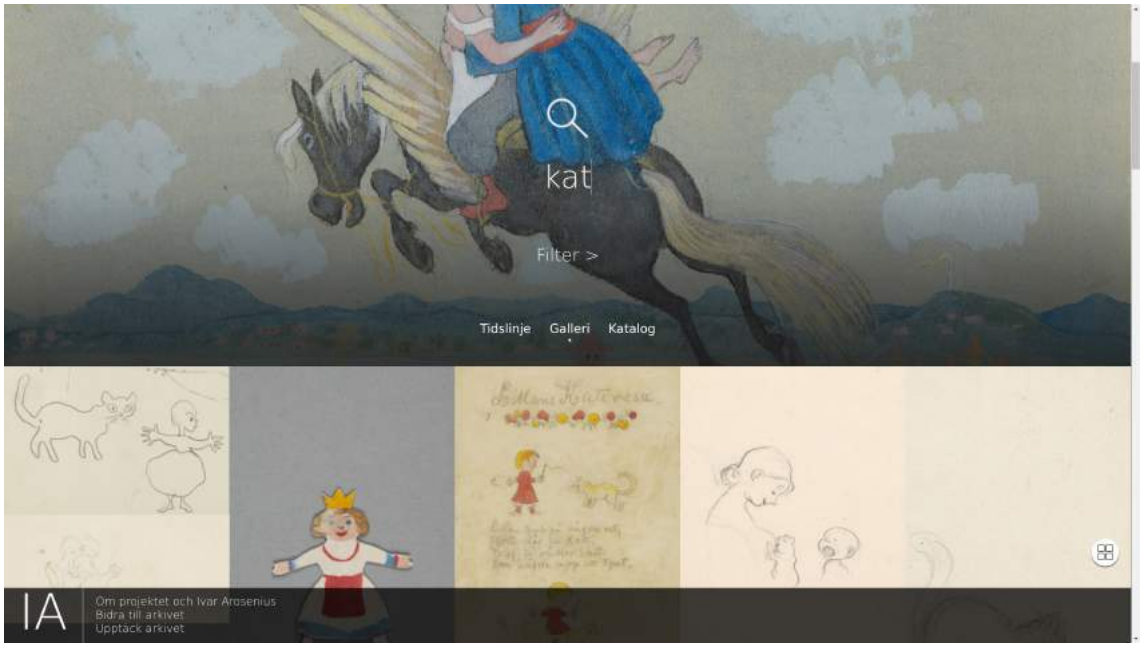

Figure 6.8: The Arosenius archive, showing some search results for a misspelled search term.

7
Results

In the attempt to answer the research questions of this thesis, two approaches to data collection were utilized: an interview was performed with six web professionals, and an analysis of the navigational accessibility of an online artist archive was performed. In this chapter, the findings and conclusions from both of these approaches will be presented, along with two solutions concepts created based on these findings. A more detailed description of the collected data is available in chapter 6.

7.1 Major Factors Preventing Accessible Navigation

The interviews conducted revealed a number of issues regarding accessibility work. The results were not directly related to navigation, but rather web design work as a whole. However, the findings should still prove relevant, as the design process in general influences the way navigation is designed and implemented. For more discussion on the relation between navigational accessibility and accessibility in general, see subsection 8.2.1. As for specific examples of issues regarding accessibility and navigation, a number of such cases are presented in section 7.3.

Based on the answers given in the interviews, there are some implications that can be observed. To begin with, there is not a general consensus or understanding regarding what accessibility actually entails—each interview subject brought with them their own understanding of the concept. Despite this, there was a broad consensus that accessibility is good and valuable, most definitely related to good design, and—even when regarded primarily as disability adjustments—beneficial to all users, even those without special needs. As one interview subject put it, "usually when these things are considered, it becomes better for everyone." Why, then, is accessibility not considered more often? Well, part of the reason seems to be that accessibility is not included in many design educations and, in those cases where it is raised, it is "quickly passed by." Furthermore, it is, as one interview subject put it, "always an economic consideration when you get into the working life." The final decision as to whether accessibility should be included or not is seen as belonging to the clients, as, "the clients decide what they want to pay for, so how much emphasis we put on [accessibility] is up to the client."

In addition, it is not always clear when and by whom accessibility should be considered. Sometimes accessibility is not seen "as a problem that we have to solve on our

website", but rather as a target for specialist products. For one interview subject it was the case in the organizations he worked in, he did not "need to engage in design anymore", which in his eyes meant that accessibility was not his job. Even if this is not the case, the process for considering accessibility work is confused and unclear, leading one interview subject to wish that it would "become a more natural part of the toolkit", and another to state simply that "if you do not have a process to always include [accessibility], you do not do it." The primary factors affecting accessibility work then, rather than lack of interest with web professionals, would appear to be two:

1. Client demand is low, leading to deprioritization and a lack of time and/or money for considering accessibility.
2. Accessibility does not have a natural place in the design/development process.

These findings are in accordance with Freire, Russo, and Fortes [73]; Lazar, Dudley-Sponaugle, and Greenidge [71]; and Putnam et al. [72], who all mention lack of client requirements as a reason accessibility is not considered. Furthermore, the studies by Freire, Russo, and Fortes and Lazar, Dudley-Sponaugle, and Greenidge both hold up lack of time and lack of training as reasons, something that can be seen as related to the absence of accessibility in the design process, which would both hinder training (since it is seen as something "extra", rather than an integral part of design) and increase the perceived cost in time (with accessibility work not being viewed as included in the regular design work, instead seen as an additional task tacked on to the work). The two aspects are connected: if demand is high (such as when there are legal requirements), accessibility is included in the process and the work is done; conversely, if accessibility was a natural part of the design process it might not be seen as an "extra step", requiring extra time and money. One interesting difference to earlier results to note is the perception of "inadequate software tools" [71, p. 284] as an obstacle to accessibility—something that was not a big focus for the interview subjects in this study. This could imply that the state of accessibility supporting software tools have improved in the 14 years since the study by Lazar, Dudley-Sponaugle, and Greenidge.

7.2 Solutions Addressing Factors That Prevent Accessibility

Building on the findings from the interviews, it would appear that there are two specific types of solutions that can address the factors identified as preventing accessibility:

1. Solutions that increase client demand, leading to accessibility being prioritized.
2. Solutions helping to integrate accessibility concerns in the design/development process.

Of course, solutions need not adhere to only one of these types; it is entirely conceivable that a single solution can belong to both of them. To exemplify the types, two

concrete concepts for solutions were developed. They are far from finished prototypes, or even finalized concepts, and a lot more development work would be required before any finished tools could be created. Rather, they are intended to serve as an inspiration for further research and development, of these specific concepts or of others of the types presented here.

7.2.1 Accessibility Business Value Calculator

Accessibility is often considered by management and executives as an obstacle, something that increases the time and cost of a project while providing little direct gain. In actuality, it is often beneficial for businesses. [31], [108] In order to increase knowledge of this fact—and thereby encouraging investment and increasing requirements—a business value calculator for accessibility could be calculated. See Figure 7.1 for an example of what such a tool could look like.

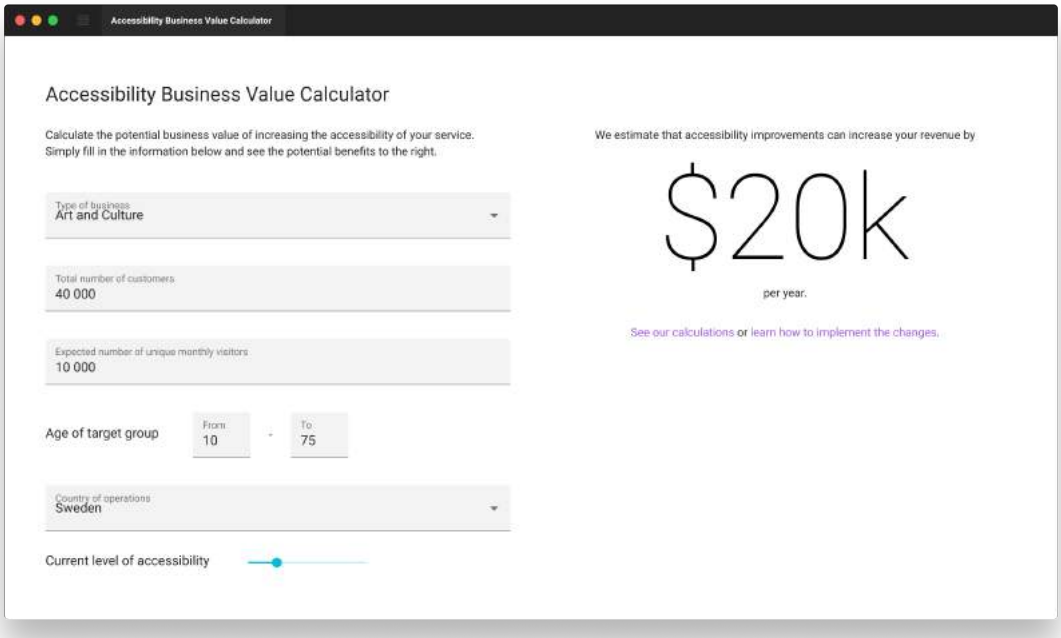

Figure 7.1: A sketch of an Accessibility Business Value Calculator.

In this concept, the user inputs a number of parameters: the size of the company, what industry it does business in, the primary target group, the purpose of its website, etc. The tool would then use this information, along with preset information (for example disability statistics in various population segments, and of course the business value of various accessibility adjustments) to calculate an estimated monetary value of adjusting the company website to be more accessible, and present this to the user. The tool could also present a list of concrete accessibility improvements, by order of business impact. Any values the tool could calculate would certainly be rough estimates—something that would need to be clear in the interface—but could still provide an indication as to the business value of accessibility, incentivizing the user to find out more. The tool would also run the risk of losing the holistic aspect

of accessibility in favor of a very concrete and formulaic “check list style” approach. This is not necessarily a disadvantage, but certainly something to keep in mind if the concept is to be developed further.

7.2.2 Accessibility Design Linter

Many integrated development environments (IDE) contain so-called linters, tools which analyze source code to identify programming and stylistic errors in source code. The concept has been expanded to accessibility, and there are a number of linters for finding accessibility errors in code, [109]–[112] but these focus on code and mainly run after it is produced, analyzing it to find WCAG violations so they can be adjusted in retrospect. There are few tools focusing on accessibility during the actual design work, before anything is implemented in code. On the other hand, there are many tools for doing graphic and user experience design, [113]–[116] but these are lacking in accessibility features, not including many tools for evaluating the accessibility on the design being worked on. Sketch, the biggest of these, has plugins for simulating color blindness [117] and analyzing color contrast [118], based on the WCAG specifications, but apart from these there are not many accessibility design tools.

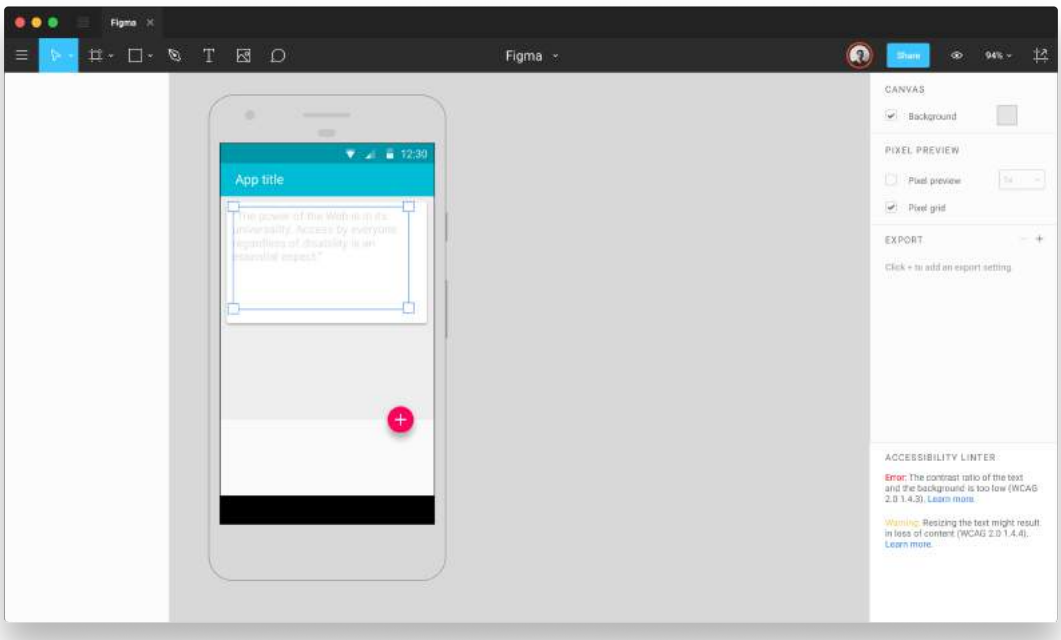

Figure 7.2: A sketch of an Accessibility Design Linter in the user experience design tool Figma. Errors and warnings for the selected content appear in the lower right.

A more comprehensive accessibility linter for a user experience design tool would include color blindness simulation and color contrast analysis, but expand on those features to include more accessibility aspects. Using the WCAG as a basis, there are certain requirements that are content specific and thus hard to analyze in the design phase. However, there are a number of requirements that could potentially be

statically analyzed in the design phase. Some examples are font size and resizability, line and paragraph spacing, content order, consistency, and target sizes. Optimally, these checks would run in the background during design work—not requiring the designer to do anything other than design, and provide a warning with information and a suggested solution once it catches some error. See Figure 7.2 for an example of such a warning by the linter could look like.

Utilized effectively, an accessibility design linter could help with both main obstacles. Through making accessibility work easier—by moving the workload from the designers to an automatic tool—the cost is reduced, potentially leading to clients prioritizing it. Through automatically calling attention to accessibility, the tool would also force it to be acknowledged throughout the design process, increasing awareness and eventually leading to it becoming an expected part of the process.

7.3 Navigational Accessibility Issues of the Arosenius Archive Website

This section will present a number of issues related to accessibility and navigation in the Arosenius archive [20], as identified in the analysis and the student exercise reports (Appendix A) and supported by earlier research. The Arosenius archive is used as an example; similar issues likely exist on a number of existing websites.

7.3.1 Lack of Context

An issue that is not raised in WCAG, but rather relates more to the holistic view of accessibility identified by interview subjects (discussed in subsubsection 6.3.1.1) is that of missing context for the archive. On the start page, there is no direct information about who Ivar Arosenius is, what the purpose of the archive is, or what type of content the archive contains. This might lead to a confusing experience for a user, as they do not know what to expect or what they might find. There is a link immediately available leading to a set of web pages with information about the research project and the website, but having some information directly available would save the user from having to perform an extra step in their cognitive mapping process. An experienced user, like an art researcher familiar with Ivar Arosenius and with practice using other art archives, might not be impacted by this lack of context, but for a less experienced user, this lack of context could leave the user disoriented. [80] This is troubling, as Webster and Ahuja showed that "strong relationships exist between disorientation, engagement, performance, and intentions to use a Web site." [76, p. 671]

7.3.2 Keyboard Operation

WCAG guideline 2.1 requires that one "make[s] all functionality available from a keyboard" [62], which the Arosenius archive does. Not only does the archive allow TAB-chain navigation, it also provides a search function, which is a "very powerful

way to improve keyboard access" [119, p. 184] (especially when designing for special needs [120], [121])—and the search function is located at the beginning of the TAB-chain, something that is necessary for it to be effective in this regard. [119] However, there are issues with the approach to keyboard operation taken. Specifically, the site violates WCAG success criterion 2.4.7, which requires that "[a]ny keyboard operable user interface has a mode of operation where the keyboard focus indicator is visible." [62] This is important not only to help visually impaired users navigate using only the keyboard, but also benefits users with "attention limitations, short term memory limitations, or limitations in executive processes." [122]

7.3.3 Search Functionality

The search function does a number of things right—for example, it shows suggestions for related keywords as the user is typing, giving the user hints of content that exists and stimulating exploration. However, there are two big issues with it. If the user misspells a search term (for example, a researcher might remember a name slightly wrong, a senior citizen with impaired mobility might miss a key, or a child might have trouble with spelling in general), the archive sometimes display no results (see Figure 7.3), even if part of the search term being spelled correctly. Gappa et al. recommend that search functions should should "accommodate weak writing skills, neglect typing and spelling mistakes, and recognise conjugated verbs and declined nouns" [121, p. 84]; one way to accomplish this would be to present suggestions for what the user might have meant when misspelling a certain search term—identifying that "ivr arosenius" is similar to "ivar arosenius" and asking the user if that was their intention—allowing them a clear way to quickly progress. This is also expressed in WCAG success criterion 3.3.3:

> If an input error is automatically detected and suggestions for correction are known, then the suggestions are provided to the user, unless it would jeopardize the security or purpose of the content. [62]

Furthermore, some students noticed in their report for the exercise mentioned in subsection 6.3.2 that search results for the search term "Paris" included results not included in the results for the search term "Frankrike" (France) (see Figure 7.4)—even though one would naturally assume that content related to Paris necessarily are related to France. This is a problem, as it might lead to a user missing content that they might be interested in, or cause them to distrust the archive if they recognize that they are missing expected results.

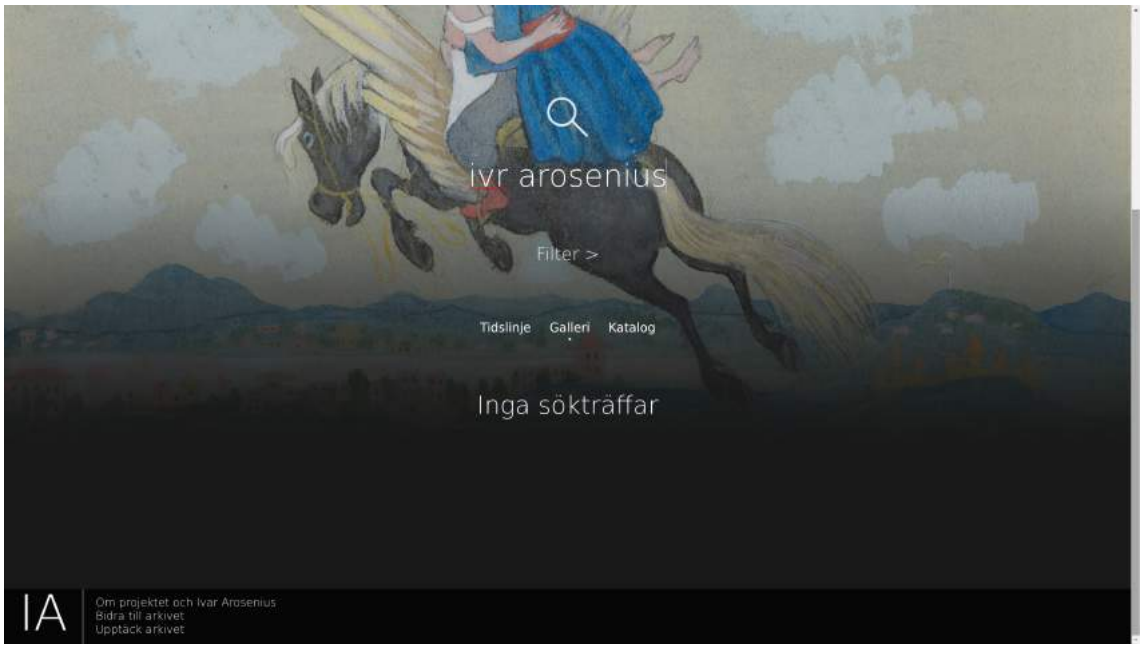

Figure 7.3: The Arosenius archive, showing no search results for a misspelled search term.

(a) The Arosenius archive, showing results for the search term "frankrike".

(b) The Arosenius archive, showing results for the search term "paris".

Figure 7.4: The Arosenius archive, showing different results for search terms "paris" and "frankrike".

8

Discussion

8.1 Methodology

Of the methods presented in chapter 4, a very small number were used. User research was performed using only individual interviews [88], the data was analyzed using content analysis as presented by Wadsworth [86] and Kuniavsky [87], and although parallel prototyping [93] was performed, no specific prototyping or evaluation methods were used—in the latter case, because no evaluation was performed. This is not to say that the methods used were inadequate. The interviews yielded large amounts of data, which was efficiently extracted using content analysis (although there were some issues with researcher bias, discussed more in subsection 8.2.1). Furthermore, they were quite time efficient and not very difficult to prepare or conduct. Altogether, the semi-structured individual interviews performed were suitable for identifying major factors preventing web professionals from creating accessible navigation. Similarly, the analysis of the Arosenius archive was successful in identifying a number of issues regarding accessible navigation.

However, utilizing a bigger and more diverse array of gathering and analyzing information might have yielded more and different results. Specifically, surveys [88] could have been helpful to paint a broader, if shallower, picture of experience and opinions among web professionals. Conversely, group interviews might allow for an even deeper exploration of the topic, allowing subjects to expand on each others' ideas and recall situations or experiences they might otherwise have forgotten. A longer study, consisting of field visits and observation, might have provided more insight into the actual practices of web professionals, rather than relying on self reported information—the two do not necessarily differ, but might. For the Arosenius archive analysis, even more issues might have been identified if a more rigorous set of analysis methods had been utilized. Most valuable of all would have been actual user testing, but even barring that evaluation methods such as heuristic evaluation [102] or automated testing tools (like the WAVE tool [46]) might have allowed for identifying more, and perhaps bigger, navigational accessibility issues on the archive.

8.2 Results

The original intended outcome of the thesis was a number of prototypes for supporting web professionals in creating accessible web solutions, supported by data gathered through interviews. During the work on this thesis, the focus began to

shift, with the interview findings becoming more important as a result in their own right, eventually surpassing the solutions and becoming the main result. This was both because of increased awareness as to the value of the interview findings, and because the realization that because of time constraints the solutions would not be able to be developed to the extent originally envisioned.

8.2.1 Interview Findings

As mentioned in section 7.1, the issue of navigation was not raised much during the interviews, despite this being the original intention. This was mainly due to interview subjects' inability to give clear answers on this topic, which in turn was because of failure on the interviewer's part to pursue these questions when the original answers where not immediately clear. It might also have to do with unconscious bias on the interviewer's part throughout interview progression; it is possible that as the most interesting aspects of previous interviews were considered to be the parts not related to navigation, less and less emphasis was placed on this area during subsequent interviews. Nevertheless, the interviews were useful identifying factors preventing web professionals from working with accessibility, and one can argue that the underlying principles of accessibility—regardless of which of the views of accessibility one takes—can be applied to navigation specifically without much trouble. For special needs adjustments, it is equally as important (or conceivably even more so) that the menu or a search field is readable (with or without a screen reader) as that the content is. If the menu is unreachable on a certain device, the website cannot be considered technically accessible even if the content works fine. Though there may be a lot fewer words in a website navigation system, if that language is not accessible, it will certainly be more difficult to navigate. Finally, when looking from a holistic point of view, accessibility was seen as relating in many ways to usability and user experience, which assuredly would include navigation. In conclusion, navigation accessibility can easily be considered a subset of general accessibility—thus, factors that prevent web professionals from creating accessible websites in general likely prevent them from creating accessible navigation in particular as well.

Regarding the interview findings, one should always be careful about drawing big conclusions from qualitative data, especially when the sample size is as small as in this case. It is also important to be aware of potential cultural biases—all interview subjects were Swedish, with experience from working in Sweden. More specifically, they were all from Gothenburg, one of the largest cities in Sweden, with a relatively large technology sector, which may influence their experiences and opinions. However, the results generally correspond to those found in earlier studies [71] [72] [73] [74], which would imply that these are more general trends. Still, more research would certainly be valuable. Specifically, more quantitative research into web designers' and developers' opinions on accessibility could be beneficial, in order to have a firmer basis for drawing conclusions. More general qualitative research would also be of value—extra interesting in this case might be widening the scope, researching client and organization management opinions on accessibility and the requirements process from their point of view, to see how this relates to web designers' and de-

velopers' experiences.

8.2.2 Solutions

The original intention was to present the solution prototypes in an annotated portfolio, as described by Gaver [85]. However, this was abandoned due to the low level of the prototypes being deemed unsuitable for such presentation. One issue that is that is not specifically addressed by the solution concepts is the lack of accessibility education. The reason for this is that this is seen as a bigger overarching issue that is simply out of scope for this project.

8.2.2.1 Accessibility Business Value Calculator

The main benefit of the Accessibility Business Value Calculator, as the concepts exists now, is that it takes a broad view of the problem and tries to get to the root of it, rather than focusing on individual aspects. This could be detrimental, as clear and focused efforts might be more easily implemented; however it is also a benefit, as it allows for removing the cause of problems rather than trying to solve each specific problem as it arises. Since a lot of currently existing work (like the resources presented in section 2.6) primarily concern these specific cases, a tool which tries to address the underlying problem could be quite valuable.

However, there are also a number of problems with the concept. Perhaps foremost of these is the essential fact that it is incredibly difficult to calculate a financial value of accessibility. There are simply so many interconnected factors that giving a definitive answer becomes an enormous task—and providing a simple and easy-to-use service even more so. There is also the discussion of what the motivation for accessibility *should* be. According to a 2014 survey by WebAIM [123], 82 % of web accessibility practitioners answered that their personal motivation for implementing accessibility is that "it's the right thing to do" [123]. Regarding organizations' motivations, WebAIM notes:

> Respondents who indicated that their organization's site is already highly accessible were over 3 times more likely to indicate that morals (it's the right thing to do) were their motivation than those whose web site is not yet accessible. [123]

This may imply that, regardless of the actual ethical case, being morally motivated might simply be more effective.

8.2.2.2 Accessibility Design Linter

The idea Accessibility Design Linter arose from two very similar ideas raised separately by two different interview subjects—coincidentally, the two most concrete ideas raised during the interviews. This could of course be entirely because of sampling errors (as discussed in subsection 8.2.1), but it could also indicate that this is a tool that there is a real demand for. Another advantage of this approach is that it could likely be quite easily introduced into a modern web design workflow, especially if it was built into an already used design tool, such as Sketch [113] or

Figma [115]. However, the similar tools that already exist—even the ones that integrate with Sketch [117], [118]—are not widely used, despite being free and existing on the market for a couple of years. This implies some resistance to the adoption of this equipment, which one would need to overcome. Additionally, while identifying and aiding in solving specific issues is certainly valuable, there is no guarantee that it will bring accessibility into the regular design process, meaning that it may not really do anything to solve the underlying problem.

Furthermore, in the case of the Arosenius archive, such a linter would likely not have been helpful in identifying the issues. All of the issues detailed in subsection 6.3.2 are related to the content and/or arise from user interaction with the archive, meaning that they are difficult to catch using a static analysis. Even for a theoretical future design linting that is able to simulate content to evaluate, for example, keyboard operation, it would be extremely difficult to identify and propose solutions to the lack of context and the resulting disorientation a user might feel upon entering the website. While a tool that does this is not inconceivable, it is certainly far from the reality of today.

8.2.2.3 Future Work

As mentioned in section 7.2, the concepts are not intended as finished prototypes or, indeed, finalized concepts. Rather, they are to be viewed as a starting points for further research and development. What this development would would entail and look like of course remains to be seen, but the main aspect would of course be to investigate whether any of time would actually help with the problem, that is, can they support web professionals in creating accessible solutions? To answer this one would need to conduct further prototyping and user testing, but also long-term studies of their effects (if any). Apart from developing these two concepts, it might be interesting to look at the two ideas that were conceived of during brainstorming but not further developed. Information about users' (special) needs were mentioned during the interviews as something that was useful—how might a service for easily presenting this be designed? How might accessibility be brought into the design process, so as to prevent it from "falling through the cracks" during design?

8.2.3 Arosenius Archive Analysis Findings

The intended outcome of the Arosenius archive analysis was to identify a specific issues regarding accessible navigation on the website, something it certainly did. However, it is important to note that the analysis was not only limited in time but was also performed by only one person, who is not an expert on accessibility—all of which clearly limits the reliability. Despite this, the identified issues correspond quite well to existing research [76], [80], [121] and many issues could be connected directly to guidelines or success criteria of WCAG [62], both of which strengthen the legitimacy of the claims.

Identifying the causes of design issues solely from identified issues, without any insight into the design process, is of course incredibly difficult. Despite this, we

can attempt some guesses as to what the reasons for the problems identified in section 7.3 are. To begin with, one can note that none of the issues likely would have been caught by an automated testing tool, as all are related to the actual interaction between the users and the archive, and therefore cannot be statically analyzed. The issue of not indicating keyboard focus should have been detected while testing the website, either the designers' own testing—simulating various special needs—or user testing including visually impaired users. The problem of confusion at the lack of context is something that would have been hard for the designers to catch themselves (as they naturally are quite familiar with the context), calling for user testing to detect this particular issue. For the issue of misspelled search terms, as well, user testing—with a diverse group of users including users prone to misspelling—would have been valuable. In this case, however, simply having a more accessibility focused starting point and being aware of this issue as a possibility might have been enough to avoid it.

Another approach to improve accessibility and address the identified problems would be to perform user testing, with a diverse group of testers. The importance of user testing is raised by Yesilada et al. [74], whose subjects agreed that "accessibility testing should rely on user testing in order to obtain more valid and reliable results." [74, p. 130] In addition, Putnam et al. [72] found that "direct interaction with end users in the context of disabilities was also uncommon" [72, p. 90] and Freire, Russo, and Fortes [73] note that "tests with final users are not frequent" [73, p. 93], both of which support the finding that user testing is difficult to perform. The issue with user testing is related to the two factors identified in section 7.1. Firstly, since there is an absence of accessibility in the regular design process, this precludes accessibility concerns from being raised and arrangements—such as diverse user testing—from being made. Secondly, user testing can often be costly in terms of time and money, and clients might not be willing to pay for it if they do not see the potential benefits. Information on users—although not user testing specifically—was also raised directly by some interview subjects, who noted that "there are an extreme amount of [disabilities] that you almost certainly miss" and "it helps to gain insight into what the demands on the end user are."

9

Conclusion

The intended goal of this thesis was to answer the following research questions:

1. *Which major factors are preventing web professionals from creating accessible website navigation?*
2. *What types of solutions could address factors that prevent accessibility?*
3. *What specific issues regarding accessible navigation does the Arosenius website, as a digital archive of artist material, display?*

To answer the first question, interviews were held with a number of web designers and developers, to gauge their opinions on web accessibility and their understanding of and thoughts about the current state of the situation. From these interviews, a number of conclusions were drawn about web professionals' views of web accessibility and how it relates to them and their work. The findings (together with previous research [71]–[74]) suggest two primary factors preventing web professionals from creating accessible solutions:

1. Client demand is low, leading to deprioritization and a lack of time and/or money for considering accessibility.
2. Accessibility does not have a natural place in the design/development process.

Building on these identified factors, and considering how to address them, two types of solutions were identified:

1. Solutions that increase client demand, leading to accessibility being prioritized.
2. Solutions helping to integrate accessibility concerns in the design/development process.

In an attempt to answer exemplify these two types of solutions, two concrete concepts for supporting web professionals in creating accessible solutions were developed:

- A tool for analyzing and estimating the business value of accessibility, in order to incentivize clients and provide a financial argument for requiring accessibility.
- An accessibility design linting tool, for automatically identifying accessibility issues in designs early on, in order to decrease the cost of accessibility work and providing it a place in the design process.

Neither of these solutions were implemented, and thus could not be tested, so it remains to be seen whether either of them would actually be helpful in supporting accessible web design and development. Thus, further research and testing is needed to investigate how web accessibility work could be supported. However, the work of this thesis can hopefully serve as a valuable inspiration and starting point for such work.

Finally, for the third question, an analysis of the Arosenius archive was carried out, in which obstacles to accessibility in the navigation of the archive were identified and discussed. Three main issues were diagnosed:

1. **Lack of context** for the archive, potentially leaving users disoriented [80] and thereby disengaging them [76].
2. **Keyboard operation** not being optimally implemented, specifically violating WCAG success criterion 2.4.7 [62].
3. **Search functionality** issues, with the archive being inconsistent in which search results it displays, as well as not providing correction suggestions for misspelled search terms (as per WCAG success criterion 3.3.3. [62]), thereby failing to accommodate weak writing skills [121].

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A

Appendix 1: Report exercise 4

Report exercise 4

Group X

Findings

Heuristic

- Senior's perspective:
    - White buttons when viewing a picture are not clear
    - Difficult to find a good contact method for seniors, such as regular mail
    - Screen flashing intensely when clicking a picture because of the animation
- Children's perspective:
    - Found a button for rotating the pictures that had an icon often associated to refreshing the page.
    - Found that the filter interface was hard for children to navigate through
    - The interface was not consistent, icons changed place when enlarging pictures

- Researcher's perspective:
    - Pictures tagged with Paris were not necessarily tagged with France
    - Not all pictures had correct measurements associated with them
    - Only downloadable format was JPG. A researcher might want a better file-format, e.g. .PNG or RAW.

Cognitive Walkthrough

- Children's perspective:
    - No pictures to make the site interesting and easy for children
    - The information page "Ivar Arosenius" has very small and hard text and no pictures
    - The text "Arosenius 1909-2018" isn't clear. Does it mean that he lived those years?

- Senior's perspective:
    - The site in general seams to have been designed more for looking good than being easy to use. Navigation icons are small overall, grey text on black background etc.
    - There are no help functions for people with disabilities.

    - Icon for viewing pictures in full screen mode are hard to see.
    - The “Fler objekt relaterade till …” often isn’t interesting, and totally hides that you can scroll past it to find the rest of the archive.

- Researcher’s perspective:
    - Search function not placed in conventional location. Might even be hard to see a white search icon on top of a background image.
    - When you search “Frankrike” you don’t see the images tagged with “Paris”. This makes the entire search function unreliable since you can’t be sure you’ve found all the relevant images after a search.
    - There isn’t a filter for year, or year span.

Cognitive Walkthrough vs. Heuristic Evaluation

The cognitive walkthrough and heuristic evaluation showed mostly the same issues for the site. One interesting occurrence were the rotate-button shown on the left next to the pictures. The button has the icon of a classic “refresh” button. This was discovered by the group performing the heuristic evaluation and not the group making a cognitive walkthrough, since it made no sense to refresh the page. Some other functions that were irrelevant and strange was not discovered in the walkthrough but in the heuristic evaluation, since the walkthrough was focusing on a specific task to be performed, and other functionality was not of concern.

The heuristics we used (Nielsen’s 10 from the course book) were sufficient for the task. However, some were kind of difficult to apply. For example: measuring consistency was relatively hard since the environment constantly changed. Same with system status, since the match between the system and the real world wasn’t very good. Recoverability from errors, however, was easy to measure, since it wasn’t particularly easy to do.

User test

We will explain that the website is a gallery containing Ivar Arosenius art. We will ask the users to “think out loud” while the test is conducted (in front of a computer). Their thoughts will be noted by us.

Perspectives:

Group members 1 & 2 - Seniors
Group members 3 & 4 - Research
Group members 5 & 6 - Children

Tasks(Art research):

- Find how many of Arosenius works' were produced in France
- Find a painting from 1904 in Paris
- Find a painting with similar colors as the one you found in the previous task
- Find the facebook page
- Find how to submit an arsenius painting on the website

Tasks(Seniors):

- Can you view two different self portraits of Arosenius?
- View one picture in fullscreen
- Find a painting from 1904 in Paris
- Find a painting with similar colors as the one you found in the previous task
- Find Ivar Arosenius year of death

Tasks (Children):

- Can you find a self portrait of Arosenius?
- Can you find the name and where it was painted?
- Try to view the picture upside down?
- Can you help me find who's behind the website, who created it?
- Can you find out how Ivar Arosenius died?

Instructions for testing each task:

- Measure how well/if they managed to complete the task
- Write down any comments the test subject has for each task after it has been completed/time is up
- Ask follow up questions

Follow up questions after each task:

- Do you think you completed the task?
- Was the task difficult to perform? What specifically?
- Other comments?

Result

The group performed user tests according to the plan above, and made some interesting findings. It was sometimes hard for the tester to imagine being a senior, or a child 7-9 years old.

- The scrolling function were often found to be used immediately by children, but the seniors were more inclined to click the links in the left corner instead.
- When “researchers” had completed the first task they thought they had found all pictures from France even though they hadn’t.
- The color-filtration tool was expected to be found in the filter settings, but since it wasn’t there some test subjects had trouble finding it. Some test subjects found it with ease, however it seemed like they found it by accident.
- On the task “Find Ivar Arosenius year of death”, the senior tester were confident he died 2018 and lived for 109 years, until reading the biography page. As noted on walkthroughs and heuristic evaluation, this heading is confusing.
- Everyone found the fullscreen feature.
- It’s not always clear how to get back to the main page.
- Simulated child (daycare teacher) found rotation the easiest of all tasks, stating the reason “It is just like iPad!”. Gave up on finding the creator of the page.
- Simulated elderly person missed all the search functions and wound up navigating randomly. Was unable to find the side menus. Was convinced a search feature should exist but gave up without finding it. Comment: “It lacks structure.”
- A simulated child complained about not finding contact information and other links at the bottom of the page, as you usually do. This of course isn’t a typical child behaviour but worth mentioning nontheless since the person ended up giving up finding the creator of the page.

In conclusion, the archive website appears to be rather confusing for most users. The menus and filtered are hard to find as they are scattered across different parts of the website and are not explicit enough what the user will achieve by using them. The fact that the archive celebrates only one artist, Ivar Arosenius, is not obvious enough as a proper presentation about the artist is rather difficult to find. Instead, the user might be lead to believe that the years written on the page heading refers to the artist’s birth and death years. Navigating the page was also notoriously difficult; there is no obvious way of returning to browsing the rest of paintings after viewing one of them.

As all of our user groups were simulated, we do not have any reliable data on the differences in how different users will perceive the website. We can only assume that children will probably find the website dull, unattractive and difficult, that art researches may have some difficulties in finding the specific information and artworks due to the rather poor organization of the catalogue and that elderly people may easily get lost in the chaotic and poorly guided structure of the website. It is unlikely that any real user group will find pleasure and enjoyment in using the archive.