eGovernment Accessibility for the Blind and People with Low Vision

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Friday, May 4th, 2012

An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science.

Abstract

By 2015, Denmark intends to digitize government services. The effect of this transition on populations with disabilities such as the blind is unclear. We collaborated with the Danish Association of the Blind to interview blind and low-vision users and conduct usability studies of Denmark's citizen portal, Borger.dk. We found many accessibility barriers, which we used to make recommendations and deliver a user-friendly metric for assessing webpage accessibility for this population.

Executive Summary

Denmark is on the forefront of a European Union (EU) movement to digitize government services by 2015. Denmark pushed to meet this goal by creating Borger.dk, a portal website that links citizens to many digital government services. However, in the creation of this eGovernment portal, accessibility issues for citizens with disabilities may not have been fully considered. Groups such as the blind and people with low vision, for example, find that navigating websites can be time consuming and frustrating. In such cases, digitization of information can serve to limit the accessibility of publically available information. Although Borger.dk has already been updated three times to improve its accessibility, no attempts have been made to test the accessibility features specifically associated with screen readers and magnifiers, the primary assistive technologies used by the blind and people with low vision. For the next update of Borger.dk, the Danish Association of the Blind has taken a vested interest in addressing the accessibility issues that affect its constituents. The project team was asked to identify access problems that blind and low vision users (using typical screen readers and magnifiers) might encounter with Borger.dk and to make recommendations for their next update.

To accomplish this objective, our team first researched the goals of eGovernment, a term used to describe the digitization of government services. These goals were centered on building an accessible system, reducing the cost of government, and minimizing its environmental impact. We then defined what "accessible" means in terms of the usability of websites, "that people with disabilities can perceive, understand, navigate, and interact with the web and that they can contribute to the web" (Web Accessibility Initiative, 2005). We also collected background information on special provisions and assistive technologies for the blind and low vision users, and possible socio-cultural implications of eGovernment. The objective was to understand how the blind and people with low vision accessed computers using their assistive technologies and how this affected their interface with the Internet. The team reviewed the literature and interviewed experts from the United States, England, and Denmark to understand these issues. We also reviewed standard guidelines for accessible website design such as the Web Content Accessibility Guidelines (WCAG) 2.0, ISO 9214, and Section 508 of the United States Rehabilitation Act. Guidelines from these standards were used to synthesize a web accessibility metric that focused on accessibility for the blind and people with low vision.

We would eventually use this web accessibility metric, in combination with data from a usability study, to produce an accessibility score for Borger.dk. Upon arrival in Copenhagen, Denmark, the team interviewed six blind users of Borger.dk to gain an understanding of how they interacted with the government, what parts of Borger.dk they had used, what difficulties they had encountered with eGovernment, and what possible socio-cultural implications they could foresee with the widespread implementation of eGovernment. From these interviews, we created a set of tasks that blind users might

typically perform on Borger.dk and we used these tasks to run a usability study. This study was conducted with eight users who were blind or low vision from Copenhagen and Aarhus, and two sighted users from Copenhagen as a comparison. The study was conducted in a talk-aloud manner, where users were given one hour to complete the given tasks while vocalizing their thoughts and actions in real time. Participants completed five tasks on Borger.dk: logging in with NemID, filling out a form, locating a legal document, using the tax system, and using Digital Post. Following the usability study, participants were brought together in a focus group to discuss and answer questions about their experiences with Borger.dk. The data from the interviews, usability study, and focus groups were compiled into a set of findings about web accessibility for this population. These findings were used to create a user-focused web accessibility metric that was used to evaluate Borger.dk, and to compile a set of recommendations for the future improvement of eGovernment.

We found that most blind individuals we recruited (or tried to recruit) rarely used Borger.dk. Interviewed users looked forward to using an accessible version of Borger.dk because it would enable self-service, maintaining privacy and instilling self-confidence. The idea of self-empowerment by independent use of the Internet was very important to the study participants. They communicated with the government mainly to locate general information or to access the tax and healthcare systems. Most felt that current non-digital systems were difficult to use because of the time and expenses it may take to reach the government office, and the need for a sighted helper when at the office. The blind and low vision users will need to start using eGovernment, such as Borger.dk, as it quickly becomes the standard; however, it will be difficult to do so without improving the accessibility of the website according to the findings from our usability study and web accessibility metric.

Many participants found Borger.dk difficult to use because of technical bugs, illogical website organization, confusing screen layout, and interface problems with assistive technologies. Participants found the placement of information on various pages of the website illogical and could not find the documents they needed by using standard search functions, tabs, and the site map. They also found missing information, empty links, and poorly defined headings, which contributed to the navigational challenges that blind users normally face when using Borger.dk. The technical bugs present with Borger.dk include non-descript NemID error messages, missing submit buttons on PDF forms, poor search results, and a need to login multiple times. To improve the interface between the Internet and assistive technologies, websites must not contain improperly labeled PDF forms, large numbers of Java applets, and same-page popup windows. These were the major sources of frustration for the usability study participants.

Due to these difficulties, not all users were able to complete the tasks in the usability studies. Only 3 of 8 users were able to complete Task 1 – Log into Borger.dk using NemID. Task 2 was to find and fill out the form to apply for Information Technology (IT) equipment; 7 of 8 users were able to find the form, but none of them were able to fill it out.

This task was especially frustrating for many users because finding the form required a significant amount of time – some individuals took over 30 minutes to locate the form. Task 3 was to locate the Act on Retaining the Right to Spousal Pension in Separation and Divorce. Every participant was able to find this form, but it took many of them long periods because the form was only available from one section of the website and the search box did not find it. The final two tasks involved accessing an annual tax statement on Skat.dk through Borger.dk, and using Digital Post. Most users were unable to complete Task 1 – Log into Borger.dk using NemID, so they were unable to complete these tasks, which required NemID. We were able to compare the success of the blind and low vision users against our sighted users in the usability study. We found that to complete all 5 tasks, it took blind users on average between 45 minutes and an hour, but took our sighted users only 10 to 25 minutes. This gap shows another barrier to accessibility regarding the amount of time it should take to complete a task.

When participants were brought back for a focus group discussion, we were able to gauge their level of frustration in comparison to other websites they have used. When asked to rank the difficulty of using Borger.dk, the participants gave Borger.dk a rating of 3 on a scale of 1-5, meaning "ok, with more difficulties." When asked about their frustrations when using Borger.dk, participants again gave a rating of 3, saying it was "becoming increasingly more annoying." All of the focus group participants mentioned that they enjoyed accessing eGovernment systems because it gave them more independence, but that current systems are not fully accessible.

Using this data, we refined our preliminary metric, making it user-friendly by wording questions non-technically and assigning weights to the aspects of accessibility that are more critical to the blind and people with low vision. The metric was designed to be used as a crowd sourced usability study that could be digitally completed by any number of average users to find a statistically significant accessibility score distribution of a new website. In our own assessment of Borger.dk with the metric, it received a 62% score in accessibility for the blind and a 63% score in accessibility for people with low vision. To be considered truly accessible for the blind and people with low vision, a website must be able to score a 100%. This final metric can be used on any website and is designed to help generate a list of improvements to increase the accessibility of an evaluated website.

Our final recommendations for eGovernment in Denmark include specific organizational and technical issues that may help in improving the accessibility and usability of Borger.dk. Our first recommendation is that Borger.dk conforms to the WCAG 2.0 WAI-AA level so that every part of the website is at least accessible with a screen reader. We also recommend performing a test of each new website or revision using our web accessibility metric. To be considered truly accessible, each website must score a 100%, which represents a website that meets all accessibility standards for the blind and people with low vision. Denmark should also reorganize Borger.dk more logically, improve the search function, convert PDF forms to vertical web forms, limit the use of Java, and

consider users with other disabilities. Another recommendation is that educational classes to familiarize the blind and people with low vision should be implemented. If these changes are made, most of the accessibility problems that we found in our testing and interviews will be solved and the ability of the blind and people with low vision to navigate Borger.dk will be greatly improved.

Authorship

Both authors collaborated on the majority of the report. Together, they drafted the introduction, background, and methodology.

Heather Peruffo

This author was responsible for scheduling all interviews and setting up usability studies. Most communication between sources and the team went through this author. She also was responsible for keeping track of due dates and was the organizational leader of the team. She also wrote and completed first revisions on the following sections of the paper: Abstract, Introduction, and Results. Author was responsible for all work plans, progress reports, PowerPoint presentations, and any visuals involved in the project. Lastly, she developed all interview, focus group, and usability study procedures and questions, and analyzed all data.

From this project, I believe I learned a lot about my strengths and weaknesses as a teammate. I believe I learned more about my strengths and weaknesses in writing, and have grown as a writer. I learned a lot regarding how to support my claims with sources, and organize a technical paper into a prose document. I have learned a lot about how to interact and work within the blind and low vision community, and it has been a very inspiring experience.

Johan Skende

This author was responsible for much of the initial research into the history and implications of the digitization of government services. This author was also responsible for some of the communication with expert sources in the United States. He compiled and formatted the final version of this report. He was responsible for initially writing the sections of the Background on eGovernment and Web Accessibility, parts of the Methodology, and the Conclusions and Recommendations. He also developed the initial and final revisions of the Web Accessibility Metric and performed the final editing on the paper.

In the course of this project, I had many valuable experiences and learned a great deal. I learned how to work effectively in a small team. I also improved my technical writing and revision skills, which will be very valuable in the future. I learned how to design and implement studies and focus groups, and how to communicate more effectively with others. Most importantly, I gained experience working in an environment with people with disabilities, seeing how they lived their lives on a daily basis. This project has been very motivating and inspiring to me.

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1 Introduction

The exchange of information between citizens and the government is vital to the function of a democratic society; however, some groups can experience difficulty accessing the government due to disabilities, as well as material and geographical constraints (Dobransky & Hargittai, 2006). For example, individuals who are bound to a wheelchair or who live far away and lack transportation may find it difficult to travel to their municipality center to fill out forms. To overcome these barriers, some governments have proposed using the Internet as a way to increase all citizens' access to government services. eGovernment, a term used to describe the digitalization of government communication, could also make government greener and more cost effective. For these reasons, Denmark and other countries in the European Union (EU) have chosen to implement a set of mandates in the near future to expand eGovernment systems.

Yet, for some citizens, the Internet itself may be a barrier to the accessibility of government. Some people cannot afford to purchase a computer or Internet access and may not have access to public Internet hotspots such as libraries. Other groups, such as the elderly, may not be comfortable with or educated in using the Internet. According to *The New Joint Public Digital Strategy* (2010), these problems are less pronounced in Denmark where 3 in 4 Danes access the Internet daily (para. 2). Moreover, the number of people who do not have these skills will decrease over time; however, at present, these problems do exist for a portion of the population. Other groups, such as the blind and people with low vision[1], are affected by more serious and pervasive problems. They may find it cumbersome, expensive, and complicated to access poorly designed websites, even with assistive technologies such as magnifiers, color contrasters, and screen readers. To ensure that eGovernment is a step forward for this population, we must consider barriers to accessibility, analyze the accessibility of current systems, and identify alternative methods to create an accessible system.

Web accessibility is defined as the ability of a person to "perceive, understand, navigate, and interact with the web, and that they can contribute to the web" (Web Accessibility Initiative, 2005). If a user is unable to do any of these things, he or she does not have full access to a website. Perception refers to a user's ability to discern what is on a webpage. For example, a blind user may not perceive an on-screen flowchart as sequentially connected parts of a whole since a screen reader would present it only as a set of discrete boxes. In this way, blind users simply cannot perceive certain types of visual information. Understanding refers to a user's ability to comprehend correctly the information that is being perceived. For example, if an article is written poorly, or if a blind

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[1] In an attempt to use the accepted terminology and not offend any groups, we will be using the phrase "the blind and people with low vision" throughout this report.

user's screen reader interprets parts of the article out of order because of an inaccessible page layout, the user might misunderstand the content. Navigation refers to a user's ability to move around a page and between different pages of a website. For example, if a website is set up so that a screen reader misses the navigation links because they are in a different frame, parts of the website could be inaccessible to the user. Contribution and interaction both refer to a user's ability to enter information and communicate with a website. For example, a user must be able to fill out a form, complete the CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) at the end, and submit it. Yet, the blind and people with low vision cannot discern the symbols in a CAPTCHA, so an accessible website must utilize an alternative system, such as one based on audio recordings. Only when all of these requirements are fulfilled can a website be considered fully accessible.

A new method is needed to test eGovernment websites for such accessibility requirements, specifically for the blind and people with low vision. Some general web accessibility guidelines already exist for rating websites and providing good design criteria, such as the Web Content Accessibility Guidelines (WCAG) that are based on the previously given WAI definition of access. These guidelines can be further strengthened when combined with other accessibility standards such as ISO 9241 and Section 508 of the United States Rehabilitation Act. Recent attempts to synthesize new accessibility metrics from these standards can also be considered when creating a new metric, such as those by Parmanto and Zeng (2005), Nedbal and Petz (2008), and Gonzalez, et al. (2003). These existing metrics rate websites based on general usability and accessibility, taking into account all disabilities. However, this means that some websites that are not accessible to the blind and people with low vision can receive high accessibility ratings for conforming to the other standards. For example, the Gentofte eGovernment website in Denmark has won numerous awards for usability and accessibility, but it is completely inaccessible to the blind and people with low vision using a screen reader (Hans Rasmussen, personal communication, March 19, 2012). A user-centric metric based on existing accessibility standards but improved with results from usability studies with blind users and users with low vision can provide relevant suggestions for eGovernment website design that is compatible with screen readers and magnifiers.

The blind and people with low vision use a number of technologies to access the Internet. Compatibility between accessibility technologies and the web must be considered when implementing an eGovernment system. With current accessibility standards, many of the provisions for screen readers and magnifiers are only required for the top accessibility level which most websites do not target. This can result in websites that are designed to have a high accessibility score, but which are not accessible to the blind and people with low vision. In order to take websites that are currently accessible to the general population and make them accessible to the blind and people with low vision, we must design an accessibility metric specifically tailored to cover provisions concerning screen readers and

magnifiers. This metric could be used to generate suggestions to improve the accessibility of eGovernment websites for the blind and people with low vision.

      The goals of this project were to 1) create a website accessibility metric for the blind and people with low vision, and then to 2) use and refine the metric to assess the accessibility of the Danish eGovernment system, specifically the citizen portal Borger.dk. We conducted interviews, usability studies, and focus groups with the blind and people with low vision to understand the issues that they encounter when accessing Borger.dk and solicit their suggestions for improving the accessibility of eGovernment services. We provided the Danish Association of the Blind with this analysis of the accessibility of Borger.dk and a list of recommendations for further improvement of Danish eGovernment websites. We also provided a detailed accessibility report that can clearly illustrate accessibility issues that might result from the new eGovernment mandates. In the process of developing our analysis, we refined and tested our accessibility metric with input from the blind community, and we delivered this metric to the Danish Association of the Blind so that it may be used for further analysis of new eGovernment websites.

2 Background

One of the basic intentions of modern democracy is to provide all citizens with equal opportunity to contribute to and access government information, resources, and services. However, some groups have limited access to the government due to lack of material resources, geographical location, or individual disabilities (Dobransky & Hargittai, 2006). Many progressive governments have proposed the Internet as a way for all citizens to access government services, yet the Internet may itself be a barrier for some, as discussed in the previous chapter. In particular, the blind and people with low vision can encounter barriers in using the Internet, and eGovernment may limit rather than improve their access to these needed services.

Three key terms must be defined before discussing accessibility of eGovernment websites for the blind and people with low vision. They are – visual impairments, web accessibility, and eGovernment. According to the World Health Organization, visual impairments are "a severe reduction in vision that cannot be corrected with standard glasses or contact lenses and reduces a person's ability to function at certain or all tasks" (Global Data on Blindness, 1995, Para. 1). Web accessibility is defined by the Web Accessibility Initiative (2005) as the user's ability to "perceive, understand, navigate, and interact with … and contribute to the web." eGovernment refers to a digital system that allows a user to access government services over the Internet. It is important to understand these three terms, as they will be used extensively throughout this report.

In this chapter, we begin addressing this problem by discussing the historical foundations of eGovernment, as well as current eGovernment implementation in Denmark. Next, we define visual impairment and accessibility, and we discuss general accessibility barriers to the Internet. Following that, we review the assistive technologies and some of the special provisions available to the blind. We present a brief summary and critique of web accessibility standards and metrics currently in use. Finally, we acknowledge potential problems eGovernment systems might introduce for the blind and people with low vision, such as social isolation[2].

2.1 Historical Foundations of eGovernment

Over the past several decades, countries have begun moving government information and services to the Internet in an attempt to make government interaction more accessible and cost effective. The popular term that refers to this digitalization of

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[2] Most of the documents that were used for our research into Danish government systems, revisions to current Danish laws, and accessibility provisions in Denmark were only available in Danish. In some sections of this chapter, we have relied on input from experts, particularly John Heilbrunn, Vice President of the Danish Association of the Blind. When citing some Danish documents, we used the Google Translate service (translate.google.com) to obtain rough English translations.

government services is eGovernment. For a quick chronological summary of these eGovernment initiatives in Europe, including some minor ones that will not be discussed in this report, refer to Table 1.

Table 1: Chronological Summary of important eGovernment Plans and Initiatives in Europe, with a focus on Danish policies.

Year(s)	eGovernment Plan / Initiative
1968	Central Personal Register (CPR)
1994-1996	Danish Info-Society 2000 and IT Policy Action Plan 1995
2000	Digital Denmark – Conversion to the Network Society
2003	Danish OCES Digital Signature System implemented
2003	Denmark eDay1 Initiative
2005	Denmark eDay2 Initiative
2009	*Malmo Declaration*
2010	European eGovernment Action Plan 2011-2015
2010	Denmark *New Joint Public Digital Strategy* (Ny Fællesoffentlig Digitaliseringsstrategi) for 2011-2015
Sources for dates: Damsgaard & Henriksen, 2007; Denmark: Efficient EGovernment, 2010; Hoff & Hoff, 2010; Malmo Declaration, 2009; European eGovernment Action Plan, 2010; and New Joint Public Digital Strategy, 2010	

The first IT-based government system in Denmark was the CPR, or Central Personal Register, which was originally implemented in 1968 (Hoff & Hoff, 2010). Through the Central Personal Register, each citizen is assigned a CPR number that is then used for identification and to securely access personal information (Hoff & Hoff, 2010; John Heilbrunn, personal communication, February 9, 2012). This system predates the implementation of the Internet, so it was originally accessed mainly by way of paper identification cards. However, as the Internet became prevalent in society, the CPR system became digitized, providing an effective and stable foundation for the recent implementation of a digital identification system for use with eGovernment (Hoff & Hoff, 2010).

In 1994, Denmark published the *Info-Society 2000* eGovernment initiative as a response to the EU Bangeman-report (Damsgaard & Henriksen, 2007). The main goal of this initiative was for the public sector to build an effective IT framework for the benefit of both citizens and business (Damsgaard & Henriksen, 2007). Based on this initiative, the Danish Ministry of Research created the *IT Policy Action Plan* (1995), which named the purpose of a digital society: "economic development, increased employment, improved quality of life, and better environment" (p. 9). Key objectives of the Action Plan include providing universal access to information, ensuring security of private information, and supporting democracy by giving all individuals access to the government (IT Policy Action

Plan, 1995, p. 12). Proposed digital systems in the *Info-Society 2000* plan include a digital national public health network and an electronic library network (Damsgaard & Henriksen, 2007). The *IT Policy Action Plan* briefly mentioned that the Ministry of Research would create a new plan to support Internet access for people with disabilities (1995, p. 35). This action plan was the first step in Denmark's implementation of eGovernment and established an important basis for future digital policy.

The next major step for eGovernment in Denmark was the Digital Denmark initiative in 2000. According to Damsgaard and Henriksen (2007), the major goals of this initiative include greater availability of Internet services, implementation of faster XDSL Internet, and education of citizens in Internet use. This initiative was also the first mention of a digital signature system for secure access to Danish eGovernment systems (Damsgaard & Henriksen, 2007). The Digital Denmark initiative was an important step in spreading the availability of the Internet to many Danish citizens.

As eGovernment became a major focus in Danish politics, Denmark implemented a digital identification and signature system that enabled secure digital transactions between citizens and the government using the CPR number. A system known as OCES was used to access eGovernment websites such as SKAT.dk, the Danish tax system (Hoff & Hoff, 2010). Even at its peak, most citizens still opted for traditional government channels, with only 21% of Danish citizens using the OCES digital signature system. Despite poor adoption rates, OCES was used for many years as the sole method of accessing eGovernment services (Hoff & Hoff, 2010).

The eDay initiatives passed in 2003 and 2005 were major turning points in Danish eGovernment implementation. Starting on eDay1 (September 1, 2003), Danish government offices could require that all communication with any other office be digital (Damsgaard & Henriksen, 2007). On eDay2 (February 1, 2005), the powers granted to the government on eDay1 were extended to businesses and private citizens (Denmark: Efficient eGovernment, 2010). These eDay initiatives provided a foundation for eGovernment in Denmark by first internally digitalizing the government before allowing voluntary adoption by businesses and citizens.

While Denmark was passing these eGovernment initiatives, the EU held a number of Ministerial eGovernment Conferences (Excellence in Secure eGovernment, 2003). The *Malmo Declaration* (2009), authored during the 5th Ministerial eGovernment Conference in Malmo, Sweden, presents the shared eGovernment objectives of all EU member countries. According to the *Malmo Declaration* (2009), the purpose of eGovernment is to include all citizens in the governing process, especially those groups that are currently excluded due to social or digital barriers (p. 2). The intent of eGovernment is to provide easy access to public information, make administrative processes easier and more transparent, and involve citizens in the creation of public policy (*Malmo Declaration*, 2009, p. 3). However, the *Malmo Declaration* does not present a concrete methodology for meeting these goals; it requests more input, stating, "We will actively seek collaboration with third parties, for

example businesses, civil society or individual citizens, in order to develop user-driven eGovernment services" (*Malmo Declaration*, 2009, p. 2). The assumption made is that the only barriers to universal accessibility of eGovernment are the amount of research and number of suggestions that are considered when implementing such a system. However, the possibility must be considered that eGovernment cannot provide everyone with access to government services and must instead be integrated with existing systems.

On December 15, 2010, the European Commission published the *European eGovernment Action Plan 2011-2015* to present a more detailed plan for the implementation of eGovernment. Unlike the *Malmo Declaration*, the *European eGovernment Action Plan* (2010) has a section that addresses user empowerment and inclusive services; however, it is still open-ended because no specifics are mentioned – countries are expected to implement their own inclusive services (p. 6). The major objective of this Action Plan is that, by 2013, the EU member countries will develop quantitative standards for web accessibility of eGovernment services using input from experts. The EU Action Plan was written with the assumption that eGovernment websites can be made accessible to everyone by conducting extra research and taking more suggestions, but this is not necessarily true and must be considered.

In response to the EU Action Plan, the Danish Government released the Ny Fællesoffentlig Digitaliseringsstrategi, or *New Joint Public Digital Strategy* for 2011-2015 (2010). The *New Joint Public Digital Strategy* (2010) attempts to justify the transition to eGovernment by presenting the statistic that 3 in 4 Danes are on the Internet daily (Para. 2). However, this also means that 25% of Danes are not on the Internet daily. Individuals in this population may not have Internet access at all, or may suffer from disabilities that prevent effective use of the Internet. In anticipation of such criticisms, the *New Joint Public Digital Strategy* (2010) proposes two ways to transition to eGovernment.

The first way is to develop eGovernment while maintaining current paper, telephone, and human-based systems. However, this plan will not provide the economic benefits that the Danish government desires from eGovernment implementation (*New Joint Public Digital Strategy*, 2010). The second, more ambitious plan is to convert current government interactions to exclusively digital systems, potentially making government processes easier and more convenient for the majority of the population, while providing economic benefits. However, this plan would limit access to government services for some subsets of the Danish population who cannot easily use computers, such as the physically disabled, the blind, or people with low vision.

To this end, the *New Joint Public Digital Strategy* (2010) presented no real solutions. It mentions that an eGovernment system should not block access to government services for any individuals or businesses in Denmark, but the goal is still to implement eGovernment while attempting to make these individuals and businesses digitally self-reliant (*New Joint Public Digital Strategy*, 2010). The *New Joint Public Digital Strategy* (2010) also calls for user involvement in the development of the new system to ensure that

it will be accessible. However, like the other eGovernment plans that have been proposed, this plan assumes that universally accessible eGovernment websites are possible with further studies and suggestions. Such an assumption requires verification, especially when dealing with something as far-reaching as the government. The pros and cons of eGovernment, as well as current and future accessibility technologies, should be considered when determining the best ways to implement and integrate an accessible eGovernment system in Denmark.

2.2   The Current Status of eGovernment in Denmark

The early start of implementation, as well as subsequent follow-up initiatives and systems, has put Denmark ahead of other countries in terms of eGovernment. As early as October 2003, Denmark ranked in the top two countries in the world for the availability (72%) and sophistication (86%) of online government services (Cap Gemini, 2004). Denmark has a number of active eGovernment systems that are currently used in parallel with traditional systems.

By the beginning of 2010, it had become clear that the OCES digital signature system that had been in use since 2003 needed replacement. Denmark decided to implement a more secure, centralized ID system called NemID, which would be more convenient and easier to use (Hoff & Hoff, 2010). This NemID system has been implemented in Denmark and is tied directly to each citizen's CPR number, allowing for access to eGovernment services from almost anywhere with a unique identifying key assigned to each citizen for each transaction (John Heilbrunn, personal communication, February 9, 2012; Hoff & Hoff, 2010). NemID is the entryway into the entire Danish eGovernment system, so significant effort was put into making it accessible for everyone. According to John Heilbrunn, this effort has succeeded because NemID is accessible to the blind and people with low vision by a number of different systems (personal communication, February 9, 2012). Options to access the unique NemID codes required for eGovernment interaction include a computerized phone system and the ability to have a number of codes sent via paper mail (John Heilbrunn, personal communication, February 9, 2012). However, NemID only gets a user into the eGovernment portal, which must also be accessible.

The main ways to access eGovernment in Denmark are the Citizen Portal – Borger.dk – and the Business Portal – Virk.dk (Denmark: Efficient EGovernment, 2010). According to the book *Denmark: Efficient EGovernment for Smarter Public Service Delivery*, a review of eGovernment in Denmark by the Organization for Economic Co-operation and Development (OECD), the Borger.dk portal, which is accessed via NemID, contains all eGovernment services for citizens, while the Virk.dk portal allows businesses to digitally self-report to the government (2010). These two systems are the center of eGovernment in Denmark and were designed to encourage businesses and citizens to use eGovernment by making it easily accessible (Denmark: Efficient EGovernment, 2010). We already know that entry into these systems through NemID is accessible to the blind and people with low

vision (John Heilbrunn, personal communication, February 9, 2012). The accessibility of the Borger.dk portal itself and some of the services that are contained within it are examined in this report.

Two current Danish eGovernment systems designed to facilitate communication between the government and citizens are NemSMS and DokumentBoks. NemSMS allows the government to send text messages to citizens, while DokumentBoks provides a secure way to send and receive messages between citizens and government offices (Denmark: Efficient EGovernment, 2010). Given the opportunities, convenience, and added security that eGovernment systems can provide, ensuring their accessibility is vital to ensuring a high quality of life for the blind and people with low vision. Current eGovernment mandates generally say that web accessibility should be considered, but do not require adherence to web accessibility standards, leading to an uncertain digital landscape for people with disabilities.

2.3 Visual Impairments and Blindness

According to the World Health Organization, visual impairment is "a severe reduction of vision that cannot be corrected with standard glasses or contact lenses and reduces a person's ability to function at certain or all tasks" (Global Data on Blindness, 1995, Para. 1). The main causes of visual impairment are macular degeneration, glaucoma, cataracts, and diabetes (p.1). The World Health Organization estimates that, as of 1995, there were 285 million visually impaired people in the world and, of these, 39 million people were blind. More than half of the people with low vision are elderly and have special needs in their daily lives (p.1). They may require assistance with simple tasks such as cooking in a kitchen, navigating around a city, or shopping in a crowded mall. Often, the blind and people with low vision have problems interfacing with common technology, such as computers, cell phones, and MP3 players. Additionally, the elderly often lack experience with computers, which can make it even more difficult to use newer digital technologies.

Visual impairment is categorized by an individual's level of vision. According to the World Health Organization, "there are five main categories of low vision and blindness and even more categories of visual impairments" (Global Data on Blindness, 1995, p. 4). For a full summary of these categories, see Table 2 below. According to John Heilbrunn, the Danish Association of the Blind only accepts members with less than 10% vision, so that will be the group we will primarily focus on for this project (personal communication, February 9, 2012).

Table 2: Level of Visual Impairment and Blindness according to the World Health Organization.

	Level of Blindness	Definition	Implications
0	**Mild or no Visual Impairment**	Vision better than: 6/18, 3/10, 20/70	Maybe glasses
1	**Moderate Visual Impairment**	Vision better than: 6/60, 1/10, 20/200 Vision worse than: 6/18, 3/10, 20/70	Glasses and possible need for magnifiers on computer interface
2	**Severe Visual Impairment**	Vision better than: 3/60, 1/20, 20/400 Vision worse than: 6/60, 1/10, 20/200	Magnifiers and color contrasters for computer interfaces
3	**Blindness**	Vision better than: Can count fingers @ 1 meter distance Vision worse than: 3/60, 1/20, 20/400	Strong magnifiers for some but mainly screen readers for computer interfaces
4	**Blindness**	Vision better than: Light perception Vision worse than: 1/60, 1/50, 5/300	Screen readers for computer interfaces
5	**Blindness**	No light perception	Screen readers for computer interfaces
6	**Other**	Color blindness, etc.	Color contrastors for some cases
Data in this table obtained from the following *World Health Organization* document: International Statistical Classification of Diseases and Related Health Problems (2010)			

2.4 The Accessibility of the Internet

According to the Web Accessibility Initiative (WAI) (2005), "Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the web, and that they can contribute to the web". The main intention of accessibility is equal access and equal opportunity for all. The Internet is a promising platform for eGovernment, but the accessibility of many existing web services is questionable.

Perceivable means "information and user interface components must be presentable to users in ways they can perceive" (Web Accessibility Initiative, 2005). The Merriam Webster dictionary defines perceive as "to become aware of" (2008). Together, these definitions suggest that, for the Internet to be accessible, the blind and people with low vision must be able to become aware of the information on a website.

To navigate, interact, contribute to, and understand a website, the user must be able to interface with components of a site and the navigation system must be operable (Web Content Accessibility Guidelines, 2008). Navigation is vital to Internet accessibility because, without it, a user would not be able to get to different pages or between frames on a website. Interaction and contribution are also vital to the accessibility of a website because users need to add information and fill out forms on an eGovernment website, so that they may participate in government processes. Understanding contributes to the accessibility of a website because it ensures that elements that can be accessed also have meaning to a user. Understanding is defined by the WAI (2005) as "information and operation of the user interface must be understandable," and the Merriam-Webster Dictionary defines understand as "to grasp the meaning of" (2008). Thus, for a user to understand the content of a website, it must be written in clear language that does not confuse its users.

To access the Internet, one must use a computer or other Internet-enabled device. These devices can be costly and difficult to use for people who are not previously acquainted with modern technology. A low-cost computer from an online commerce website such as Newegg.com is priced at around $450 USD, or 2500 DKK in 2012, which can be a daunting sum of money for some people. Additionally, many in the elderly population are not Internet-ready; according to the Danish Ministry of Research, 65% of people 60 to 74 years old are using the Internet, meaning that 35% of the elderly in Denmark do not have Internet access (Charlotte Sahl-Madsen, 2010). Alternative methods to complete eGovernment forms exist for people who cannot afford a computer, such as Internet Cafes and library computers; however, these services have their own associated costs in extra time and money, which many people cannot spare.

The definition of accessibility presented by the WAI (2005) does not account for every aspect of web accessibility for the blind and people with low vision. Consider somebody using a screen reader to fill out a form that got distracted and cannot remember what the screen reader told him or her to write once in form mode. If this keeps happening, the user might become frustrated and eventually give up. This would make the system useless to the blind and people with low vision because the form would not be accurately submitted without considerable effort. If this was a government website, then whatever information that user was going to submit to the government will now not be sent due to a badly designed system. Such a system cannot be easily accessed or understood by all users, so it is inaccessible. However, assistive technologies and accessible website design, aided by special provisions where needed, can provide people with low vision and the blind with a good chance to have an accessible eGovernment system.

2.5 Assistive Technologies and Special Provisions

Assistive technologies alone cannot ensure full web accessibility for the blind and people with low vision because screen readers, magnifiers, and other accessibility devices have limitations and can be frustrating to use. However, without these technologies, the blind and people with low vision would not be able to access the Internet. Specifically, they would not fulfill the definition of accessibility by the Web Accessibility Initiative, to perceive, navigate, understand, contribute, and interact with websites (2005). Magnifiers and screen readers can offer the blind and people with low vision a more accessible Internet experience, but can also be the source of frustration and wasted.

Magnifiers are used by people with low vision to increase the size of screen elements to a readable level. According to Paul Blenkhorn, et al. (2006) of the University of Manchester Institute of Science and Technology, magnifiers have two common features: enlarging items on the screen and contrasting colors. Some commercial examples of magnifiers are Ai Squared's ZoomText and Sensory Software's Magnus. Blenkhorn, et al. (2006) mention that color inversion can also be used to reduce glare, helping those who are elderly, are colorblind, or suffer from macular degeneration to see elements on the screen more clearly (p. 57). Blenkhorn, et al. (2006) also explain that text can be magnified to different levels, ranging from 2x to 32x, based on user needs and preferences (p. 57).

When the average computer monitor is considered, the limitations of magnifiers become evident. Enlarging an image does not also increase its resolution, so magnified images can appear blocky and unreadable. Additionally, at higher levels of magnification, only small sections of the screen are visible at a time. This can make it difficult and confusing to interact with elements on the screen. Magnifiers create an accessible interface with computers for some people with low vision, but can prove frustrating and inaccessible at higher magnification levels. For an example of the very limited and confusing view that a magnifier can present, see Figure 1.

Figure 1: An example of a magnified screen that would be difficult to navigate.

Screen readers are the only way for people with full blindness or very low vision to access a computer. In a study by Emma Murphy, Ravi Kuber, Graham McAllister, Philip Strain and Wai Yu (2003) on the difficulties experienced by Internet users with visual impairments, it was determined that web pages are often too difficult to interpret using even the most advanced assistive technology (p. 79). This problem is exacerbated by web designers who often do not design accessible websites due to the significant time and resource commitments required to bring in only a small additional audience. As a result, web elements such as graphics, frames, and videos are often left unlabeled, making it difficult for screen readers to read all of the content on a website.

The study by Murphy, et al. (2003) mentioned that JAWS, a screen reader by Microsoft, is considered the best reader on the market but still has many areas for improvement (p. 83). Users of screen readers like JAWS navigate their computers and the Internet using only their keyboards with synthesized speech cues from the computer (Murphy, et al., 2003, p. 83). This can be a frustrating experience. Sharon Strzalkowski, an employee at the Massachusetts Commission for the Blind, explained that navigating the Internet using JAWS could become especially frustrating when encountering images with no alternate text and technologies such as Adobe Flash (personal communication, February 8, 2012). Sharon also mentioned that JAWS gives no context for where you are on a web page, requiring much focus to avoid the frustrating experience of getting lost (personal communication, February 8, 2012). Despite the complexity, sluggishness, and frustration of using screen readers, they remain the only way for people with blindness or low vision to effectively access the Internet.
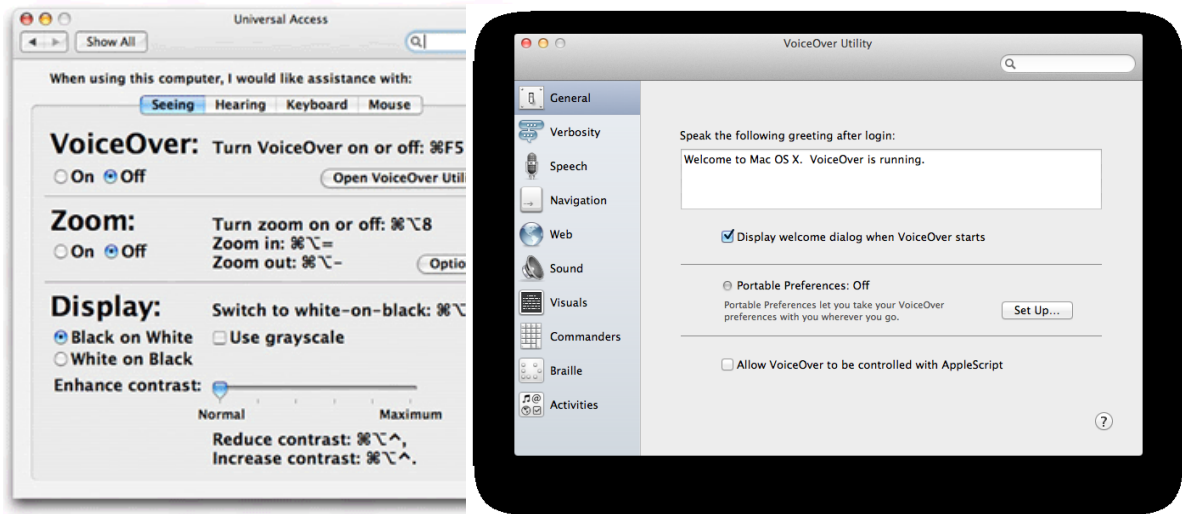
Figure 2: The Apple Operating System Settings showing how simple it can be to adjust accessibility options.

The Microsoft Windows operating system has similar accessibility features, though they are more limited than those in Apple's Mac OS X. The Windows accessibility screen can be seen in Figure 3. Note that four mouse clicks are required to navigate this screen, while only two are needed to perform similar actions in Mac OS X. This built-in system is not very customizable, nor is it as full-featured as commercial software like JAWS, but it can prove useful in allowing the blind and people with low vision to access the information they need from any computer, even those without their own personal accessibility software.
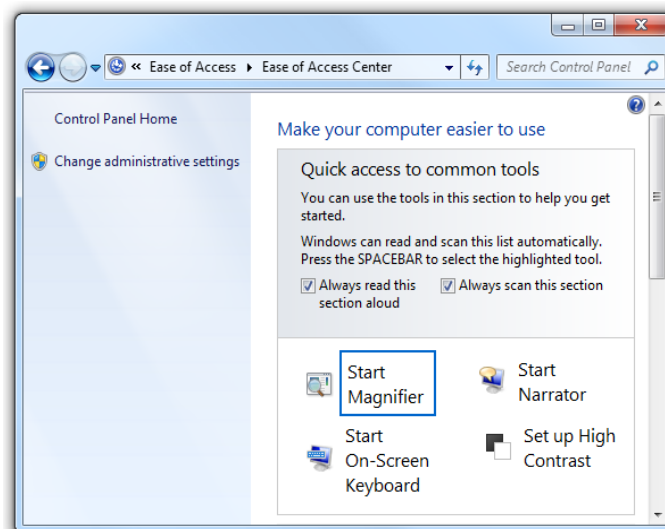
Figure 3: The Windows Accessibility Screen, which is not as easy to access as the Apple screen.

Some people who are blind or have low vision lack the confidence to leave their homes or are not Internet-ready because of the steep learning barriers associated with accessibility technology. Screen readers utilize keyboard control to verbalize the information on a webpage. According to Sharon Strzalkowski, a rehabilitation counselor for the Massachusetts Commission for the Blind, a screen reader requires a user to have an innate understanding of a keyboard and the layout of a computer interface (personal communication, February 8, 2012). She also mentioned that, to interact with online forms, a blind user must focus and have good memory so they do not lose their place on the page. Operating a screen reader requires a great deal of focus and diligence and can easily lead to frustration. Screen readers also make it difficult to perceive all the information on a webpage because they give a very limited view of the content and have no real way to present a general overview of the page. During this interview with Sharon, we were introduced to an eGovernment form used by the city of Worcester, Massachusetts to collect emergency preparedness information from citizens. This form demonstrated to us the difficulty of switching between read mode, where written information is read aloud to the user, and form mode, where the user can enter information into form fields. This links to the definition of accessibility, because the screen reader is allowing a user to perceive, understand, and navigate the information on the screen in read mode and interact with the web in form mode. Thus, ensuring that this interface between a website and a screen reader is effective can help ensure the accessibility of a website.

Websites on the Internet constantly change and evolve to use newer technologies. When sighted people use the Internet, technologies such as Adobe Flash, Java, and Adobe PDF help present information in a visually appealing manner. When a blind person uses the Internet, these technologies are a barrier to access unless they are compatible with their screen reader. In an interview, John Heilbrunn explained that Jaws, a Microsoft Windows-compatible screen reader, could not translate Java applications without additional software (personal communication, February 9, 2012). Sharon Strzalkowski mentioned that JAWS often has trouble with reading PDF documents (personal communication, February 8, 2012). Sharon also discussed CAPTCHAs that are used to verify that a human is filling out a form. For a sighted person, a CAPTCHA is a small box with difficult-to-read scrambled letters that the user must interpret, type, and submit. When blind people fill out a CAPTCHA, the words are read in a computer-generated audio recording with background noise, where the first letter of each word represents a letter in the CAPTCHA. Sharon Strzalkowski explained that it was easy to get a CAPTCHA wrong because it is difficult to understand what is being said and it is easy to forget the exact order of the words being spoken. Another web design decision that can make a form inaccessible to a screen reader is to place multiple text input boxes next to each other with only one title. The screen reader often continues down the form vertically, skipping those boxes. The frustrations associated with Internet accessibility for the blind and people with low vision make prospect of universal accessibility a difficult but necessary undertaking. Fulfillment of the

long-term goal of making all websites accessible requires collaboration between assistive technology companies, web designers, and policy makers.

Recent versions of the Mac OS X and Microsoft Windows operating systems have built-in accessibility software. Apple's products, such as the Mac OS X operating system, the iPhone, and the iPad are especially popular among the blind and people with low vision because of the excellent accessibility technologies included (John Heilbrunn, personal communication, February 9, 2012). The Mac OS X operating system has a screen magnifier, the VoiceOver screen reader, and support for add-ons such as Braille displays. However, this system still has limitations; the built-in magnifier has a limit of 16x magnification, while people who are legally blind may require magnifications of 32x to 50x (Blenkhorn , et al., 2006). Mac OS X also has the capability to invert the screen colors at any time with a simple key combination, potentially reducing glare for people with low vision. Figure 2 shows the accessibility settings available on the Mac OS X operating system.

Special provisions must be considered for the blind and people with low vision when implementing a national eGovernment system. However, these special provisions come in three different categories, each with varying levels of desirability and acceptance.

1. Implement accessibility standards within the eGovernment websites that all citizens use, allowing the blind and people with low vision to access these systems by using assistive technologies.
2. Retain existing systems, such as government offices staffed by people, in parallel with eGovernment systems, allowing the blind and people with low vision to choose the most accessible system.
3. Create new systems only for the blind and people with low vision, such as automated phone lines or caretakers provided by the government to help at home or in public areas in an attempt to ensure accessibility for everyone.

The most desirable of these special provisions is the implementation of accessibility standards within eGovernment websites. John Heilbrunn, Vice President of the Danish Association of the Blind, said that blind people do not want to rely on special systems to access government services, since they want to utilize the new, more convenient systems that everyone else will be using (personal communication, February 9, 2012). However, according to Stephen Saxby, an expert who attended the 2006 Ministerial eGovernment Conference, many current eGovernment systems were implemented prematurely and exhibit bad practices that are now being repeated in newer systems (2006). These systems must be reconsidered and rebuilt with factors such as accessibility in mind from the start, then continually iterated upon and improved (Nedbal & Petz, 2008). Until then, a completely accessible eGovernment system is not possible without special provisions. Additionally, not all government systems can be translated directly to digital form while maintaining their effectiveness, organization, or accessibility – some government services must be transformed to become accessible on the Internet (Saxby, 2006). Thus,

eGovernment implementation must come about through research and repeated iteration toward progressively better systems.

Until eGovernment systems are improved to the point of becoming fully accessible with technologies such as screen readers, the second most desirable special provision will be to retain existing government systems in parallel to eGovernment services. This would ensure that no accessibility is lost because existing systems would be left intact. However, eGovernment plans such as Denmark's *New Joint Public Digital Strategy* (2010) propose eGovernment as a way to decrease operating costs. Retaining current systems while implementing new ones would only increase costs, making this provision undesirable to the Danish government.

The special provision that is least desired is the creation of a separate system only for the blind and people with low vision. For example, Denmark has already started implementing a number of eGovernment systems, and the Ministry of Finance allows people who don't have access, such as the blind and people with low vision, to not be committed to these systems at all (John Heilbrunn, personal communication, February 9, 2012). These special provisions generally involve somebody else completing these eGovernment forms for the user, either through a phone hotline, the hiring of a secretary, or a trip to the local agency (John Heilbrunn, personal communication, February 9, 2012). These provisions allow the blind and people with low vision to access eGovernment systems. However, Stephen Nicholls, creator of the OneTouch self-defense system for the blind, notes that "Blind individuals do not want to be singled out, they want to use the same systems sighted people use" (personal communication, February 15, 2012). These special systems would not provide the same flexibility or opportunity as eGovernment systems because they would require working within the operating hours of a government office or assistant (John Heilbrunn, personal communication, February 9, 2012). While these systems are not convenient or ideal, they work to fill in any accessibility gaps that exist in eGovernment.

2.6   Web Accessibility Standards and Metric

Websites are inherently visual and require interaction in two dimensions, so detailed web accessibility standards have been published by a number of organizations in an attempt to make them accessible to more people. Currently, the standard way to quantify the accessibility of a website is to use the 91-checkpoint system outlined in the Web Content Accessibility Guidelines (WCAG) (Parmanto & Zeng, 2005). Higher WAI ratings are assigned to websites that pass more WCAG checkpoints (Parmanto & Zeng, 2005). However, creating a truly accessible website is a challenging endeavor that requires significant investment of time and money. It is not surprising that, in an analysis of the accessibility of the websites for Austria's 40 largest cities, only 30% were WAI-A compliant, 7% were WAI-AA compliant and only 3% were WAI-AAA compliant (Nedbal & Petz, 2008). According to John Heilbrunn, Denmark's goal was to have all government websites

accessible to screen readers by 2008, but 80% of those websites are still not accessible as of 2012 (personal communication, February 9, 2012). There have since been a number of attempts at better accessibility metrics, such as those by Parmanto and Zeng (2005), Nedbal and Petz (2008), or Gonzalez, et al. (2003), but none of them are widely accepted, resulting in further confusion about what constitutes a fully accessible website.

Accessible eGovernment websites based on one or more of these standards have not been implemented in Denmark because they are not legally mandated. According to Signe Bernhard, who performed a study on the accessibility of the Danish Radio website, there is no motivation for central government offices, municipalities, and third party contractors to spend significantly more money creating an accessible website because they are not required to (personal communication, April 27, 2012). In her interviews, she had found that the developers behind these websites were very enthusiastic to implement accessibility provisions, but the managers did not prioritize accessibility because they were not required to (personal communication, April 27, 2012).

Many of the accessibility barriers in websites such as Borger.dk stem from the elements of the page, not just the design. Not all websites are written in simple HTML or XHTML; some modern web designers choose to employ newer technologies, such as Adobe Flash and Java, which screen readers cannot interpret. Even a simple element that is included in most websites – an image – cannot be read by a screen reader without alternate text (Murphy, et al., 2003, p. 79). These technologies must be studied and made accessible before using them to implement eGovernment.

In the case of the Danish eGovernment system, one such problematic technology is Java. John Heilbrunn said that, to use NemID with a screen reader, you must first install Java and the Java Access Bridge so that the interface with the screen reader will work. Then, whenever Java undergoes a semi-regular update, the Java Access Bridge must be reinstalled before the user can access the eGovernment system again (John Heilbrunn, personal communication, February 9, 2012). Another issue arises with the now-widespread use of 64-bit operating systems. Hans Rasmussen, head of the Gentofte Disability board and a web accessibility consultant for the Danish Association of the Blind, mentioned that the 64-bit version of the Java Access Bridge would not automatically update (personal communication, March 19, 2012). This can become inaccessible for users who do not have the technical knowledge to go into the control panel and manually update the technology. Further development of Java may be necessary before it can become a standard for accessible website design.

The other major technology that can be inaccessible to screen readers is Adobe Flash, which is used extensively on modern websites. Hans Rasmussen mentioned that Flash could be made accessible by a developer using alternate text, but people usually do not bother; Flash displays dynamic content, while screen readers handle static content (personal communication, March 19, 2012). For example, Flash applications tend to have playing video or moving objects. Such information would be impossible to display through

a screen reader. Instead, Hans Rasmussen recommended that all content be displayed in parallel with technologies such as Flash (personal communication, March 19, 2012). For example, a Flash video is fine if the information presented in the video is also available as text on the page. It seems that Flash is not a practical way to present information in an accessible manner.

2.7 Additional Problems with Total Online Services

The blind and people with low vision often experience social isolation due to fear or lack of confidence. Stephen Nicholls, a sensei in martial arts and creator of OneTouch self-defense for people with low vision, discussed cases when his blind students were not willing to travel to his seminars, even with a guide, because it was too much risk and effort (personal communication, February 15, 2012). Stephen also mentioned that one of the motivations for the creation of his OneTouch program was the high rate of violence and sexual abuse toward the blind and people with low vision, especially among the female population (personal communication, February 15, 2012). These factors can make it easier for some people just to stay home, eventually losing touch with other people and becoming isolated.

Currently, the only social contact some blind people and people with low vision experience is when going to a government office to file paperwork or pick up a welfare check. With the implementation of eGovernment systems that do not require such trips, many of these people will lose their only source of social contact and become fully isolated. Stephen Nicholls referred to the possibilities as "disheartening" and said that it would be "disappointing to see eGovernment be a contributing factor to [the social isolation] of the blind community" (personal communication, February 15, 2012). The other side of this argument is that eGovernment could actually open free time for more meaningful social activities, such as the social gatherings hosted by the Danish Association of the Blind (John Heilbrunn, personal communication, February 9, 2012). This issue was further considered, with input from our focus groups, in the conclusions and recommendations section of this paper.

3 Methodology

The intent of this project was to provide the Danish Association of the Blind with a way of ensuring that the blind and people with low vision in Denmark maintain full access to government services as they are converted to eGovernment. As part of our mission, we wanted to understand the difficulties people with low vision face. Our questions included:

1. What features make a website accessible or inaccessible to the blind and to people with low vision?
2. What are some of the current eGovernment systems in Denmark and what features do they employ?
3. How accessible are these developing sites to the blind and to people with low vision?
4. What are some alternatives to these eGovernment systems that are or can be implemented either in parallel with eGovernment sites or as special provisions specifically for the blind and for people with low vision?
5. Are there other socio-cultural implications these systems could have for the blind and for people with low vision?

We answered question 1 by reviewing current guidelines and metrics and considering which of them might apply to the blind and people with low vision specifically. We synthesized and added to these guidelines, creating a prototype website accessibility metric specifically for users with blindness and low vision. This prototype is presented in the results chapter. In researching question 2, we discovered that Borger.dk is the main portal for citizen access to eGovernment in Denmark. Once in Denmark, we interviewed a number of Borger.dk users and experts in web accessibility to identify the issues that might arise for the blind and people with low vision. We began by considering the features and types of tasks that the blind and people with low vision might have to complete on Borger.dk. We decided to focus question 3 entirely on Borger.dk and some types of tasks it entails – forms, secure mail, and government document searching and reading, primarily documents involving visuals and verbal text. We addressed questions 3 through 5 with interviews, focus groups, and a usability study involving blind users and centering on such tasks.

The Danish Association of the Blind plans to use the answers to these questions to advocate for improved accessibility to government services for the blind and people with low vision. They will also recommend the use of our refined metric in future assessment of accessibility of eGovernment websites. The overview of our project, including all objectives and deliverables can be seen in Figure 4.
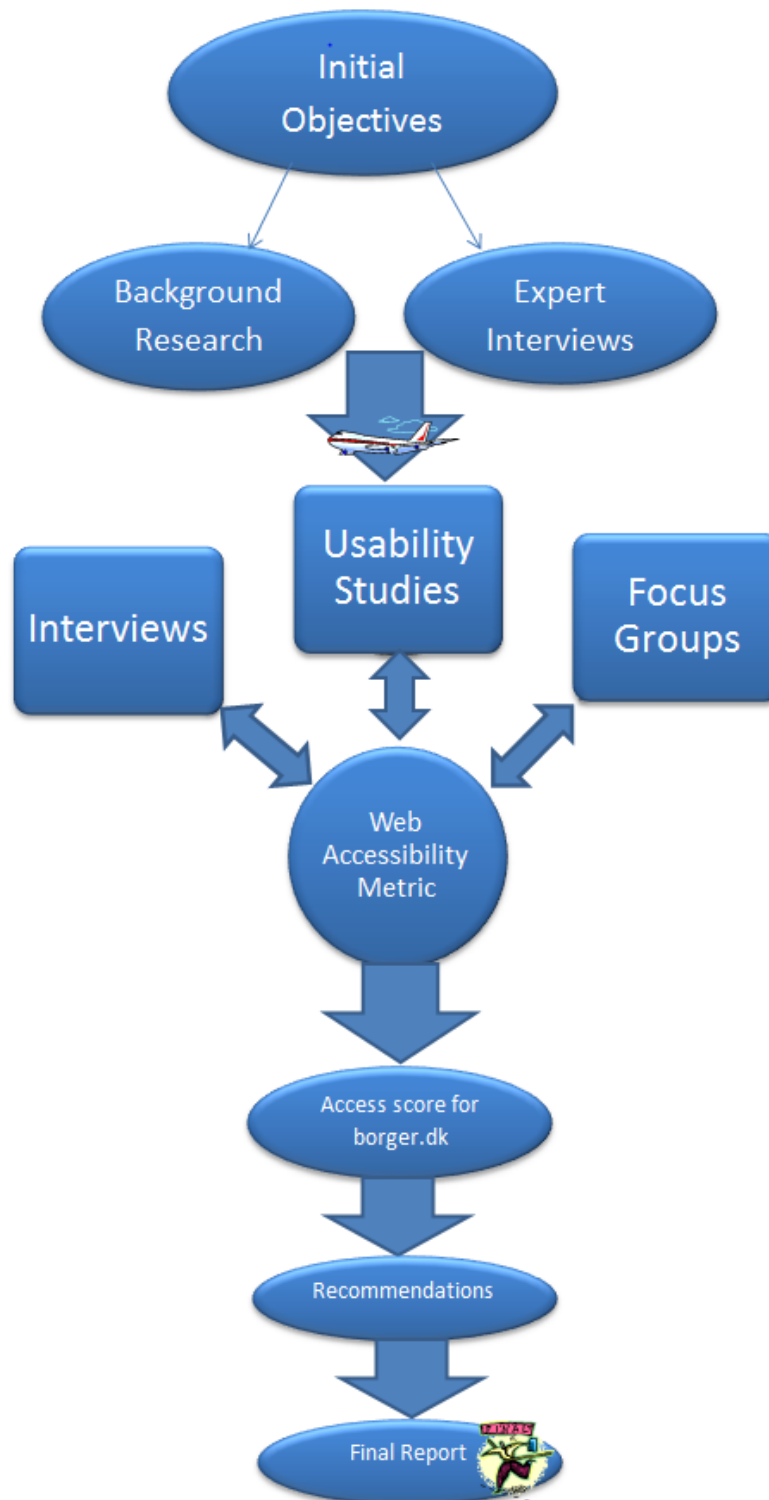
Figure 4: Project Overview

This project was undertaken from March 11, 2012 to May 8, 2012. The following sections explain our methods in detail.

3.1 Develop and Refine a Web Accessibility Metric for the Blind and People with low vision and Use this Metric to Assess the Accessibility of Borger.dk

We began by developing a web accessibility metric based on existing standards and metrics, but we focused on accessibility for the blind and people with low vision. This process involved adding only those criteria related to the blind and people with low vision, and then expanding them based on information from a literature review and expert interviews. Once in Denmark, we further tested and refined this metric using user feedback from interviews, the usability study, and focus groups. We created a feedback loop, as highlighted in Figure 5, by using each step in the process to improve the metric, which was then used for the next step in the process. In this way, we could continuously gather data about the accessibility of Borger.dk.

Synthesize Metric
- Integrate background research to create a web accessibility metric specifically for the blind and people with low vision.

Interview
- Interview the blind and people with low vision about their use of eGovernment and assistive technologies.
- Determine the perceived accessibility of Borger.dk with currently available technology.

Usability Study
- Observe eight users as they performing a list of tasks through Borger.dk within one hour.
- Utilize a "talk aloud" system in which the users verbalize experiences with Borger.dk as they use it.
- Compare user feedback on the accessibility of Borger.dk against the metric.

Focus Groups
- Gather participants from the usability studies.
- Ask about the process of accessing Borger.dk and any problems or ways to improve it.
- Discuss the other perceived implications that eGovernment may have on the blind and people with low vision.

Figure 5: Overview of the iterative process of improving the metric while conducting interviews, a usability study, and focus groups.

3.1.1 Synthesize Metric

The initial draft of the web accessibility metric was synthesized through research into existing web accessibility standards, such as the Web Content Accessibility Guidelines (WCAG) 2.0, ISO 9241, and the US Rehabilitation Act Section 508. There has already been a multitude of effort in synthesizing these standards into quantifiable accessibility metric, such as those by Parmanto and Zeng (2005), Nedbal and Petz (2008), and Gonzalez, et al. (2003), so we attempted to utilize some of the research by these groups in developing the first draft of our metric. Our metric was unique because it was specifically geared towards access issues that affect the blind and people with low vision. The purpose of this approach was to create a simpler and more compact metric to quickly evaluate a website and suggest improvements.

After synthesizing the initial web accessibility metric and joining the Danish Association of the Blind in Denmark, we began to evaluate and improve the metric in Denmark using interviews, a usability study, and focus groups. We focused our testing and analysis on the NemID and Borger.dk systems currently functioning in Denmark, as well as the preliminary implementations of Digital Post and the December 2012 Amendment to the Civil Registration Act when available. According to John Heilbrunn, NemID has been made accessible to the blind and people with low vision over time, so we researched the steps that had been taken to improve its accessibility (personal communication, February 9, 2012). However, most municipal eGovernment websites through Borger.dk have not been made accessible to the blind and people with low vision (John Heilbrunn, personal communication, February 9, 2012). Thus, Borger.dk became the primary focus of our research.

3.1.2 Interview

We first interviewed six people who were blind or had low vision and who had previously used Borger.dk. These users were recommended to us by the Danish Association of the Blind. When choosing the users to be interviewed, an attempt was made to find people who use different assistive technologies, have different Internet skill levels, and are in different age groups. The following statement was read aloud before each interview to establish informed consent:

> We are a group of students from Worcester Polytechnic Institute in Massachusetts. We are here working in conjunction with the Danish Association of the Blind to evaluate the accessibility of Denmark's new eGovernment portal, Borger.dk. We strongly believe with your help we can improve the accessibility of Borger.dk, and ensure that future eGovernment sites are accessible for everyone.
>
> Your participation in this interview is completely voluntary and you may withdraw at any time. Please note that any information you give us may be quoted but your name and identity will be completely

confidential. No names or identifying information will appear in any of the project reports or publication. We would like to record this interview to use only for our reference in writing this report. Your participation is greatly appreciated. If interested, a copy of our results can be provided at the conclusion of our study.

The questions that were asked of the participants of the study are included below in Figure 6. For the full interview protocol, see Appendix B.

Interview Questions

1. How old are you?
2. What municipality are you from?
3. What government systems do you need to access in a year?
4. Do you find current non-digital government systems accessible?
    a. How do you access these systems?
    b. Please explain what is/is not accessible.
5. What assistive technologies do you use?
6. What is your approximate Internet skill? Beginner (basic web browsing and email), intermediate (using the Internet for your job), or advanced (web design experience or IT)?
7. How would you describe the ease of use of the Internet with your assistive technology?
8. Can you explain what parts of Borger.dk you have used?
9. Did you find it simple or difficult to use Borger.dk?
    a. Can you describe these difficulties?
    b. On a scale of 1-5, where 1 is simple with no difficulties, 2 is simple with few difficulties, 3 is ok with more difficulties, 4 is difficult with many difficulties and 5 is impossible, can you describe your difficulties with Borger.dk?
    c. Would you say you experienced any frustrations when using Borger.dk?
    d. On a scale of 1-5, where 1 is "you are relaxed", 2 is "you are annoyed", 3 is "you are getting agitated", 4 is "you are frustrated", 5 is "you no longer want to use it" what is your level of frustration when using Borger.dk?
    e. What, if any, parts of Borger.dk do you prefer to access online?
10. What effect, positive or negative, do you feel Borger.dk will have on people in the community?

Figure 6: Interview Questions. The full interview protocol, including introduction and conclusion can be found in Appendix B.

The interview summary sheets and audio recordings were analyzed after the preliminary interviews. The data resulting from this analysis was used to revise the first draft of the web accessibility metric described above. The next step was to perform a usability study with eight subjects who were selected with assistance from the Danish Association of the Blind.

3.1.3 Usability Study

Ten subjects were chosen for the usability study using a number of criteria. Subjects with a professional working proficiency in the English language were preferred for this study, to negate the need for additional personnel such as translators. To ensure that the subjects would have enough expertise to at least complete part of the usability study and provide some data, six people with prior Borger.dk use experience were chosen. Two additional subjects with no prior experience with Borger.dk were chosen to provide a first-time perspective on the accessibility of eGovernment. Finally, two sighted users of Borger.dk were chosen to compare the accessibility of Borger.dk between sighted people and the blind. Frustration is another major factor in the accessibility of a website, so users were only given one hour to complete their given tasks. After one hour, a user trying to accomplish these tasks might begin to become frustrated, reflecting negatively on the accessibility of the website. An attempt was made to select users of different age ranges, because different age groups tend to have different technological proficiency levels. Due to limitations on the maximum number of users that could be tested at one time, the eight blind or low vision users were split into two groups of four and each group was assigned to a different day. The two sighted users were tested on the same day after the tests with the blind and low vision subjects had been completed.

When each subject was brought into the room with a researcher, the following prompt was read to establish informed consent and provide background information about the study:

> We are a group of students from Worcester Polytechnic Institute in Massachusetts. We are here working in conjunction with the Danish Association of the Blind to evaluate the accessibility of Denmark's new eGovernment portal, Borger.dk. We strongly believe with your help we can improve the accessibility of Borger.dk, and ensure that future eGovernment sites are accessible for everyone.

> Your participation in this study is completely voluntary and you may withdraw at any time. Please note that any information you give us may be quoted but your name and identity will be completely confidential. No names or identifying information will appear in any of the project reports or publication. Your participation is greatly appreciated. If interested, a copy of our results can be provided at the conclusion of our study.

You must first fill out a confidentiality form, and please note that your voice will be recorded during this study, but no identifying information will be revealed in the reported findings of this study. Your voice recordings will only be used for our reference in writing our report, and during your study we will be using our own metric to answer questions regarding to usability.

The researcher then instructed the subject that the following tasks would need to be performed during the one-hour duration of the study:

1. Log into Borger.dk using the Java-based NemID.
2. Find the link to apply for Information Technology equipment. Choose the Herlev municipality and fill out the PDF application for the JAWS screen reader.
3. Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.
4. Find the Annual Statement tax form on Borger.dk, and comment on its accessibility.
5. Use digital post to compose a note to your doctor. Do not send this note.

The usability study was performed in a "talk-aloud" style, where each subject as instructed to verbalize all thoughts and actions while using the Borger.dk website. Subjects were instructed not to reveal personal or private information during the study so that they would not be identifiable from their voice recordings. For example, subjects were told to say, "I am entering my address" instead of vocalizing their actual address. The audio recording software was started and the subjects independently performed as many of the tasks as possible within the time limit while verbalizing what they were doing and thinking throughout the process. No help was provided during the testing, but subjects were reminded to continue verbalizing if they fell silent. The final audio file from each subject was encrypted, password protected, and stored in a secure online server with a physical backup. Additionally, any notes the researcher may have recorded during each session were scanned into the computer, encrypted, and stored in the same location as the audio recordings.

3.1.4 Focus Groups

At the end of each day, when all four subjects had completed the usability test, they were brought into a room together for a focus group discussion. No focus group discussion was conducted for the sighted participants. The same questions that were asked in the preliminary interviews were asked of the focus group participants. These questions can be referred to in Figure 6. Major points of the focus group discussion were recorded on paper by the researchers. Additionally, the focus group discussions were recorded in the same

manner as the usability studies, and the final recordings were encrypted, password protected, and stored in the same manner and location.

The data from the usability studies and focus groups was collected, analyzed, and used to draw conclusions about the accessibly of Borger.dk and the web in general for the blind and people with low vision. These conclusions were used to further revise the web accessibility metric. This revised metric was used to generate a final accessibility score and list of suggestions for Borger.dk. This represents a two-way system in which NemID and Borger.dk were used to refine the web accessibility metric, which was then used to examine the accessibility of NemID and Borger.dk. The findings from our application of the final version of our web accessibility metric were used to prepare an advocacy report for the Danish Association of the Blind to present to the Danish government.

3.2   Identify the Existing Non-Digital Systems Essential for the Blind

The fourth objective of this project was to develop a better understanding of alternatives to eGovernment systems. We found out what some of these alternatives were by asking our liaison, John Heilbrunn at the Danish Association of the Blind, for information about current systems. We began by reviewing paper and digital documents we were provided for relevant information. In our six preliminary interviews, we asked how the users perceived the accessibility or non-accessibility of those systems. At the end of every interview we asked users for their opinion on non-digital systems and their accessibility so we understood what we would need to consider if we chose to augment the digital system with another non-digital system of government in order to maintain access. Given the clear inevitability of eGovernment implementation in Denmark, it was important to recognize accessibility aspects of existing systems and relate them to the digital medium if possible. If not, we recommended an augmentation to the current systems to maintain access for the blind and people with low vision.

3.3   Determine Other Possible Impacts of eGovernment on the Blind Community

Our fifth objective was to gather information on other possible impacts, social or other, of eGovernment on the blind and people with low vision. With the advent of eGovernment, social contact could be affected for some isolated individuals with disabilities. We asked questions about the social implications of an eGovernment system in our interviews and focus groups, supplementing our scholarly journal research. Using the general information and keywords from this question in our interviews, we performed a more thorough search of scholarly journal articles pertaining to this topic. Finally, we took the information gleaned from our interviews and research, and we prepared a series of questions that we asked at the end of the focus groups.

At the conclusion of the project, we looked for patterns in the qualitative data we gathered from our research, interviews, usability studies, and focus groups. We noted

common problems and advantages of eGovernment, as well as other comments that could improve the design of future eGovernment websites. We also compiled a summary of the potential impacts of eGovernment on the community of blind people and people with low vision. We used this summary, as well as guidance from the Danish Association of the Blind, to form a set of recommendations on how to avoid unforeseen negative social impacts on the blind and people with low vision in Denmark.

4 Results and Analysis

This project's objective was to test the accessibility of the Danish eGovernment portal for citizens, Borger.dk, for blind and low vision users. After reviewing existing web accessibility standards and metrics, we created our own preliminary accessibility metric focusing on features specific to the blind and people with low vision. Next, we conducted preliminary interviews with users of Borger.dk who were blind or had low vision and who used JAWS as an assistive technology to find out their thoughts about the accessibility of Borger.dk. We then did a more in-depth usability study of Borger.dk with blind people, sighted people, and people with low vision to identify problems they might have with the site. These groups were asked to perform five common tasks – filling out forms, finding government documents, using the tax system, and communicating over digital post. Participants then formed focus groups to reflect on their experience with the system and discuss what they found difficult and frustrating, and socio-cultural implications for the future. We used this data to revise the preliminary metric into a final user-centric metric that can be used to rate the accessibility of websites for the blind and people with low vision, based on real users' experiences, not on abstract design criteria. Using data from our study we were able to fill in the metric and give Borger.dk a final accessibility score as well as generate a list of suggested improvements to the website.

4.1 Preliminary Web Accessibility Metric

The first version of our web accessibility metric was synthesized and condensed primarily from the WCAG 2.0, ISO 9241, and US Rehabilitation Act Section 508. We included criteria that were the same across all three metrics and applied to web accessibility specifically for the blind and people with low vision. When criteria differed between the standards, we used the quantifiable metrics by Parmanto and Zeng (2005), Nedbal and Petz (2008), and Gonzalez, et al. (2003) for guidance in selecting the best criteria for our population of users. The first draft of this metric appears in Table 3.

The metric was designed to be simple enough in format and language that any user could complete the form and generate a rating for any website. However, due to the technical nature of the documents that were used to create the metric, much of the language is still technical and requires background knowledge in Information Technology to understand accurately. Additionally, each criterion in the metric is weighted equally, which may not accurately reflect the actual value of each criterion in the final accessibility

of the website. We planned to correct these problems and to add any important features that might be missing based on what we learned in the preliminary interviews, the usability study, and the focus groups.

Table 3: Web Accessibility Metric First Draft.

Web Accessibility Metric Rating Sheet	
Website:	
Please give all responses as 1 for yes and 0 for no.	
Perceive	
Do all elements that can't be read by a screen reader (images, Java applets, etc.) have alternate text or a caption available?	
Do all CAPTCHAs have an audio option?	
Is a documented structure, layout, or site map available and compatible with a screen reader?	
Wherever color is used to convey information, is there an alternative that conveys the same information?	
Can all text on the website be increased in size without the loss of readability (ie. Text moving behind images)?	
Is all information that can be conveyed with text represented as screen-reader compatible text, not an image?	
Reply with 0 if any background audio plays automatically on the website and can't be turned off easily when using a screen reader.	
Navigate	
Can the entire website be navigated and all controls operated using a keyboard?	
Reply with 0 if the website scrolls automatically, with no screen-reader accessibly way to disable that functionality.	
Reply with 0 if any content on the website auto-updates without notifying the user of any changes to the content.	
Do all pages on the website have a clear title that is read first by a screen reader?	
Is an option provided to link back to the navigation box of the website after each section of content?	
Is the site navigation the first thing presented after the title, with an option to skip the navigation and go to the first section?	
Interact and Contribute	
Reply with 0 if there are any timers present on the website that are essential to its use.	
Can all forms be entirely completed in Form Mode of a screen reader?	
Is each box in a form paired with exactly one descriptive title, using appropriate markup that can be interpreted by a screen reader?	
Do all forms with CAPTCHAs retain entered information after a failed attempt?	
Are forms organized linearly from the top to the bottom of the page?	
Score	%

4.2 Preliminary Interviews

Six Borger.dk users who were blind or had low vision were interviewed according to the procedure described in the Methods chapter.   These interviews lasted approximately 15 minutes each. Participants ranged in age from 32 to 59 years old, and were from various municipalities including Aarhus, Copenhagen, Hellerup, Fredericksberg, and Helsignor. All participants reported using the screen reader JAWS as an assistive technology, and 4 out of 6 participants reported an intermediate skill level in Internet usage. Of the remaining two participants, one reported advanced Internet skills and the other reported beginner Internet skills.

4.2.1 Use of Non-Digital Government Services

The participants interviewed were asked to explain their use of non-digital government services (Question #3, Appendix E). The interviewees explained that they had used the following government services:

- Disability Forms
- Change of Address Forms
- Healthcare Information
- Taxes
- Job Search
- Banking
- Marriage Forms
- Communication with Government Offices
- Passport Registration
- Public Information Look-up

It was reported that the most popularly used system for the blind and people with low vision was the completion of disability forms (all 6 participants), followed by the tax system (5 of 6 participants), and look-up of government information (4 of 6 participants).

4.2.2 Views on the Accessibility of Non-Digital Government Systems

Participants were also asked to assess the accessibility of the non-digital government systems they used (Question #4, Appendix E). Five of the participants expressed that current non-digital government systems were not easily accessible. Participants accessed these systems by way of another person, such as a caretaker, a colleague at work, or a spouse. For example, one participant said that "it gets very complicated, because there is no privacy, everything requires another person's help." They reported needing help traveling to government offices and sometimes filling out paper forms. One participant noted that she could not cast a private vote at the ballot box because she had to tell somebody else which vote to put on the ballot. Three of the six participants expressed that privacy and independence are sometimes sacrificed for access to the non-digital systems, and this was a concern for them. The dependence on others and lack of

privacy are negative social and psychological effects of keeping government offline. Perhaps, for this reason, five of the six participants claimed that an online system would be an improvement, despite some potential accessibility problems with compatibility, navigation, and complexity.

4.2.3 Use of Borger.dk

One important question we had (see Question #4a, Appendix E) was how often members of the blind community had used Borger.dk. We recruited only interviewees who had some experience with it, but we found that it was not easy to find such users. Many we tried to recruit simply had never used the system, even though it had been available for years. This lag in use itself suggests that the system may be intimidating or inaccessible to blind users, although it may be useful to compare non-use of the system in the blind community with non-use in the sighted community to determine how quickly Borger.dk is being accepted by each group.

Our six subjects reported using various parts of Borger.dk but did not use the system regularly because the information they were looking was accessible from other websites. Appendix E includes a full list of their responses to this question. They mostly used it for filling out forms and looking up information they needed. The most commonly used systems were the disability forms (all participants reported using them) and the Skat (tax) system (5 of 6 of participants had used this system, which mainly consists of online forms). Five of the participants also reported using Borger.dk to search for government documents containing information they needed, such as health care allowances. This confirmed that the tasks we designed for our user-testing study (fill out a disability form and find budget information) were relevant.

4.2.4 Difficulties with Borger.dk

The group then asked participants to rank Borger.dk on a scale of 1 to 5 where 1 is simple with no difficulties, 2 is simple with few difficulties, 3 is ok with more difficulties, 4 is difficult with many difficulties, and 5 is impossible(see Question #9b, Appendix E). Three of six participants ranked Borger.dk at a 3, ok with more difficulties, but the other three ranked Borger.dk as a 2, simple with few difficulties. While these responses contradict what we had understood from our research, we also understand most users do not simply access Borger.dk from the website, and instead access its features from other websites (for example, one would not access the tax system from Borger.dk but instead simply go to Skat.dk). According to the Borger.dk website, it has been updated three previous times in an attempt to improve its usability and accessibility. The fact that there are still multiple problems with the accessibility of Borger.dk speaks to its complexity. Accessibility is a multifaceted issue that requires multiple individual considerations, which cannot be addressed in one revision.

When participants were asked to describe the difficulties they encountered with Borger.dk, we received varied responses (see Question #9a, Appendix E). One general theme, however, was compatibility. Interviews confirmed that screen reader users found JAVA applications and PDF documents incompatible. Participants were generally unable to view and navigate these applications. Participants also mentioned that Borger.dk was a slow and cumbersome site to learn, sometimes requiring a sighted person to explain the basic layout. The final major issue mentioned was the use of English commands in some parts of the website, such as "Expand." This presents a language barrier in Borger.dk for some users, such as the elderly, who may not have been educated in the English language.

4.2.5   Frustrations with Borger.dk

Participants were asked whether they had experienced any frustrations when using Borger.dk (see Question #9c, Appendix E). Two participants reported having no frustrations, two reported some frustrations, and two reported that they were highly irritated. Their high level of irritation stemmed from a lack of access with the Java access bridge, and a very slow difficult process. Frustration can also be an important factor in accessibility because if one is frustrated, they may lose interest in using the system, and refuse to access it. If a person no longer wants to use Borger.dk, then the government has to provide another way for them to access the information and systems that Borger.dk previously offered. This counters the idea of accessibility for all and leaves some potential users left out because of frustrations.

Participants were then asked to rank their frustration on a scale of 1 to 5 where 1 is "you are relaxed", 2 is "you are annoyed", 3 is "you are getting agitated", 4 is "you are frustrated", and 5 is "you no longer want to use it" (see Question #9d, Appendix E). Three participants reported a 3, as they were getting agitated with the system working improperly. Only one participant reported being completely relaxed when using the Borger.dk portal. Frustrations were increasing over time and could eventually lead users to stop using the website. To encourage the use of Borger.dk, an attempt should be made to simplify and streamline the website organization and improve compatibility, making use of Borger.dk a less frustrating experience.

4.2.6   Social Implications of Borger.dk

We also asked users about the positives and negatives of using Borger.dk (Questions #9e and 10, Appendix E). When asking participants if they thought that digitization of government was a good idea, participants all agreed that there would be an overall positive impact on the blind and low vision community. Participants mentioned that they would love to have all government services accessible from the comfort of their own homes, because it gives them the opportunity to complete important tasks independently. The idea of being able to do something on one's own is very uplifting, and instills a sense of

confidence. It is this confidence and independence that encourages the blind and people with low vision to use eGovernment, despite difficulties.

Two participants mentioned some possible negative consequences of eGovernment implementation. One participant explained that social isolation could become an issue, because some blind people only ever leave their homes when they are absolutely required to, such as to complete mandatory government forms. These people will no longer have that task under a complete eGovernment system, so they may become completely isolated from the outside world. Even small government interactions like filling out forms or asking questions, go a long way in keeping someone from being socially isolated. Another participant mentioned that it might not be as easy to get assistance with filling out government documents, which can be confusing at times, if you are sitting at home. Phone helplines have limited hours, so assistance with accessing Borger.dk can be difficult to find.

These responses to the preliminary interview questions were consistent with what we had found in our background research. We used these responses to refine the tasks in our usability study. We decided to focus on disability forms, the tax system, legislation, and digital post. These interviews gave us a sense of the frustrations and difficulties that people encountered in their use of Borger.dk before we performed our usability study.

4.3 Usability Study

Eight individuals participated in a usability study using the procedure outlined in Appendix C. Some of these individuals had used Borger.dk before, while others had not. None of the participants had used all of the systems that were covered in the study. The usability study sessions were limited to one hour per user. Participants ranged in age from 29 to 66 and reported intermediate and advanced internet skills. Studies took place on April 24, 2012 in Copenhagen, Denmark and on April 25, 2012 in Aarhus, Denmark. Demographics of the participants can be seen in Appendix D.

4.3.1 Could They Succeed at the Given Tasks?

Participants exhibited different levels of success with different tasks. Time, number of clicks they took to find information, frustration level, and ability to continue and complete tasks without help were all considered when evaluating a participant's success with a task. In many cases, participants were not able to complete a task for various reasons. Notes taken during usability studies are included in Appendix G. Table 4 below shows a comparison of the number of blind and low visions users who were able to complete the tasks versus the number of sighted users who completed each task.

Table 4: Comparison of Usability Study Success Rates by Task

Task	Description	Blind and Low Vision Success Rate	Sighted Success Rate
1	NemID login	3/8	2/2
2	Disability Form	0/8 to end, but 7/8 found form	2/2
3	Pension Act	7/7	2/2
4	Tax Statement	5/8	2/2
5	Digital Post	1/8 to completion, but 3/8 could do	2/2

Completing each task took, on average, 35 minutes for each blind or low vision user. Sighted user 1 completed each task in 10 minutes on average and user 2 completed each task in 25 minutes on average.

4.3.1.1   Task 1: Log into the Borger.dk system using the Java-based NemID

This first task proved to be more problematic than originally expected. Only three out of the eight study participants were able to successfully log into Borger.dk using their NemID. Of the five participants who were not able to login with NemID, two did not set up the NemID phone system prior to the study, one received a vague error notification, and two could not navigate to the login boxes because their screen reader could not see them. This was because they either did not have the Java Access Bridge installed or their local version of Java had auto-updated and they had not yet manually updated the Access Bridge. The following is an account of an attempt to log into Borger.dk using NemID by participant 8, a 36-year-old intermediate computer user from Aarhus, using the JAWS screen reader.

Steps Taken:
1. Searches the Borger.dk front page for the phrase "Log In" using screen reader.
2. Finds and clicks on Log In link.
3. Mentions that the log in page tells users to access NemID with their code cards and makes no mention of the phone system that the blind and people with low vision can use.
4. Spends 10 minutes searching for the edit boxes to type the login information, but the screen reader cannot detect them because the users Java access bridge is not correctly updated.
5. Clicks on Help link.
6. Returns to the login page after browsing the help page unsuccessfully for a solution.
7. Searches for Edit boxes on the login page using JAWS, but is told that there are none.
8. After searching for another 10 minutes, participant gives up out of frustration.

Participant 8 was, in the end, unable to access NemID after attempting to for around 30 minutes. The principle cause of this inaccessibility was the use of Java for NemID. The login information boxes for NemID were part of a Java applet, not HTML edit boxes, so the screen reader was unable to detect them. Use of the Java Access Bridge would be necessary

to access these items, but the access bridge is not preinstalled on user computers and must be updated manually after every automatic Java update, so it would require an advanced level of computer knowledge to be truly accessible. Being able to perceive the information on the screen is the most basic level of accessibility, and yet this is a frequent problem when Java is used. Users who were unable to log in, proceeded to complete tasks 2 and 3, but were unable to complete tasks 4 and 5.

4.3.1.2 Task 2: Find the tab to apply for information technology equiptment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader

Nobody was able to complete task 2 to the end by filling out the PDF form, but seven of eight participants were able to locate the PDF form. Two of the participants took more than 30 minutes to locate this PDF link, and for the remaining five it took at least 15 minutes to find the link. One participant took 35 minutes trying just to find the PDF and then got too frustrated to continue. The participant was, however only one click away from the actual link. Below is an account of participant 5, a 46 year-old intermediate user from Aarhus who was partially sighted and used ZoomText, color contrasting, and VoiceOver for Mac. Take careful note that this user is not fully blind, and is not using a JAWS screen reader, but instead a magnifier and a screen reader.

Steps Taken:
1. Clicks on Disability tab
2. Finds a section called 'availability' and thinks the forms could be here. Proceeds to click on 'availability' tab
3. Turns on VoiceOver to read through and search for wanted information on the page
4. Finds some hints towards assistive technology but at this point is reading through everything on the page (10 minutes)
5. After 10 minutes user states, "I am not the sort of person who gives up, but finding some documents can be frustrating".
6. Navigates back to the disability section.
7. Reads through every tab on the page (about 20 minutes into searching now) and decides, again that accessibility is the one to click on.
8. Once again reads through accessibility section, using VoiceOver.
9. At 24 minutes, user states, "At this point I would give up, have a cup of coffee and say 'ugh'".
10. Finds a link on assistive technology of some sort, clicks on it but is led into an IT page in another window. At this point it takes her a few minutes to realize she is no longer in Borger.dk, but there was nothing that explained that she had moved to a new site.
11. At 30 minutes she asked for a hint. User was told, "Go back to the disability tab, and find a tab other than availability"

12. User backtracks and clicks forwards several times trying to find a way through to something about assistive technology.
13. User explains how illogical the steps must be, because she was logically searching through categories she believed it should be in such as the Rights tab, and was not getting any desired results.
14. Continues reading through links but cannot seem to find exactly what she is looking for
15. User expressed frustration at this point, and asks to call the assistance hotline for help, because normally that is what she would choose to do at this point, however because she was in the study she did not.
16. Finally finds her way into text about assistive technologies again, and begins to read through text using VoiceOver.
17. After 38 minutes, user chooses to give up and proceed to the next task.

This participant did however, later report that she had success while waiting for other participants to carry out their tasks. It took her about another 20 minutes to find the correct tab after the study concluded. All participants found this task particularly challenging because the form was located 7 clicks into a maze of ambiguous headings, and users had to take one direct path to find this form.

4.3.1.3 Task 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Find Section 11, and summarize what it says.

Most of the participants who attempted Task 3 met significant difficulty. One participant did not attempt this section because he ran out of time (considering our sessions were 1 hour per user), but the other seven participants were all able to try to find the Act on Retaining the Right to Spousal Pension by Separation and Divorce. This task became even more frustrating because many participants had already spent considerable time completing Task 2. Participant 3, a 66-year-old user with intermediate skill in using the Internet used a JAWS screen reader to attempt to locate this document. Below is an account of the steps he took in his attempts to find it.

Steps Taken:
1. Searches for Legislation link under the Self Service section.
2. Clicks on link to server with Danish legislation – leaving Borger.dk
3. Uses search to look at keywords related to this act. Possible translation problems here between English and Danish that may affect the outcome of this task.
4. Search showed no results for many of the keywords because the search only seemed to search headings and abstracts, and not the full body of an article.
5. Returned to Borger.dk, from the legislation website.

6. Clicked on the pension tab and used screen reader to search front page of section. Found nothing.
7. Back to Borger.dk front page, clicked on Family and Children link. Navigated to Separation section of the Family Legislation page.
8. Returned to family legislation and clicked on the Family subsection.
9. Clicked on the Separation and Pension link and found some information about the law. However, there was no link to the full text of the law itself in the summary.

Participant 3 works in a career that requires regularly looking up legislation. Yet, he was unable to find the full text of this legislation due to the complexity of the layout of Borger.dk. This was a problem, again with the complex architecture and illogical layout of the site. Ambiguous headings made it difficult to guide users in a good general direction for articles that could cross a series of tabs. Note that this participant, like many of the others, navigated through many of the subsections of Borger.dk in an attempt to find this legislation. One might think that this legislation could be located in a number of different sections of Borger.dk – pension, divorce, or family – but it is only under one of those sections. Better organization and labeling of sections, or a more robust search function that is able to search body text and not just headings for key words could all contribute to alleviating this problem, even for sighted users who found the layout of this site complex to navigate.

4.3.1.4 Task 4: Find your annual tax statement form on Borger.dk

Many participants explained that generally in order to access this information, they would go through Skat.dk, the tax website. On Borger.dk however, there is a link to skat.dk, which was what we hoped they would find. Users, however who were not able to login to Borger.dk with their NemID were unable to complete this task. Out of our eight participants, only five were able to find their tax information through Borger.dk. This task was not as difficult as tasks 2 and 3 and took participants less than 15 minutes to complete. However, this task was not without its own set of difficulties. Below is the account of the steps participant 2, a 40 year-old intermediate user from Copenhagen using a JAWS screen reader, had to take to find his form.

Steps Taken:
NOTE: at this point user is already logged into Borger.dk
1. Finds link to Tax on Borger.dk
2. Scrolls through all headings to find Skat
3. Clicks and is redirected to Skat.dk
4. Tries to navigate using Headings mode in Borger.dk, but finds that there are too few headings to navigate
5. Navigates into the headings menu for JAWS and scrolls that way.

6. Finds something that looks right, clicks on it but finds it is wrong
7. Returns to the headings menu and scrolls more looking for annual tax statement.
8. Clicks on Skat tab, and is redirected to Skat.dk.
9. Finds another login screen here, and has to login again with his NemID.
10. Participant asks why Borger.dk can't retain login information, and why he must again login with his NemID
11. Has NemID call his phone, and fills in new password
12. Finally gets into his personal tax files for Skat.
13. Finds a link for his annual tax statement after some searching.
14. Clicks on it, and is brought to his form.
15. Participant explains that the form is accessible.

Note: Took participant 12 minutes to locate Skat.

Participant 2 was a typical user who had only used Borger.dk once before. He explained that he was very conversant in using skat.dk, but it was eye opening that he could access it directly from Borger.dk. It was harder to locate skat.dk through Borger.dk however, especially for a blind individual who must search the whole site, because the search function does not adequately search through items. Users mentioned that a Google search would bring up more specific results within the Borger.dk site than the resident search bar. If all information is accessible in one location, it should make information easier to find, but right now it is making information much harder to find.

4.3.1.5 Task 5: Use digital post to compose a note to your doctor. Do not send this note.

Considering our study was limited to one hour to see exactly how much a user could access in one hour, and considering the problems and time participants experienced logging into Borger.dk, only two of our eight participants were able to complete this task. It seems that while some doctors do use eBox for communication, they also all have individual websites used for communication, which may or may not link to Borger.dk. Originally, from our preliminary interviews, we had assumed that this step would be different for all users based on staggered implementation for municipalities but this was not the case. Many users of Borger.dk in our study explained that eBox was available to them, but only five had ever used it for communication. Participant 2, again, a 40 year-old intermediate user from Copenhagen using a JAWS screen reader, was able to complete this task. However, participant 2 used a procedure across systems to gather all the information in order to complete this task. Below is an account of the steps he took to complete this task.

Steps Taken:

NOTE: at this point, user is already logged into Borger.dk

1. Goes to Outlook, finds doctor's name and information in Outlook calendar
   a. Some trouble navigating here, takes participant about 7 minutes to find doctor's information
2. Goes to Borger.dk and scrolls using JAWS headings until he finds Post
3. Clicks on post, where he finds yet again a log on screen.
4. Participant attempts to log in, but finds he needs a code that he does not know
5. Looks through notepad for his code, but cannot seem to find it.
6. Navigates through his doctor's site, and finally finds the code (takes about 8 minutes)
7. Goes back to log in, and is successful.

4.3.2 What Types of Problems Were Encountered?

During the testing of Borger.dk, four types of problems were encountered by both the blind and low vision participants. These were technical bugs, problems with site architecture, problems with screen layout, and issues interfacing with assistive technologies.

4.3.2.1 Technical Bugs

Some of the main problems encountered concerned technical bugs in Borger.dk that would affect all users equally, whether sighted, blind, or low vision. Technical bugs were located in various areas of the site, and proved very difficult to work around when using a screen reader.

One technical problem was indicated when participant 7, a 45 year-old advanced user from Fredericksberg, attempted to log in and was faced with an error message. He read the message, but it did not specifically explain what the error was so he did not understand how to fix it. Participant 7 explained, "NemID is working in my NetBank, but there seems to be an issue on Borger.dk. The problem is the error is nondescript, so I do not know what I would need to fix to be able to log in."

In Task 2, when users were asked to find an application for information technology equipment and apply for a JAWS screen reader, two main technical problems were indicated. The first was indicated by sighted participant 2, who was able to access the PDF form, but could not find a submit button to send it in. She had to input her email, which still took her to the webpage with the blank PDF form that she was then unable to submit. This violates the interaction and contribution parts of accessibility. The second problem indicated by two users in our Aarhus study, was once again concerning interaction and contribution. When both users attempted to select their municipality, the drop down menu moved to a different municipality. For example, participant 6 chose the Herlev Kommune,

but when she tabbed away from the box and tried to click continue, the drop down menu changed her choice to the Faxe Kommune.

Another technical bug we encountered dealt with the search function. The search bar did not search links, page content, or form names, only page titles and headings. Five of the eight participants expressed that Google was a much more effective way of searching for information on Borger.dk than the search bar implemented into the site. Five participants searched for Task 3, to find the Act on Retaining the Right to Spousal Pension by Separation and Divorce, using the search terms 'divorce + pension'. Unfortunately, this navigated to a page about divorce and pension, but here there was no link to the specific act. Participant 3 specifically had a lot of trouble, and searched for multiple combinations of key words and found related information, but no link to the specific legislation. He expressed frustrations with the logical placement of documents. He felt that the layout of the website was illogical and the search function was insufficient, so information was difficult to find.

4.3.2.2   Website Architecture Issues

Another major category of problems encountered with Borger.dk was architectural and organizational issues with the website itself, including problems with the location of content. Some items were in illogical places, others were difficult to navigate to, and some were just problems with the way the site was coded.

Next, we were informed that the heading tags were wrong in some locations. Heading tags (H-tags) inform users what the headings are and what level the heading is. Main headings are labeled as H1, then subheadings H2 and so on. Participant 7 informed us that, when he tried to get a view of the whole page through the site map, the H-tags were used incorrectly, making it difficult to navigate. In one area, he found a paragraph wrongly labeled as a heading.

The heading tags brought about another set of issues regarding the site map. Participant 5 for example, was a partially sighted user who tried to use the site map to navigate, but found it incomplete. She expressed her frustration and said, "At this point, on any other website I would search the site map, but since that does not seem to work I'd like to call the helpline, which I cannot do. This is so frustrating." For the purpose of the study, to see exactly how long it took a user to complete these tasks on their own, we could not let her use the helpline. This is a navigational issue, and without an accurate and complete site map, many users with assistive technologies could search for a long time and never find exactly what they are looking for.

Navigation was difficult because of the home page organization and the selective search bar, even for normal sighted people. Every participant, including our sighted participants, mentioned that the logic of the site was very difficult to follow and that commonly used features were not in obvious locations. The progression one had to take to find the application for information technology went as follows: Disability-> Daily Help –>

Aids and Consumer Goods. While selecting Disability was obvious, when you clicked on it your options were as shown in Figure 7.

Figure 7: Screenshot of Disability Tab Choices on Borger.dk

Not one of our participants chose Daily help first. Even when they finally navigated to the Daily help section, they were presented with the choices as portrayed in Figure 8.

Figure 8: Screenshot of Daily Help Tab Choices on Borger.dk

Logically, from here one could either chose Coverage for necessary additional expenses for adults or aids and consumer goods. The lack of an obvious logical progression proved to be a problem for many individuals, and everyone explored and read a link that was incorrect before navigating in the right direction. The fact that it took 3 participants more than 30 minutes to read, and work their way towards the correct links hints at problems with the logical structure of the site. Additionally, participants explained that they would prefer that important forms and links be in a place where they could easily scroll and find the appropriate one, or be accessible with the search function. The lack of logical progression made navigation very difficult and increased user frustration.

We found the search function to be useless when searching for specific information. In our usability study, the participants found that, if they searched for key words, the search function would often return very few results that were generally irrelevant to their search. This was evident in task 3 when users were asked to locate an act on retaining spousal pension in divorce. Most users searched the key words 'pension' and 'divorce' but found that the nine results that came up did not take them to this law. This is a serious navigational issue with Borger.dk. Some users even mentioned it was easier to search for information on Borger.dk using Google.

The last major problem with site architecture had to do with missing content. In task 2, users were asked to find a PDF for information technology equipment. After spending considerable time searching, if the Copenhagen municipality was selected, the users would encounter a message saying that this form was not available for the selected municipality. Study participants felt that this information should have been clear earlier, before they had spent this time searching for the form.

4.3.2.3   Site Layout Issues

In task 1, we asked users to log into Borger.dk using their NemID and encountered many problems. On the right side of the web page, there is a button for logging into Borger.dk. However, to login with your NemID, you must first select a municipality. As can be seen in Figure 9, this box is listed below the Log In link, so the screen reader will read it after that link. Logically, a user would click Log In without ever having seen the municipality selection box.

Figure 9: A Screenshot of the Borger.dk Login Box

4.3.2.4   Interface Problems with Assistive Technologies

The final major category of problems encountered with Borger.dk involved the interface between the website and the assistive technologies that the blind and people with low vision use. While there are known accessibility issues with PDF documents, Adobe Flash, and Java, these generally have an accepted workaround that can be implemented. In our usability study, we encountered additional problems that made it very difficult for some participants to use the website.

A screen reader does not read the visible page that can be seen by sighted users – it reads the code that makes up the page. If the page is set up in columns, it will read top to bottom through each column, not horizontally across the page. While the current focus on Borger.dk is self-service, the "Self Service" box was located in the right column of the website. Somebody using a screen reader would have to navigate through the entire first column, containing most of the content on the web page, before even encountering this box. For our participants, we found that it took, on average, five minutes to listen to the main content of the website before encountering the right column. Because of the way a screen reader traverses the code, forms should also be arranged vertically in only one column for maximum accessibility.

We had encountered a problem with this in the United States. There was a form for people who needed special assistance in an emergency. It was organized into two columns and the second column was inaccessible because the screen reader recognized the edit boxes in a vertical fashion, not horizontally. We found similar problems in some of the forms on Borger.dk as well as many instances where PDF forms were not created to be accessible.

NemID proved to be easy to use for experienced users who had already dealt with the bugs, but for new and inexperienced users these bugs proved to be a barrier to accessibility. One such bug was that edit fields where the user needed to type login information were not detected by the screen reader because users did not have their Java Access Bridge up to date. This caused the screen reader to skip over these boxes, which made it difficult for users to perceive them and to input information. No prompt was given by either Java or Borger.dk that indicated the need for Java Access Bridge.

As mentioned in the background, in order to access Java applets from a screen reader, a user must have the Java Access Bridge installed. The Access Bridge needs to be updated every time Java updates and many users find it difficult to update without prior technical knowledge. One participant mentioned that, if NemID (which is a Java-based application) did not work, he knew he had to update his Access Bridge and so let one of his sighted friends update it for him.

The last major interface problem we found was same-page popup windows. Sometimes, when clicking from one page to another on Borger.dk, a popup would open within the same browser window asking if Borger.dk could save cookies to a user's computer. Unfortunately, because a screen reader interprets the code behind the website, this popup window made the rest of the page inaccessible, even if continue was pressed, because screen readers cannot detect dynamic changes to a website like that. Users wished that there had been a verbal warning that they were leaving the page, maybe asking if this was the desired course of action.

4.4 Focus Groups

After each group of usability studies, we brought participants together in a focus group and put some questions up for group discussion. Two total focus groups were conducted, one in Copenhagen and one in Aarhus; each took roughly 30 minutes. Participants were asked questions regarding their feelings about Borger.dk. We based the focus group questions on the preliminary interview questions. The discussions that ensued helped us get a larger picture of people's feelings on Borger.dk.

4.4.1 Difficulties with Borger.dk

Participants discussed some of their major issues when using Borger.dk, and mentioned that it was reasonably difficult to use. Compared to other websites, the Copenhagen study group found Borger.dk much more difficult to use because of the lack of search function, where participants in Aarhus found the location of information very complicated.

When asked to describe their difficulties (see Question #1a, Appendix G) participants found many problems with the Borger.dk site. In Copenhagen, participants found the dropdown boxes where you chose your municipality did not work well for letters early in the alphabet. They also found it frustrating that you had to choose your municipality at every section of the site, and could not understand why once you were logged into NemID the system did not recognize your municipality automatically. Many found it very difficult to find the drop down box near the login link, because it was beneath it, and became frustrated when they could not login. They also became frustrated with the headlines because they were not consistent or particularly helpful in navigation. The Aarhus group found similar problems, but was mainly concerned with the lack of site map. They felt a site map was the easiest way to navigate and mentioned that it was nearly useless for navigational purposes because it lacked description and guidance.

Participants were then asked to rank their difficulties with Borger.dk on a scale of 1 to 5 (see Question #1b, Appendix G), where 1 was simple with no difficulties and a 5 was impossible. Three participants in Copenhagen ranked it as a 3, 'ok with more difficulties', and one person ranked it as a 4 which meant 'difficult with many difficulties'. The participants explained that if they had to use the site more they would become more used to it and not encounter as many difficulties. One participant explained that there are still a lot of glitches on the site, which make it not user friendly. The Aarhus group all ranked the site around a 4 if you were looking for something specific, or a 3 if you were just browsing the site. They mentioned that typically if they had an agenda, they would go straight to the source site, like for taxes, they would go straight to Skat.dk instead of through Borger.dk.

Participants were asked to explain the most difficult task in the usability study (see Question #2 and 2a, Appendix G). In Copenhagen, the group felt that logging on was the most difficult task because three of the four people were unable to logon. However, in Aarhus, users felt there was not a task that was the most difficult but that it was difficult to

change their thinking in between tasks when looking for different types of information. The idea that some tasks were looking for a specific document, and others were sending information were complicated for users to switch between.

In Copenhagen, the group discussed Task 3, finding the act on spousal pension was the most difficult, because you could make your way to the summary of the law, but not find the link to the actual law. They also explained how using the site map proved to be useless because it did not lead you to the most important information, but instead led you to very broad categories where users must "guess your way through a maze of links".

4.4.2 Frustrations with Borger.dk

Groups then discussed their frustrations while using Borger.dk (see Question #1c and 1d, Appendix G). All users in Copenhagen mentioned being frustrated at one point or another when using Borger.dk. One participant ranked his frustration as a 2, "you are annoyed" because he was not able to login to NemID. Two participants ranked their frustrations at a 3 meaning "you are getting more agitated", because it took them a while to find what they were looking for, and it was more difficult than they had expected it to be. One participant, who was very frustrated, ranked himself at a 4 which meant "you are frustrated", because he never did get what he was looking for, and even when he did find the link to the application form for Task 2, the application was not there.

The Aarhus group had similar findings, with one person ranking her frustration at a 4 because it took her so long to understand the layout of the site before she could even start looking for her task. All other participants in Aarhus ranked their frustrations as a 3, but explained that it depended on the part of the site they were using. They mentioned that they were not as frustrated using Borger.dk as some other government websites and felt that they could learn to manage the difficulties with accessibility if they had to use the website more often for more tasks.

4.4.3 Making Borger.dk More Accessible

We asked participants how they thought the accessibility of Borger.dk could be improved (see Question #2b, Appendix G). In Aarhus, participants explained that it would be good to have more headings, with different levels of headings. They mentioned the idea of H1 and H2 tags, explaining how it would be helpful to have the H2 tags explain what is included in H1. One participant mentioned that this would be especially helpful on the main page of Borger.dk where there are many categories, but the topics are so broad sometimes it is unclear exactly which one to choose. We discussed a similar idea in Copenhagen, but all participants in Copenhagen felt that if Borger.dk just conformed to WCAG-AA status of accessibility, it would help greatly improve accessibility. Both groups explained that it was annoying when they came across missing content, and wished they could have found out earlier on the site what was and was not available to them. One participant explained that if once he had found out the form was not available online he wished that it gave more

information on where he could find it. Another participant explained that after she logged in, a page with all the forms available to her would be extremely helpful. One participant, who was especially conversant with computers, wished that the error messages he received upon attempting to login to NemID had been more descriptive, so he could have found the problem and fixed it.

4.4.4   Social Implications of Borger.dk

Our final few questions for participants were regarding the effect Borger.dk could have on the community (see Questions #1e and 4). When asked what effect they felt Borger.dk would have on the people in the community, participants had many different ideas. In Copenhagen, the main idea was less paper. Participants thought that less paper was not only better for the environment and a greener solution but also held many possibilities for the blind and low vision community. Participants explained that documents and information online could be much easier for them to access if they could do it by themselves. They saw this as a huge benefit to the blind community, because it would raise self-confidence and independence. If they were able to fill it out by themselves, it would also help them keep more of their information private. The Aarhus study brought up the problem with making this system accessible for everyone because of a lack of internet education. They discussed how it would be difficult to teach the elderly (especially the blind or low vision populations) to use the internet and a parallel system might be helpful for a while to provide assistance. They discussed other disabled groups, such as those who are mentally less able because they will also require more assistance when using the online system. One woman explained that in order for society to go digital, there will need to be a way to contact someone for assistance like a help hotline. The system currently has a help hotline, with very limited hours that many people found helpful when it was available. Users hope that this hotline continues to function properly, to allow for outside assistance.

We asked participants if they preferred to access government information online, and all participants agreed that if all information were accessible to them they would prefer to use Borger.dk. In Copenhagen, participants agreed that if everything were on Borger.dk they would learn to use it better, and would prefer to access everything in the same place.

4.5   Final Web Accessibility Metric

After collecting data from our preliminary interviews, usability study, and focus groups, we revised the preliminary web accessibility metric to have a more user-centric approach. This new metric is not based on web design principles, like the established standards, peer-reviewed metrics, and our preliminary metric were. It is instead, based on user experience because it is compiled using data from our usability study, interviews, and focus groups. This final web accessibility metric is designed to be used as a crowd sourced tool to quickly rank websites based on accessibility. For example, if a new eGovernment

site is released, this web accessibility metric may be sent to several hundred people via email with instructions to first use the website for one hour, and then complete the form. The resulting scores could be used to determine a statistically significant accessibility rating. The final web accessibility metric is shown in Table 5.

Table 5: Final Web Accessibility Metric

Accessibility Metric					
Website:			**Reviewer:**		
Question 1:	**Perceive**	**Understand**	Navigate	Interact	Contribute
How many images on the website were accessible using a screen reader? (alternate text present)					
	1	Very few images			
	2	Major images in articles			
	3	Most or all images, including navigation buttons			
Selection:		**Weight:**	**3**	**Score**	**0**
Question 2:	**Perceive**	**Understand**	Navigate	**Interact**	**Contribute**
Are there any Java-based technologies present on the website?					
	1	Yes, and they are inaccessible to a screen reader			
	2	Yes, and they are accessible with the Java Access Bridge			
	3	No			
Selection:		**Weight:**	**1**	**Score**	**0**
Question 3:	Perceive	Understand	Navigate	**Interact**	**Contribute**
Did any of the forms on the website have a CAPTCHA?					
	1	Yes, with no audio option			
	2	Yes, but inaccessible for another reason			
	3	Yes, with an audio option or no CAPTCHA			
Selection:		**Weight:**	**1**	**Score**	**0**
Question 4:	**Perceive**	Understand	**Navigate**	Interact	Contribute
Did the website have a site map?					
	1	No, or yes but inaccessible			
	2	Yes, with images or text arranged both horizontally and vertically on the page.			
	3	Yes, with text arranged only vertically.			
Selection:		**Weight:**	**3**	**Score**	**0**
Question 5:	**Perceive**	**Understand**	Navigate	Interact	Contribute
Whenever inaccessible dynamic content is present (ie. Video files, Adobe Flash content, etc.), is the same information conveyed in text elsewhere on the page?					
	1	No			
	2	Yes, elsewhere in the page.			
	3	Yes, next to the dynamic content or as a caption.			
Selection:		**Weight:**	**2**	**Score**	**0**
Question 6:	**Perceive**	Understand	**Navigate**	**Interact**	**Contribute**

Can the entire website be navigated using only a keyboard?				
1	No			
2	Yes, with some confusion (such as a multiple-column layout)			
3	Yes, with no confusions			

Selection:		Weight:	3	Score	0
Question 7:	**Perceive**	Understand	**Navigate**	Interact	Contribute

Are there any pop-up windows on the website?				
1	Yes, over the current page in the same window			
2	Yes, in a new window			
3	No			

Selection:		Weight:	1	Score	0
Question 8:	**Perceive**	**Understand**	**Navigate**	Interact	Contribute

Is the first item that a screen reader encounters the page title?				
1	No			
2	No, but the title is near the top of the page			
3	Yes			

Selection:		Weight:	1	Score	0
Question 9:	**Perceive**	Understand	**Navigate**	Interact	Contribute

Is the site navigation encountered directly after the page title, with an option to skip past it to the content?				
1	No			
2	Yes, but with no option to skip past it			
3	Yes			

Selection:		Weight:	1	Score	0
Question 10:	**Perceive**	**Understand**	Navigate	**Interact**	**Contribute**

Are all form fields accessible with a screen reader, including dropdown selection boxes and Continue/Submit/Reset buttons?				
1	No			
2	Yes, but not organized vertically so they are confusing to a screen reader user			
3	Yes			

Selection:		Weight:	2	Score	0
Question 11:	**Perceive**	**Understand**	Navigate	**Interact**	**Contribute**

Is each element of a form (edit boxes, buttons, etc.) paired with only one label?				
1	No			
2	Yes, but sometimes there are mixed elements. For example, the label Last Name, First Name could be followed by two boxes, one for each name.			
3	Yes			

Selection:		Weight:	1	Score	0
Question 12:	**Perceive**	**Understand**	Navigate	**Interact**	**Contribute**

Are the forms on the website organized in a single column, vertical layout that is read linearly?				
1	No			

2	Yes, with few boxes placed horizontally, such as first and last name			
3	Yes			

Selection:		Weight:	**2**	Score	**0**

Question 13:	**Perceive**	**Understand**	Navigate	**Interact**	**Contribute**

Are there PDF forms on the website that are accessible to a screen reader?

1	PDF Forms present, with improper or inaccessible fields
2	PDF Forms present, with properly labeled fields
3	No PDF Forms on the website, all web-based forms

Selection:		Weight:	**1**	Score	**0**

Question 14:	**Perceive**	Understand	Navigate	**Interact**	**Contribute**

Are there page elements on the website that change on a timer? (ie. Forms that can't be submitted after a certain amount of time has passed)

1	Yes, with no indication of a timer and/or no way to delay it
2	Yes, with an accessible way to delay or stop the timer
3	No

Selection:		Weight:	**1**	Score	**0**

Question 15:	**Perceive**	Understand	**Navigate**	Interact	Contribute

Could you find what you were looking for using only the navigation links on the website?

1	No
2	Yes, but it took more than 20 minutes or more than 30 clicks
3	Yes

Selection:		Weight:	**2**	Score	**0**

Question 16:	**Perceive**	Understand	**Navigate**	Interact	Contribute

Could you find what you were looking for using the search feature?

1	No search feature available
2	Search feature provided limited or unusable results
3	Yes

Selection:		Weight:	**2**	Score	**0**

Question 17:	**Perceive**	Understand	**Navigate**	Interact	Contribute

Were all links on the website accessible?

1	No, content was missing or pages were not there.
2	Some, but others had missing content or opened in other windows
3	Yes

Selection:		Weight:	**1**	Score	**0**

Question 18:	**Perceive**	**Understand**	**Navigate**	Interact	Contribute

Was the information on the website logically organized?

1	No
2	Yes, but it took more than 20 minutes or more than 30 clicks to find a desired page
3	Yes

Selection:		Weight:	**2**	Score	**0**

Question 19:	Perceive	**Understand**	Navigate	Interact	Contribute

Is the website all written in the native language of the intended user?					
1	No				
2	At least the major site content is in the native language, with some layout elements in English				
3	Yes				
Selection:		**Weight:**	1	**Score**	0
Question 20:	**Perceive**	**Understand**	Navigate	Interact	Contribute
Are all headings on the website labeled correctly?					
1	No				
2	Most headings are labeled correctly, but some content is also labeled as a heading				
3	Yes				
Selection:		**Weight:**	2	**Score**	0

Provisions for Low Vision					
Question 1:	**Perceive**	Understand	Navigate	Interact	Contribute
Is the color scheme of the website accessible to those with color blindness?					
1	No, impossible to read with one or more forms of color blindness.				
2	Yes, readable with most forms of color blindness				
3	Yes, always readable with alternate color schemes available				
Selection:		**Weight:**	3	**Score**	0
Question 2:	**Perceive**	Understand	Navigate	Interact	Contribute
Is all color-based information on the website also conveyed without color?					
1	No				
2	Yes, in most parts of the website				
3	Yes, always				
Selection:		**Weight:**	2	**Score**	0
Question 3:	**Perceive**	Understand	Navigate	Interact	Contribute
Can the size of the text on the website be increased without losing the readability (ie. Text moving behind images)?					
1	No, absolute size values are used so the layout may not be zoomed				
2	Yes, with some text obstruction				
3	Yes				
Selection:		**Weight:**	1	**Score**	0

Accessibility Score			
Blind Only	0.0%	With Low Vision	0.0%

Currently accepted web accessibility metrics are worded technically because they are based on web design principles and can generally only be understood by people involved in the industry. Our preliminary metric, which was derived directly from a

number of these standards and metrics including WCAG 2.0 and Section 508, was worded similarly. However, our final metric was developed based on the results of the usability study that we performed. Therefore, this final metric has been designed to be user-centric, with simple language that most computer users can understand. At the end, there is an automatically generated accessibility score, calculated from the rating (1 to 3) given for each question multiplied by the weight assigned to each question. We assigned higher weights – either 2 or 3 – to some of the more important aspects of the metric so that they would have a great impact on the final score. It is worth noting that our final metric is unlike most other metrics where a score of 80% means that it is accessible. For a website to be classified as accessible with our metric, it must score a 100%. The provisions in our metric were to highlight the accessibility problems that are faced most commonly by users who are blind or have low vision. Therefore, a truly accessible website, especially one that will be used for eGovernment, should meet every standard and score a perfect score.

It is important to note that our final web accessibility metric is only intended for use with the blind and people with low vision. Ideally, there would be a similar web accessibility metric that could be used to test web accessibility for people with every type of disability, but that has not yet been implemented. However, an effort was made to ensure that our metric does not contradict the currently accepted standards such as WCAG 2.0 and Section 508, so that a website analyzed with our metric did not become less accessible for somebody with another disability.

A copy of this web accessibility metric form that has been completed for Borger.dk can be found in Appendix F. Borger.dk scored 62.6% in accessibility for the blind and 63.2% in accessibility for people with low vision. This means that Borger.dk is currently not accessible for either group. Recommendations can be made for the improvement of Borger.dk by looking at what it scored in each category and seeing what is needed to score higher. For example, Borger.dk received a score of 1, out of a possible 3, on Question 10 concerning the accessibility of form fields with a screen reader. In order to improve to a score of 3/3, the developers of Borger.dk would need to ensure that all form fields meet those requirements – that form fields and buttons are organized vertically and labeled correctly, so they can be accessed with a screen reader.

5 Conclusions and Recommendations

The Danish Association of the Blind is committed to ensuring that eGovernment websites are accessible for the blind and people with low vision. When we analyzed Borger.dk, we found a number of accessibility problems; however, we are optimistic that these issues can be corrected with sufficient resources because truly accessible websites for the blind and people with low vision do exist and are possible to implement. The following conclusions and recommendations can be used to ensure that Borger.dk, as well as other websites, are accessible to the blind and people with low vision.

In discussing our conclusions and recommendations, we will begin by drawing conclusions about the use and perception of current Danish government systems that do not use eGovernment. Then, we will discuss both the difficulties and the frustrations that users encountered when using Borger.dk. We will then summarize the socio-cultural implications of eGovernment. Finally, we will present our conclusions about the accessibility of Borger.dk and discuss which aspects of the WAI definition of accessibility it does not meet. We will then discuss our specific recommendations for the improvement of Borger.dk and of the implementation of eGovernment in Denmark as a whole, specifically for the blind and people with low vision.

5.1 Use and Perception of Danish Non-Digital Government Systems

Danish citizens currently use non-digital systems to access government; the Danish government wants, by 2015, to completely replace these with digital systems on Borger.dk. The blind and people with low vision need access to many of these non-digital systems, including disability forms and healthcare forms, without the assistance of others. These forms are only available as paper forms that must be filled out by hand and given to the relevant government office. Those interviewed either had a secretary, a spouse, or a friend complete these forms for them.

This brings up a major problem in the current government system in Denmark for the blind and people with low vision. Because all government communication that is done through paper forms must be completed by a third party that is assisting these individuals, there are major privacy concerns. It is impossible for somebody who is blind or who has low vision to know if the information that he or she is giving is being entered into the form correctly or if it is being used fraudulently by the person who is entering it. For example, when voting in an election, a blind person must tell a designated person at the election center for who they wish to vote. However, they have no way of knowing if the vote was cast correctly. Moreover, such systems foster dependency on sighted users who fill out forms, escort or transport blind citizens to government offices where they can get assistance, and more. These citizens are constrained not only by their own schedules, but by those of others who might assist them.

Existing non-digital government systems in Denmark therefore are not accessible to the blind and people with low vision without the provision of extra support and assistance, and they impose constraints that sighted users might not have in getting access to these systems. Therefore, the implementation of eGovernment services is an important step in allowing the blind and low vision users to become more independent, use the systems when and where it is convenient, and keep personal information private.

5.2 Difficulties Encountered in Borger.dk

Understanding the difficulties encountered by the study participants is vital to improving the accessibility of Borger.dk and other future eGovernment websites. Participants in the preliminary interviews and focus groups expressed different opinions about these difficulties.

Participants in the preliminary interviews were required to have used Borger.dk in the past, but many had not used it recently. Most of these participants initially reported that Borger.dk was generally easy to use inasmuch as they had used it, which was not frequently or extensively. Most of these users had ranked their Internet skill as intermediate or advanced and all of them reported getting some initial assistance from others when they first tried to use the website. These factors may have influenced their perceptions. The one interviewee who ranked his Internet skill as beginner initially reported that Borger.dk was difficult to use. He mentioned that the difficulties mainly stemmed from the complex layout, which is difficult for a blind person to navigate because there is no way to get an overview of the page without going through each line with a screen reader. However, when the same interviewees were asked a more detailed question that had them rank how easy or difficult it was to use Borger.dk, they did not rate it as easy. Rather, the average rating (from 1-5, where 1 was simple with no difficulties and 5 was impossible) was in fact 3. When asked to elaborate on some of these difficulties, all of them identified problems such as screen reader compatibility and a difficult to understand site structure.

Participants in the focus groups were asked about the difficulty of Borger.dk after having recently completed several tasks in a usability study. The difficulties that they encountered were still fresh in their minds and their responses more closely resembled the one interviewee's who found Borger.dk difficult very to use. The problems were similar to those identified in the interviews, but we learned about them in far more detail. Difficulties with Borger.dk included:

- NemID error messages non-descript
- No submit button for PDF forms
- Search function did not search forms or page content
- Need to log into NemID repeatedly for different tasks
- Paragraphs mislabeled as headings
- Illogical location of forms and information

- Multiple column layout
- Java edit fields invisible to screen reader
- Mislabeled Adobe PDF forms
- Need to manually update Java Access Bridge
- Same-page popup windows

These were not just hindrances; they prevented many of the users from completing most of the tasks they were given, and they made these tasks unreasonably frustrating and time consuming. Although sighted users also experienced some of these problems, their success rate was 100% for all tasks, and the time they took to complete the tasks was around 75% lower. However, it is worth noting that these problems are not impossible to fix, which gives hope for a more accessible Borger.dk in the near future.

5.3 Frustrations Encountered with Borger.dk

Participants in this study were also asked about their level of frustration while using Borger.dk. Users were mostly frustrated when they could not complete a given task on Borger.dk in a reasonable timeframe due to incompatibility between their assistive technology and the website or due to an illogical website layout. All of the participants in this study expressed some level of frustration when using Borger.dk and ranked their frustration, on average, as 3 on a scale of 1-5 (where 1 is "you are relaxed" and 5 is "you no longer want to use it").

One major source of frustration was incompatibility between Borger.dk and the assistive technology being used. For example, NemID uses Java, which is not accessible with a screen reader unless the user has the Java Access Bridge installed. This meant that some users could not see the login boxes for NemID. There were no indications on the page that Java Access Bridge needed to be installed in order for NemID to work. Similarly, some of the PDF forms on Borger.dk were not compatible with the screen reader and therefore, could not be completed by the participants in the study. They became so frustrated that they gave up, but not after considerable effort and determination.

The other major source of frustration was the layout of Borger.dk. Many of the items on Borger.dk were not where the study participants logically reasoned that they should be greatly lengthening the amount of time it took to find what they needed on the website. The longer it took a participant to find something on Borger.dk, the more frustrated that participant became. Completing even simple tasks took so long on Borger.dk for the blind and low vision users that, in a one-hour period, almost nobody was able to complete the entire study that a sighted person was able to complete in less than 30 minutes. Some participants attempted to circumvent the complex layout by using the site map or the search tool. However, the site map was inaccessible when using JAWS and the search tool was limited and not able to search main body text, images, or PDFs. A majority of the study participants expressed the desire to use Google search to find pages on Borger.dk, which defeats the idea of a simplified one-stop-shop for all government related services.

5.4   Socio-Cultural Implications of eGovernment

While the economic and accessibility implications of eGovernment have been considered, there may be other unforeseen results of this transition. The people questioned believed that, for their community, the results would be mostly positive with some minor negative implications.

The consensus in the interviews and focus groups was that the transition to eGovernment was going to be positive for the community. The participants were enthusiastic that they would be able to interact with the government independently and privately, without the need for a secretary or caretaker. Participants also mentioned that eGovernment would have a positive effect on the environment because less paper would be used, which they felt was important.

Possible negative consequences of the transition to eGovernment were also mentioned. One concern was social isolation for the blind and people with low vision who normally do not leave their homes or interact with others – particularly other sighted people – except for the times when they have to travel to government offices or work with assistants who help them complete these necessary government tasks. If all government communication must be done online, many of these people might leave their homes even less and become even more socially isolated. Additionally, many participants expressed concern about the availability of assistive services for these eGovernment websites, in case something goes wrong or is inaccessible. If eGovernment becomes the only way to perform some government tasks, there must still be redundant non-digital systems in place to ensure that there is no loss of communication between the citizens and the government. Finally, many of the elderly, who have even less internet experience, also happen to be low vision users. This population in particular may experience the most severe problems with access, as well as become more socially isolated under an online system.

The response to eGovernment was mainly positive, with a few concerns. The participants in our study generally expressed enthusiasm about the future of eGovernment and said that they would use it more if it was made more accessible for the blind and people with low vision.

5.5   Evaluation of the Current Accessibility of Borger.dk

The currently accepted definition of accessibility by the Web Accessibility Initiative (2005) names five criteria that must be met in assessing the accessibility of a website: the user must be able to perceive, understand, navigate, interact, and contribute to the site. In our usability study, we determined that, according to this definition, Borger.dk is currently not currently an accessible website.

In our testing, some usability study participants were unable even to perceive the NemID login boxes using the JAWS screen reader. Their ability to perceive depends on the

screen reader's ability to detect information on the page, and visual information, untagged information, or mislabeled information are not detectable.

For a website to be understandable, a user must be able to "grasp the meaning of" the content (Merriam Webster Dictionary, 2008). During our testing, Borger.dk proved to not always be understandable to the study participants. For example, the two-column layout used on many images and in forms with horizontally placed boxes is difficult to understand. Although information in one column may need to be interpreted from or included with the information across from it to be understood correctly, a screen reader cannot read across but only from top to bottom, one column at a time. Forms that are laid out in two columns are not understandable and therefore not accessible to people using a screen reader.

An accessible website must also be navigable so that every part of the website can be reached by a user. Borger.dk was not easily navigable for our study participants because much of the content organization and page layout was illogical. For example, when the participants were attempting to find the Act on Retaining the Right to Spousal Pension by Separation and Divorce, they looked in the Pension and Marriage sections of Borger.dk. However, the act was accessible only through the Family and Children section. The Self Service boxes (commonly used) are located in the second column of the main page so these users spend a great deal of time reading irrelevant information in the first column before their screen reader finds the boxes on the far right. The study participants and interviewees mentioned that this is a common problem with Borger.dk and that, for the website to be more accessible, it must be organized more logically and laid out in a linear fashion. Borger.dk is also difficult to navigate with JAWS because H-tags are used for some page content, as well as for the headings on the page. Thus, when the participants attempted to use JAWS to sort by heading, they encountered regular paragraphs as well as the page headings, making it more difficult to navigate around each web page. Finally, Borger.dk was difficult for some participants to navigate because they found the site map to be inaccessible with a screen reader. A site map with proper heading tags would be accessible to screen readers and would improve the navigability of Borger.dk.

Finally, a user must be able to interact with and contribute to an accessible website. Filling out forms or submitting emails is a key example. Forms were quite difficult to complete, when users could even locate them. The PDF form to apply for assistive technologies had form fields, but they were not accessible to somebody using a screen reader. Additionally, the drop down boxes to select municipality in all parts of Borger.dk functioned inconsistently between different JAWS users. Some were unable to access the drop down boxes at all, while others were unable to commit their selections in the boxes. Instead, some of the boxes defaulted to the Faxe municipality.

5.6 Recommendations

Borger.dk does not currently meet the definition of an accessible website according to the internationally accepted Web Accessibility Initiative standards. Based on interviews, focus groups, and a usability study, we were able to make a number of recommendations for the future improvement of Borger.dk to ensure its accessibility for the blind and people with low vision.

Recommendation 1: Borger.dk should conform to WCAG 2.0 standards at the AA level

Currently, Borger.dk does not conform to WCAG 2.0 at the A level. Conformation at the AAA standard can be too cumbersome for most websites, especially those as big as Borger.dk because of provisions such as simplified language and a fully user selectable color scheme (Helle Bjarnø, personal communication, April 16, 2012). Conforming to only the A level is not sufficient because WCAG-A does not cover many of the provisions necessary for accessibility for the blind and people with low vision.

In the usability study, we discovered a number of places where Borger.dk does not currently conform to the WCAG 2.0 AA level. This is not an exhaustive list, but it does cover some major problems that affect accessibility specifically for the blind and people with low vision.

- Heading tags are not properly used throughout the site. Some page content was put in heading tags, which makes the page more difficult to navigate with a screen reader in Heading mode.
- Dropdown selection boxes are sometimes inaccessible with a keyboard – either the box cannot be interacted with or the correct selection cannot be made without the box defaulting to another selection.
- NemID login boxes are not accessible with a keyboard using JAWS because NemID uses Java technology and requires the Java Access Bridge.
- Some words used in Borger.dk are not in Danish, such as the "Expand" option. While most people in Denmark speak English, older generations were not educated in the English language and may not understand some of these prompts. Additionally, many blind citizens from non-English speaking countries immigrate to Denmark and become citizens because of disability benefits.

Recommendation 2: Website should score 100% in user testing with our metric

Any new eGovernment website that is intended for public use should score 100% when tested with our web accessibility metric, described in the previous chapter. Other metrics and standards are designed such that an accessible website will have an average score, while many of the features required to reach 100% are impractical. However, our metric was designed with user responses from our preliminary interviews and usability

study, so the criteria are all necessary for a website to be accessible for the blind and people with low vision. A website will only be fully accessible for the blind and people with low vision if every criterion in our metric is fully met.

Recommendation 3: Municipalities should build one standard, shared self-service system

Currently, the self-service sections of Borger.dk ask a user to select their municipality before presenting the form options available in that region. For example, the application for IT technology from the government is available as a PDF form for the Herlev Municipality, as a web form for the Faxe Municipality, and not available online at all for the Copenhagen Municipality. This is not user friendly because a user may spend significant time searching for a form that is, in the end, not available at all on Borger.dk. Additionally, blind and low vision users who have become familiar with the eGovernment systems in one municipality must learn new systems when moving to another municipality. These problems could be alleviated if the municipalities combine their resources to create a central, fully accessible set of digital self-service forms.

Recommendation 4: Organize Borger.dk more logically

One of the most common comments from the participants in the usability study was that the organization of the pages on Borger.dk was confusing. When users were tasked with finding a specific law or a form, they generally had to review every link on a page with their screen reader, which could take up to 10 minutes. Then, that user had to navigate a complex series of links to finally reach their destination. To access the form to apply for information technology equipment, a user had to click seven links. If the user had selected the wrong link at any point, he or she would have to click many more times until they realized that they had reached an endpoint and navigated to the wrong part of the website. A site map that is in plain text and organized vertically so that it is accessible to the blind and people with low vision would also help clarify the organization of Borger.dk. A more logical organization scheme for Borger.dk could help many blind and low vision users navigate the website more quickly and with less frustration.

Recommendation 5: The search function should locate keywords in the text

While searching for forms or legal documents, most of the study participants expressed a desire to navigate away from Borger.dk to Google.com or another search engine. They felt that these external search engines were significantly more effective at finding the content that they were looking for. The reasoning behind this became clear when the study participants attempted to use the search function on Borger.dk. Only major titles of pages were searched, neglecting the text content and even form titles, leading to generally non-relevant search results. Coupled with the sometimes-illogical layout of items on Borger.dk, this led some participants to give up on a task. Borger.dk could become significantly more accessible to the blind and people with low vision if the search function is improved to include the full text of each page and form titles.

Recommendation 6: Provide education regarding the layout of Borger.dk to the blind and people with low vision

An initial overview and understanding of the layout of a website can make a significant difference in how accessible that website is to somebody who is blind or has low vision. A screen reader interprets a page based on the underlying code, so a first-time user must spend considerable time scrolling through every paragraph, title, and link on a page to get an idea of how it is organized. When completing complex tasks that may take dozens of intermediate clicks, such as finding a piece of legislation on Borger.dk, this amount of time is compounded and a user can end up spending hours to complete the task. For this reason, many of our study participants expressed a desire for a government-sponsored course to educate the blind and people with low vision on the layout of Borger.dk. Then, if a user attempts to access Borger.dk with a screen reader, they will already have an orientation and sense of what is there, making navigation much more efficient.

Recommendation 7: Convert PDF forms to vertical web forms

Many of the forms currently used on Borger.dk are Adobe PDF files with form fields. It is possible to make a PDF form accessible to somebody using a screen reader by assigning labels to the form fields. However, once that PDF form is filled, it must either be emailed or printed out and mailed into a government office. During our usability test, the email form option was not functional with a screen reader, so the only available option was to print the PDF form. It is more difficult for a blind person or a person with low vision to print and mail these forms than to go to a government office and complete the same form. Given these problems, we recommend that all PDF forms are converted to web forms and laid out vertically, following our web accessibility metric and the WCAG 2.0 provisions, to ensure that they are accessible when using a screen reader. If all forms on Borger.dk were converted into accessible web forms, the self-service section would be accessible to the blind and people with low vision.

Recommendation 8: Limit use of Java and ensure that Flash is tagged

The most serious accessibility problem that we encountered in our usability test was the inability for some users to access the Java-based NemID login boxes. Consequently, these users were unable to access the self-service features on Borger.dk. The issue was predominantly that, in order for Java-based systems to be accessible for screen readers, the Java Access Bridge must be installed and regularly updated on a user's computer. On modern 64-bit operating systems, updating Java Access Bridge must be done manually, which requires some technical knowledge. To avoid this problem entirely, we recommend that Java be used only when necessary.

While Adobe Flash technology is not currently used on Borger.dk or any related websites, we also looked at how accessible it can be so we could make recommendations for its future use. We discovered that, while it is possible to make Flash accessible, it is

generally used for dynamic content, which would not be accessible with a screen reader anyway, such as videos or interactive games. Therefore, based on user feedback, we recommend that any Flash applets used are accompanied by a descriptive text caption for screen reader users.

Recommendation 9: Implement alternate systems for people who cannot use eGovernment

One of our major findings is that eGovernment is not currently accessible to the blind and people with low vision. Additionally, eGovernment may never be accessible to some groups, such as the elderly, due to lack of experience with technology. This makes the maintenance of alternative systems for these groups a necessity to ensure full accessibility of government services for all citizens.

Based on our findings, we recommend that current government offices are kept open at least until Borger.dk is made fully accessible to screen readers and further studies are performed on its accessibility for other disabilities. We also recommend keeping phone helplines open indefinitely as parallel systems to eGovernment to ensure that nobody is left without some form of access. Finally, we also recommend that assistants be provided to people with disabilities on request, so that groups such as elderly people with low vision or blindness, which may not be able to access Borger.dk using a screen reader due to lack of technological experience, can still interact with the government. These systems do not need to be maintained forever because technological experience among all age ranges is increasing with time, but they are necessary for at least the next several decades.

Recommendation 10: Consider users with other disabilities

For this project, we investigated the accessibility of Borger.dk for the blind and people with low vision. We offered many recommendations for the future improvement of Borger.dk and other eGovernment websites. Based on Denmark's *New Joint Public Digital Strategy for 2011-2015*, Denmark aims to replace existing government systems with eGovernment in the near future. Before this can happen, similar studies to our must be performed for groups with other disabilities, to ensure that nobody is left without access when the transition happens. According to Helle Bjarnø, an advocate for Internet accessibility and a member of the WCAG committee, people assume that a website that is accessible to the blind is automatically accessible to everyone with a disability, but this is simply not true (personal communication, April 16, 2012). Additional accessibility consideration must be made to interface with assistive technologies used by people with other disabilities.

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Appendix A: Interview Summaries

A.1: Interview with John Heilbrunn

John Heilbrunn is the Vice President of the Danish Association of the Blind. He is our primary source of contact for information about this project in his role as our project liaison. On February 9, 2012, we performed a phone interview with John. The transcript will not be published, but a summary of the findings from the interview follows.

The interview began with John mentioning that two pieces of legislation had been forwarded for comment by the Danish government. The final objective of this legislation was that, in the next three years (2012-2015), there would be four waves of digital implementation with the outcome being severely reduced paperwork between citizens and the government. The first wave, to be implemented by December 1, 2012, is a large document relating to changes of address, daycare, clubs, leisure time activities, public schools, health insurance cards, and more, which amends current legislation and moves the registration process for these items to the Internet. The second wave, to be implemented by July 1, 2012, is a long piece of legislation implementing Digital Post, which is the new digital system of communication between the government and citizens. Through this system, citizens can send personal information and requests to the government, and the government can send messages to the citizens. Some municipalities in Denmark are implementing these services as early as February 2012.

Then, John discussed current eGovernment systems in Denmark and their efficiency and accessibility. Denmark has already implemented a secure digital ID system called NemID. With NemID, you can log in and get a secure digital key for each transaction you will make with the government, allowing secure access to your eGovernment services from any computer. This system has been around for several years now, so it has been made quite accessible to blind and low vision people. For example, you can log into NemID with a username and password, then have the secure code sent to you via a phone call that will speak the code to you or via a card that is sent in the mail containing a number of codes pre-generated which you may use before requesting another card. These systems work fairly well.

The big challenge pointed out by John is what happens once you actually get into the digital government services. These systems use Java, which is not accessible to screen readers by itself – a program called Java Access Bridge must first be installed. This program must be reinstalled every time Java updates, resulting in temporary loss of access. The current system is called Borger.dk (Citizen.dk). Some of the systems within Borger.dk are the taxation system (SKAT) and a digital mail system called e-post. These systems are not currently accessible to people with low vision and blind. John mentioned that some technologically experienced blind users can "wiggle" around these systems, but, for the most part, the systems are difficult or impossible to use if you are blind. The main worry

here is that it takes a long time to adapt existing eGovernment systems to be accessible with screen readers, so there is a period of time during which these websites are not accessible to a section of the population.

Next, John discussed accessibility technologies that are currently on the market. The most used screen reader is JAWS, a program by Microsoft. The intent in Denmark was to make all public websites accessible using JAWS by 2008 – in 2012 roughly 80% of public websites are still not accessible to the blind. Reasons for this include graphics, Java, and the use of Flash, all of which either are completely inaccessible to screen readers or require workarounds. John mentioned that the two ways of implementing accessibility are:

- Design a system to be accessible from the start, which is much easier than adding accessibility for screen readers to an existing system.
- Make exceptions for the blind and low vision, such as phone systems. The issue here is that those people would not have the same opportunities and flexibility as the rest of the population because they would be limited to interacting with the government within the operating hours of those government agencies.

To ensure the accessibility of current systems, Denmark provides special provisions for people with low vision and blind through the Ministry of Finance, to obtain permission to not use the digital systems. However, John mentioned that blind people do not want to be looked at and treated specially; they just want to be able to use the same systems as everyone else. It is also important to consider the elderly visually impaired population, many of whom are not familiar with computer technologies and may not be able to learn how to use a screen reader within their lifetimes.

We then discussed the deliverables for our project. One of our major goals will be to come up with a system of accessibility metric to quantify the accessibility of a website with access technologies such as magnifiers and screen readers. Another major goal is to consider the social aspect of this change. Many blind people are isolated from society, with the only social interaction being when they get out to go to a government agency to file paperwork. With the loss of even this mandatory excursion, many people may become completely isolated. We should investigate this aspect of the problem and possible solutions. Currently, the Danish Association of the Blind does hold social gatherings for blind people, but many do not have the confidence to leave their homes and join them.

Finally, we discussed the cost of some existing accessibility systems and what the Danish government will provide. JAWS, the standard screen reader, is very expensive, though the government does provide it if they determine that there is a need. However, due to the economic downturn, many cheaper screen readers such as Dolphin and Windows Eyes are being looked at, as well as some free alternatives that exist. However, many of these systems have limited features compared to JAWS. John did mention that Apple products – Mac OS X, iPhones, and iPads – have Voiceover, which is an excellent screen reader technology that has made Apple products very popular in the blind community. Additionally, the Siri voice recognition technology on iPhones works very well in making

basic phone services accessible to the blind. Voice recognition is another big technology that makes moving around systems like newer GPS devices much easier for blind people.

At this point, we concluded our interview and thanked John for his time.

A.2: Interview with Elizabeth Myska and Sharon Strzalkowski

Sharon Strzalkowski is a vocational rehabilitation counselor at the Massachusetts Commission for the Blind. She is a blind counselor and works on setting up other blind individuals with assistive devices they need to do what they want like watch television, work on the computer, and cook. Sharon herself uses JAWS, a Windows screen reader that allows her to interface with her computer. On February 8, 2012 we performed an interview at the Massachusetts Commission for the Blind. The transcript will not be published, but the summary of the findings from the interview follows.

The interview began with Strzalkowski explaining the different technological assistance options for the blind and people with low vision. She mentioned that JAWS is the most popular screen reader, but there is also Window-Eyes, and for magnifiers the two most popular were ZoomText and Magic. We then discussed how operating system accessibility features are often not useful at all because they are not customizable, and do not have enough features to allow them to be useful for people with more severe visual impairments. We discussed how some people who may wear strong prescription strength glasses may use the alt+ and alt- feature to zoom in on sections of the computer screen they cannot see clearly, but that this feature will not zoom in enough and allow for enough screen navigation to make it worthwhile for those with more customizable needs.

We discussed the possibilities of Siri and Dragon Dictation. Strzalkowski explained how Dragon Dictation is not useful because it takes a long time to train it to the sound of your voice. If there is a mistake, you have to go back and it is very difficult to edit because you have to go backwards letter by letter. We then discussed the possibilities Siri has to offer. Strzalkowski explained that the touch screen on the iPhone would be difficult to learn, but that Siri definitely has a place in the future of accessibility technology.

When we asked Strzalkowski to fill out some forms online for us to show us how the screen reader would work her initial reaction was, "well there's the problem". Strzalkowski explained that the most frustrating part of a form is its orientation and the CAPTCHA[3]. For an individual using a screen reader, a CAPTCHA is a read to the individual using a scrambled almost incomprehensible voice and in code, where the first letter of every word is a part of the CAPTCHA code, and is to be typed in. Strzalkowski explained that often she doesn't understand what the CAPTCHA is saying, or forgets one of the letters and has to try to fill it out multiple times before she gets it right.

Strzalkowski allowed one of the researchers to try to use the screen reader. She explained that effective use of a screen reader requires an understanding of keyboard shortcuts, such as H for Headings, N for Next text, and F for Form mode. Java applications, PDF Documents, and Flash applications can all confuse a screen reader. According to

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[3] A CAPTCHA is a box at the end of a form that is filled with jumbled letters and numbers that a person must interpret in order to confuse computer programs to ensure that the entity filling out the form is human.

Strzalkowski, "You have to be very concentrated when using JAWS. It's very easy to get lost." Accessibility to forms is based on how the form is set up. Vertical forms are much more accessible than any two text boxes aligned horizontally next to each other, because a screen reader will read that as one line. She explained that online shopping carts and social media websites with multiple media types on one page can also cause major problems for screen readers. Strzalkowski concluded that screen readers work very well, as long as a webpage is set up and organized well.

We then discussed the ability of a blind person to use a computer in the first place. Strzalkowski explained, "If a person is blind and can't use a computer, there is no way for them to access online forms without help." Groups like the elderly may not have ever learned how to effectively use a computer, and many blind individuals may not be able to afford a screen reader, further limiting their ability to use a computer. We inquired about the possibility of using a phone system in conjunction with eGovernment as a way to potentially allow blind people to complete forms offline. Strzalkowski explained that while a phone system sounds like it would make a lot of sense, and would work quite well, it threatens an individual's privacy, and the potential for individuals to need to divulge social security numbers and other private information to a stranger.

We discussed the U.S. system of providing programs to the disabled. She explained that the U.S. can help bring down the cost of JAWS, but cannot necessarily provide the program for free. She said, "There are many gaps in coverage especially with Medicaid, and sometimes people have to fight for the right to get wheelchairs, how can we be expected to fight for screen readers?" Strzalkowski thought that disabilities were misunderstood, and people pity the disabled but do not take the time to understand them. She felt people give money to the disabled, but do not give them the things they really need.

The conversation then moved to the idea of the "human touch" and social isolation among the blind population. She explained that, once people are diagnosed with a visual impairment or with blindness, they often withdraw and lose their confidence. The problem partially stems from losing the idea of freedom because you are unable to drive, and it becomes difficult to get around. Strzalkowski claims that a feeling of defeat is the initial reaction when people lose their vision later in life. In an individualistic culture like the U.S., being in need of assistance is more of a problem than in a society like Japan where there is a community-based attitude.

We discussed the idea of how difficult it is for the blind to get a job. Strzalkowski explained that people often find a way to live off welfare and find it unnecessary to go find a job. With the safety net of SSI, what incentive is there for people to work? Strzalkowski explained that this contributes to the idea of defeat and does not help people gain a sense of strength and confidence. She felt we needed to encourage people to get out and learn to handle their impairments in order to promote the idea of independence.

Our interview with Sharon Strzalkowski ended here, and we graciously thanked her for her time.

A.3: Interview with Elizabeth Myska and Stephen Nicholls

Stephen Nicholls is a martial arts instructor who operates in London, England. He is affiliated with multiple schools in Europe and America with his OneTouch technique of self-defense for the blind. He describes it as a "self-confidence boosting technique for the blind and visually impaired." He travels around the world giving conferences to the community of blind and visually impaired individuals, teaching his OneTouch system and spreading confidence through the community. He is a sighted person, so he does not have as much power to reach the people he coaches. Instead, he trains blind coaches to spread his self-defense technique and his message of self-confidence. We interviewed Stephen on February 15, 2012 in Worcester, MA.

We began our interview by discussing the importance of confidence and security for blind people. Nicholls explained that, for many people, the desire to go out is halted because of the fear of being taken advantage of, getting lost, or being assaulted. He told a story of a woman who wanted to attend his seminars but would not travel, even with the assistance of him and another fellow blind coach. This lack of courage contributes to the problems that divide the blind and visually impaired communities.

Nicholls explained the schism between the National Federation for the Blind (NFB) and the American Council for the Blind (ACB). The NFB says that people with low vision do not need special provisions and can get along in the world without help. Their platform stems from the idea that they do not have special needs; they are just different. The ACB supports assistive technologies and encourages individuals to utilize any technology that gets them the help they need. They believe it is a burden to learn to live in a sighted world, so any technology that can be used to make that easier should be used. Nicholls explained that the community of blind and visually impaired people is split into either the NFB camp or the ACB camp – there is not much cross-communication and people cannot be members of both organizations.

Finally, Nicholls covered the idea of "I can do anything by why don't I?" He said that blind people want to hear that they can do anything and that nothing can slow them down, which, in our sighted society, can be an unrealistic idea. For our project, Nicholls recommended considering an auxiliary step to eGovernment before full transition. He also suggested that any new eGovernment system should be marketed specifically to the blind and people with low vision, as well as the general population, to raise awareness and excitement.

A.4: Interview with Hans Rasmussen

Hans Rasmussen has been working at the Danish Association of the Blind for 42 years in the field of digitalization. He started as a computer programmer and, in the 1980s, began teaching people how to use computers. From the 1990s, he began working with graphical and non-graphical interfaces, such as JAWS. He also acts as a representative for the Danish Association of Disability Organizations in the new payments website betaling.dk. This interview was not recorded – this is a summary of the written notes.

Hans began our interview by discussing the main problem with Danish eGovernment. The current mode of thinking is that it is sufficient to take paper forms and simply fill them out as PDFs or create a web form with the same layout and functionality. However, in order for these forms to be truly accessible, especially for the blind or people with low vision, they must be rebuilt with the digital landscape and accessibility in mind. Simply taking a scanned form and adding fields in a PDF cannot be considered effective eGovernment.

Another problem mentioned by Hans is the desire to convert every single system to eGovernment, sometimes at great cost. The Danish goal is to have 80% of the population using eGovernment services. These services will include everything that is currently done with paper forms or by traveling to a government office. However, Hans believes that some of these forms should not be converted to eGovernment. For example, requesting a pension at 65 years old is something that each citizen only does once in their lives. For something this low-volume, is it even worth it to pay for the development of an eGovernment system? Another example is signing up for schools or daycare. However, Hans did mention that accessibly digitized systems are very necessary in a broader sense, to enable everyone, and especially blind and visually impaired people, to do things at their own pace and become independent.

One of Hans's responsibilities at the Danish Association of Disability Organizations is to represent them in the new eGovernment payment system, betaling.dk (payment.dk). This is one centralized service for all of Denmark that would process all payments between the citizen and the local community, including pension checks and welfare. The legislation for this system is to be passed in April 2012, with implementation starting October 2012, and the final system fully implemented by 2013. One problem with this new system that Hans brought up was that it is centralized, so if you need assistance from the central office, how can they possibly be familiar with your specific municipalities' problems?

Hans brought to our attention that the Danish government is currently reviewing Borger.dk for accessibility and implementing a new version. However, Borger.dk is just a portal to the specific eGovernment services implemented separately by each municipality. There are a total of 98 different municipalities which each have their own eGovernment sites that we can test from Borger.dk. These sites are at vastly different levels of accessibility and a ranking was published in November 2011. We should use this ranking in

selecting subjects from different municipalities for our usability study to rule out people who live in municipalities with absolutely inaccessible websites, because that would be a waste of time with little resulting data.

Next, Hans mentioned some people who we could meet with and interview in the future. There is a blind supervisor who works in the Danish government with small business registration. We can interview her to see how she goes about her daily life with is mainly focused around filling out forms on a computer. She is one of the three people following NemID, the other two being Hans Rasmussen and John Heilbrunn. Additionally, there is a woman (Helle) who works for the W3, one of the organizations responsible for the WAI (Web Accessibility Initiative) which defines web accessibility. We could potentially interview her. Hans will contact us soon with information about both of these people.

The next topic of discussion concerned the standard accessibility technologies provided and used in Denmark. The two principle programs are JAWS and ZoomText, which are used by almost everybody so that educators can become familiar with one program and teach it to everyone. There are some free screen readers, but these are a point of worry for Hans because they have less features (such as not being compatible with Microsoft Word), but may seem like a better option for lawmakers because of their lower cost. Replacing JAWS with one of these systems would be a major step backward. It is also difficult to teach people the difference between a screen reader and the voice used. The same voice can be purchased and used for a variety of different screen readers, while the quality of the information given depends on the screen reader used. A misunderstanding of this system makes purchasing a voice difficult for those who think that the voice and screen reader are one.

Next, we discussed the accessibility of web technologies. We first talked about Java, which is used for NemID because it works cross-platform and can therefore be used on Windows, Mac OS X, smartphones, tablets, and other devices. However, Java is by itself not accessible to screen readers. When integrated with the Java Access Bridge, it will work with screen readers. However, the access bridge only auto-installs on 32-bit operating systems, leaving many users of newer computers without access unless they are technologically experienced enough to find and install the 64-bit version. Additionally, the access bridge must be installed every time Java updates. We next discussed Flash, which Hans said can be made accessible to screen readers when programmed but usually isn't. This is, however, not a major problem because most Flash content is dynamic in nature, while screen readers are only designed to read static content, so anything displayed in a Flash-based medium wouldn't be accessible anyway. Hans said that, in order to make a flash-based system accessible, the information contained in the Flash section of the website would need to be displayed in plain text as parallel content. For example, information contained in a video would need to be summarized in text as well.

This led into a discussion about the accessibility of a new system to a blind person. Even if a system is accessible to a screen reader, a blind person cannot see the entire

picture of the system like a sighted person – they can only see what they are on. So the functions and features of a new system may not be immediately clear. This necessitates training on these new systems, regardless of their accessibility, so that there may be greater understanding.

The problem that has arisen with current systems is that each municipality has its own, so even if training is available and the system is accessible, people moving between municipalities or people performing the training must be familiar with many different systems. The solution to this problem would be a central eGovernment system for all municipalities to use. However, there has been opposition to this idea from the municipalities themselves. The other limitation in a central system is that it may end up very inaccessible if designed based on current systems. For example, Gentofte has an eGovernment system that has won international awards for usability. However, it is completely inaccessible to the blind. At the surface level, this system would seem perfect as a template for a new, central system; however, such a system would be completely inaccessible to blind people.

One of our final topics of conversation was Facebook. Hans mentioned that it would be easier for blind people to say "just use Facebook" instead of giving contact information and it would be very easy for a blind person to maintain a social life through that website. Additionally, apps can be written for Facebook that present Facebook in an accessible way, readable by screen readers and magnifiers. Currently, Facebook is not very accessible and most blind people use the mobile version of the website which is formatted more simply and is therefore readable by screen readers.

Finally, we discussed the feasibility and effectiveness of voice-activated systems such as Siri on Apple devices. Hans said that they are useful to a certain extent. For example, if you ask for the weather and are given an answer, the system can be considered accessible. Similarly, if you ask for someone's phone number and it is spoken aloud or that person is called, the system can also be considered accessible. The problem comes with the input and output of such systems both coming from the same sense – hearing. For example, such a system would be difficult to use if dictating because there would be no way to immediately verify what you are inputting into the system.

At this point, we concluded our interview and thanked Hans for his time.

A.5: Interview with Helle Bjarnø

Helle Bjarnø is an advocate for Internet accessibility and a member of the WCAG committee. The conversation began with a discussion of the typical standards used in accessibility evaluation, such as ISO 9214, WCAG 2.0, and US Rehabilitation Act Section 508. Bjarnø explained that Section 508 is currently under revision. We discussed the idea of access for all and Bjarnø explained that it is typically not a good idea to look at accessibility only from the perspective of one disability group. The newest accessibility policies are eInclusion, Access for All, and Raising the Floor. These movements all aim to bring universal accessibility into the public eye. Bjarnø also explained that "The Cloud" is the way of the future, as UNESCO has been putting funding into the idea of a customizable cloud that individualizes Internet sites based on user needs. For example, if a blind person uses a screen reader and finds it easier to use the mobile version of a website, those settings can be saved to the cloud and a mobile and accessible version of a website will be delivered each time if available.

Next, Bjarnø discussed a woman from Toronto, Canada who has been pushing for universal accessibility. However, Bjarnø believes that Access for All is a more important movement than complete access in only one country. Considering that the elderly population has the highest percentage of disabilities that affect access to the Internet, more effort should be put into making websites accessible for them.

Then, we began discussing the Top of the Web competition in which Danish eGovernment websites are evaluated for usability and design. Bjarnø mentioned that, some years ago, the contest decided to stop focusing on web accessibility for disabled people as heavily, dismissing accessibility issues as merely technical problems that can easily be corrected. Bjarnø also added that education is critical for the aging and disabled populations. Anyone with a disability can purchase a computer and even access websites using a screen reader. However, many websites will be inaccessible without prior education about the layout and organization of the website.

Bjarnø explained that other groups to focus on include the low educated, illiterate, and poor. Bjarnø felt that the usability testing also needed to cover accessibility for these groups to work toward the goal of accessibility for all. She explained that accessibility in Denmark has gone down because of all the external programs and applications that websites run through. There is more multimedia, more Accessible Rich Internet applications (ARIA), and constantly refreshing content frames that stop the screen reader. Bjarnø feels that web accessibility is a technical problem at its core, but that the goal should be to enable self-service for everyone, including those with disabilities.

Bjarnø then discussed WCAG 2.0, the main web accessibility standard in use today. She mentioned that one of the main issues is in prioritizing accessibility issues in the rankings that websites are assigned. In other words, what makes a website AAA versus A? For example, Bjarnø mentioned that AAA rating is almost impossible to attain, because it

requires provisions such as very simply written content and language translation for people with hearing impairments who may have another grammar because sign language translates differently than a spoken language.

Finally, we discussed the language barrier, focusing on how Danish is such a small language that not everything can easily be translated into Danish. Navigation is an issue if the website is not designed correctly. Bjarnø mentioned that if headings are not labeled correctly with the <H1> tag, JAWS wouldn't pick them up in heading mode, making it much more difficult to navigate around a website. She explained that Borger.dk has done a lot of work on ensuring its accessibility and has conducted three usability tests to find areas for improvement. However, they cannot control third-party websites, such as those owned by the municipalities, so they cannot ensure full accessibility of eGovernment services.

We then concluded our interview and thanked Helle for her time.

A.6: Interview with Signe Bernhard

Signe Bernhard is an advocate for web accessibility who previously compiled a report on the accessibility of the Danish Radio services on dr.dk. These include the public radio and television services that all Danish citizens are required to pay for. Because everybody is paying for these services, it is vital that they are accessible. Signe evaluated the accessibility of these websites by evaluating the websites based on the WCAG 2.0 standards, then analyzing them with the AChecker accessibility verification tool. Finally, Signe used a screen reader to go through the dr.dk website and see if it was possible for a blind person to navigate it.

When she completed her analysis of dr.dk, Signe had found a number of accessibility issues. Some image elements did not have alternate text tags for screen readers and the links did not have title text. Additionally, because of the way the website was set up, the screen reader would have to navigate through every sidebar, on the left and right sides of the page, before going to the main content. This made it tedious and time-consuming to access even simple functions of the website. General navigation between pages was also tedious, because it was impossible to TAB through the website. Additionally, the page elements on dr.dk used absolute size values, making it difficult to zoom into the elements on the page for people who need bigger text.

The biggest accessibility issue encountered by Signe was with the content management system used by each TV and Radio show to post content onto dr.dk. The content on dr.dk is posted to the website through a separate system that takes user input in a non-technical interface and translates it into code, which can then be posted on the web. However, the program does not necessarily generate code that is accessible for the blind or people with low vision. Somebody using the content management system will have no idea what the difference between a heading tag and a non-heading tag is, or whether to add alternate text to any images included on the page. However, these are important accessibility provisions for the blind and people with low vision. These must be handled by the content management system, but they currently are not.

Signe mentioned a number of reasons why these accessibility problems exist on dr.dk and many other Danish public websites. Currently, there are no laws in Denmark that require the public websites to conform to any web accessibility standards or implement these provisions. Because much of the content is implemented by third party companies that are interested in maximizing profits, there is no incentive to implement the sometimes-costly accessibility provisions if they are not required by law. The accessibility issues also exist because there is a disconnect between the groups contributing to the website. The web designers put together a layout, which the web programmers implement. Then, the people contributing content use this web layout and content management system to publish the finished website. At no point is anybody checking the work of the previous group, nor is there any oversight to ensure accessibility between these groups.

Signe said that people using screen readers have particular difficulty accessing dr.dk. On the front page alone, JAWS reports 3,000 links to different pages. How can somebody who cannot see the overall layout of the page be expected to go through all of these links and the content of the page one-by-one to try to understand the complex layout of the website? If a person is persistent enough and has a sufficiently good memory, it will still take several hours at minimum to find anything on dr.dk if he or she has not used that feature before. Additionally, each department and TV show on dr.dk has its own different web pages, much like the municipality pages linked to from Borger.dk. Each of these departments and shows determines its own layout for its section of the website, so even if a blind or visually impaired user learns to use dr.dk, they may still not be able to effectively access further sections of the website.

Finally, we discussed the topic of how to convince people that accessibility is an important factor in the design of new versions of these websites. From Signe's personal experience, the problem does not come from the programmers designing these websites. In meeting with many such programmers, she discovered that they are very interested in learning how to implement a truly accessible website. The problem stems from managers who do not want to deal with the issue at the time because they are already busy, or who do not think it is important enough to focus many resources on. These are the people who must push for accessibility in order to implement truly accessible public websites.

At this point, we thanked Signe Bernhard for her time and concluded our interview with her.

Appendix B: Preliminary Interview Question Sheet

<u>Introduction</u>: We are a group of students from Worcester Polytechnic Institute in Massachusetts. We are here working in conjunction with the Danish Association of the Blind to evaluate the accessibility of Denmark's new eGovernment portal, Borger.dk. We strongly believe with your help we can improve the accessibility of Borger.dk, and ensure that future eGovernment sites are accessible for everyone.

Your participation in this interview is completely voluntary and you may withdraw at any time. Please note that any information you give us may be quoted but your name and identity will be completely confidential. No names or identifying information will appear in any of the project reports or publication. We would like to record this interview to use only for our reference in writing this report. Your participation is greatly appreciated. If interested, a copy of our results can be provided at the conclusion of our study.

Consent _____

<u>Questions</u>:

1. How old are you?

    _____

2. What municipality are you from?

    _____

3. What government systems do you need to access in a year?

    _____
    _____
    _____
    _____
    _____

4. Do you find current non-digital government systems accessible?

    _____
    _____
    _____
    _____

    a. How do you access these systems?

        _____
        _____
        _____
        _____

    b. Please explain what is/is not accessible.

        _____
        _____
        _____

_____
_____
_____
_____
_____

5. What assistive technologies do you use?

_____
_____
_____

6. What is your approximate Internet skill? Beginner (basic web browsing and email), intermediate (using the Internet for your job), or advanced (web design experience or IT)?

_____
_____
_____

7. How would you describe the ease of use of the Internet with your assistive technology?

_____
_____
_____
_____

8. Can you explain what parts of Borger.dk you have used?

_____
_____
_____

9. Did you find it simple or difficult to use Borger.dk?

_____
_____
_____
_____

    a. Can you describe these difficulties?

    _____
    _____
    _____
    _____
    _____
    _____

b. On a scale of 1-5, where 1 is simple with no difficulties, 2 is simple with few difficulties, 3 is ok with more difficulties, 4 is difficult with many difficulties and 5 is impossible, can you describe your difficulties with Borger.dk?

_____
_____
_____
_____
_____
_____
_____

c. Would you say you experienced any frustrations when using Borger.dk?

_____
_____
_____
_____
_____
_____

d. On a scale of 1-5, where 1 is "you are relaxed", 2 is "you are annoyed", 3 is "you are getting agitated", 4 is "you are frustrated", 5 is "you no longer want to use it" what is your level of frustration when using Borger.dk?

_____
_____
_____
_____
_____
_____
_____

e. What, if any, parts of Borger.dk do you prefer to access online?

_____
_____
_____
_____
_____
_____

10. What effect, positive or negative, do you feel Borger.dk will have on people in the community?

_____
_____
_____

_____
_____
_____
_____
_____

Conclusion: Thank you for your participation. Your identity will be kept completely confidential. If you are interested, again, a copy of our results can be provided at the end of our study. Our e-mail address is dk12access@wpi.edu if you would like to contact us about anything.

Appendix C: Usability Study Protocol

Introduction: We are a group of students from Worcester Polytechnic Institute in Massachusetts. We are here working in conjunction with the Danish Association of the Blind to evaluate the accessibility of Denmark's new eGovernment portal, Borger.dk. We strongly believe with your help we can improve the accessibility of Borger.dk, and ensure that future eGovernment sites are accessible for everyone.

Your participation in this study is completely voluntary and you may withdraw at any time. Please note that any information you give us may be quoted but your name and identity will be completely confidential. No names or identifying information will appear in any of the project reports or publication. Your participation is greatly appreciated. If interested, a copy of our results can be provided at the conclusion of our study.

You must first fill out a confidentiality form, and please note that your voice will be recorded during this study, but no identifying information will be revealed in the reported findings of this study. Your voice recordings will only be used for our reference in writing our report, and during your study we will be using our own metric to answer questions regarding to usability.

Protocol Steps:
1) First, they will have to log into the Borger.dk system using the Java-based NemID.
2) Then, they will have to completely fill out but not submit a form of our choice using false information.
3) Next, they will be asked to find and read a specific passage in a legal document available through Borger.dk given only the title of the document and a description of the passage.
4) Then, they will be asked to answer a question about the budget of a specific government agency over a specified period using information that is available on Borger.dk but must be found by them.
5) Finally, they will be asked to perform a sample run of the new Digital Post system if available in their municipality.

NOTE: This study will only take one hour as part of our procedure is to see how much one can get through in an hour. However, participants will be soon after ushered into a focus group, making their total time of participation no longer than 4 hours.

Conclusion: Thank you for your participation. Your identity will be kept completely confidential. If you are interested, again, a copy of our results can be provided at the end of our study.

Appendix D: Usability Study User Demographics

User #	Group	Age	Municipality	Internet Skill Level	Assistive Technology
1	Copenhagen	29	Copenhagen	Intermediate	JAWS
2		40	Copenhagen	Intermediate	JAWS
3		45	Fredericksburg	Advanced	JAWS
4		66	Furesø	Intermediate	JAWS
5	Aarhus	36	Aarhus	Intermediate	JAWS
6		41	Aarhus	Intermediate	JAWS
7		44	Aarhus	Advanced	JAWS and Braille Display
8		46	Aarhus	Intermediate	ZoomText, Contrast, JAWS (sometimes)
9	Sighted	30	Jutland	Intermediate	None
10		31	Copenhagen	Intermediate/ Advanced	None

Appendix E: Preliminary Interview Raw Data

The following are summary tables of the raw data collected during the interviews.

Question #1) How old are you?

	Person 1	**Person 2**	**Person 3**	**Person 4**	**Person 5**	**Person 6**
Age	32	37	43	47	59	36

Question #2) What municipality are you from?

	Person 1	**Person 2**	**Person 3**	**Person 4**	**Person 5**	**Person 6**
Municipality	Aarhus	Hellerup	Helsingør	Aarhus	Copenhagen	Fredericksberg

Question #3) What government systems do you need to access in one year?

	Person 1	**Person 2**	**Person 3**	**Person 4**	**Person 5**	**Person 6**
Change of Address	X					X
Healthcare	X					X
Skat (taxes)	X	X	X		X	X
Job Searches						X
Banking				X		X
Marriage	X					
Disability forms	X	X	X	X	X	X
Communication		X		X	X	
Passport	X					
General Information	X		X	X	X	

Question #4) Do you find current non-digital government systems accessible?

	Person 1	**Person 2**	**Person 3**	**Person 4**	**Person 5**	**Person 6**
Accessible?	No	No	No	Yes	Yes	No

Question #4a) How do you access these systems?

	Person 1	**Person 2**	**Person 3**	**Person 4**	**Person 5**	**Person 6**
How do you access these systems?	Caretaker/ office worker	Caretaker/ office worker	Caretaker/ office worker after trying on his/her own	Caretaker/ office worker	Send email/ call on phone/ office workers help	Caretaker/ office worker at Citizen service

Question #5) What assistive technologies do you use?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Assistive Technology	JAWS	JAWS	JAWS	JAWS, MVDA and iPhone	JAWS, notetaker, Braille display, iPhone	JAWS,

Question #6) What is your approximate Internet skill level?

Internet Skill Level	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Beginner					X	
Intermediate	X		X	X		X
Advanced		X				

Question #7) How would you describe the ease of use of the Internet with your assistive technologies?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Ease of use of Internet with JAWS	Easy when it works, otherwise it can be complicated	Varies depending on the website. Manageable the more you know about the site.	Easy, but can be difficult if you are not willing to experiment	Easy, but becoming more difficult as more programs become involved (PDF, JAVA, etc.)	Difficult, tends to let people find things for him. Time consuming.	Easy

Question #8) Can you explain what parts of Borger.dk you have used?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Searching for Information	X			X		
eBox			X		X	
Change in Address		X				X
Healthcare			X	X		
Disability forms			X			
Skat (taxes)					X	
Banking					X	

Question #9) Did you find it simple or difficult to use Borger.dk?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Simple or Difficult?	Simple	Simple	Simple	Simple	Difficult	Simple

Question #9a) Can you describe these difficulties?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Description of difficulties with Borger.dk	JAVA access bridge is difficult.	PDF and difficult forms are the biggest problems.	Many forms are PDFs, not accessible.	Not everything is in Danish, English can sometimes be hard to understand for people. Graphics without labels.	Complicated layout, it is not obvious to a blind person without prior description.	Slow.

Question #9b) On a scale of 1-5 where 1 is simple with no difficulties, 2 is simple with few difficulties, 3 is ok with more difficulties, 4 is difficult with many difficulties, and 5 is impossible, can you describe your difficulties with Borger.dk?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
1						
2			X for Borger.dk	X		X
3	X	X			X	
4			X sending information			
5						

Question #9c) Would you say you experienced any frustrations when using Borger.dk?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Frustrations with Borger.dk	Cant log on because there are JAVA access bridge problems	None.	Some.	None.	Highly Irritated.	Some.

Question #9d) On a scale of 1-5, where 1 is "you are relaxed", 2 is "you are annoyed", 3 is "you are getting agitated", 4 is "you are frustrated", and 5 is "you no longer want to use it" what is your level of frustration when using Borger.dk?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
1				X		
2		X				
3			X		X	X
4	X					
5						

Question #9e) What, if any, parts of Borger.dk do you prefer to access online?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Parts of Borger.dk participants preferred to access online.	All of it.	Change of address and tax systems	All of it.	All of it.	All of it.	All of it.

Question #10) What effect, positive or negative, do you feel Borger.dk will have on people in the community?

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Effect on the community	**Positive**. Depending on future level of accessibility.	**Positive**, depending on future level of accessibility. Better than going to town hall.	**Positive**, because it is at your own convenience.	**Positive**, because it is easier to do on your own without needing help.	**Positive** gives people freedom. **Negative** because people will not have to leave home.	**Positive** because they can do it themselves. **Negative** if you cannot easily get assistance.

Appendix F: Final Web Accessibility Metric Form for Borger.dk

Accessibility Metric				
Website:	www.Borger.dk	**Reviewer:**	**Heather and Johan**	
Question 1:	**Perceive**	**Understand**	Navigate	Interact	Contribute

How many images on the website were accessible using a screen reader? (alternate text present)

1	Very few images	
2	Major images in articles	
3	Most or all images, including navigation buttons	

Selection:	**3**	**Weight:**	**3**	**Score**	**9**

Question 2:	**Perceive**	**Understand**	Navigate	**Interact**	**Contribute**

Are there any Java-based technologies present on the website?

1	Yes, and they are inaccessible to a screen reader	
2	Yes, and they are accessible with the Java Access Bridge	
3	No	

Selection:	**2**	**Weight:**	**1**	**Score**	**2**

Question 3:	Perceive	Understand	Navigate	**Interact**	**Contribute**

Did any of the forms on the website have a CAPTCHA?

1	Yes, with no audio option	
2	Yes, but inaccessible for another reason	
3	Yes, with an audio option or no CAPTCHA	

Selection:	**3**	**Weight:**	**1**	**Score**	**3**

Question 4:	**Perceive**	Understand	**Navigate**	Interact	Contribute

Did the website have a site map?

1	No, or yes but inaccessible	
2	Yes, with images or text arranged both horizontally and vertically on the page.	
3	Yes, with text arranged only vertically.	

Selection:	**1**	**Weight:**	**3**	**Score**	**3**

Question 5:	**Perceive**	**Understand**	Navigate	Interact	Contribute

Whenever inaccessible dynamic content is present (ie. Video files, Adobe Flash content, etc.), is the same information conveyed in text elsewhere on the page?

1	No	
2	Yes, elsewhere in the page.	
3	Yes, next to the dynamic content or as a caption.	

Selection:	**2**	**Weight:**	**2**	**Score**	**4**

Question 6:	**Perceive**	Understand	**Navigate**	**Interact**	**Contribute**

Can the entire website be navigated using only a keyboard?

1	No	
2	Yes, with some confusion (such as a multiple-column layout)	
3	Yes, with no confusions	

Selection:	**2**	**Weight:**	**3**	**Score**	**6**

Question 7:	Perceive	Understand	Navigate	Interact	Contribute
Are there any pop-up windows on the website?					
1 Yes, over the current page in the same window					
2 Yes, in a new window					
3 No					
Selection: 1	Weight: 1		Score 1		

Question 8:	Perceive	Understand	Navigate	Interact	Contribute
Is the first item that a screen reader encounters the page title?					
1 No					
2 No, but the title is near the top of the page					
3 Yes					
Selection: 2	Weight: 1		Score 2		

Question 9:	Perceive	Understand	Navigate	Interact	Contribute
Is the site navigation encountered directly after the page title, with an option to skip past it to the content?					
1 No					
2 Yes, but with no option to skip past it					
3 Yes					
Selection: 2	Weight: 1		Score 2		

Question 10:	Perceive	Understand	Navigate	Interact	Contribute
Are all form fields accessible with a screen reader, including dropdown selection boxes and Continue/Submit/Reset buttons?					
1 No					
2 Yes, but not organized vertically so they are confusing to a screen reader user					
3 Yes					
Selection: 1	Weight: 2		Score 2		

Question 11:	Perceive	Understand	Navigate	Interact	Contribute
Is each element of a form (edit boxes, buttons, etc.) paired with only one label?					
1 No					
2 Yes, but sometimes there are mixed elements. For example, the label Last Name, First Name could be followed by two boxes, one for each name.					
3 Yes					
Selection: 2	Weight: 1		Score 2		

Question 12:	Perceive	Understand	Navigate	Interact	Contribute
Are the forms on the website organized in a single column, vertical layout that is read linearly?					
1 No					
2 Yes, with few boxes placed horizontally, such as first and last name					
3 Yes					
Selection: 1	Weight: 2		Score 2		

Question 13:	Perceive	Understand	Navigate	Interact	Contribute
Are there PDF forms on the website that are accessible to a screen reader?					

	1	PDF Forms present, with improper or inaccessible fields
	2	PDF Forms present, with properly labeled fields
	3	No PDF Forms on the website, all web-based forms

Selection:	1	Weight:	1	Score	1

Question 14:	Perceive	Understand	Navigate	Interact	Contribute

Are there page elements on the website that change on a timer? (ie. Forms that can't be submitted after a certain amount of time has passed)

	1	Yes, with no indication of a timer and/or no way to delay it
	2	Yes, with an accessible way to delay or stop the timer
	3	No

Selection:	3	Weight:	1	Score	3

Question 15:	Perceive	Understand	Navigate	Interact	Contribute

Could you find what you were looking for using only the navigation links on the website?

	1	No
	2	Yes, but it took more than 20 minutes or more than 30 clicks
	3	Yes

Selection:	2	Weight:	2	Score	4

Question 16:	Perceive	Understand	Navigate	Interact	Contribute

Could you find what you were looking for using the search feature?

	1	No search feature available
	2	Search feature provided limited or unusable results
	3	Yes

Selection:	2	Weight:	2	Score	4

Question 17:	Perceive	Understand	Navigate	Interact	Contribute

Were all links on the website accessible?

	1	No, content was missing or pages were not there.
	2	Some, but others had missing content or opened in other windows
	3	Yes

Selection:	2	Weight:	1	Score	2

Question 18:	Perceive	Understand	Navigate	Interact	Contribute

Was the information on the website logically organized?

	1	No
	2	Yes, but it took more than 20 minutes or more than 30 clicks to find a desired page
	3	Yes

Selection:	2	Weight:	2	Score	4

Question 19:	Perceive	Understand	Navigate	Interact	Contribute

Is the website all written in the native language of the intended user?

	1	No
	2	At least the major site content is in the native language, with some layout elements in English
	3	Yes

Selection:	**2**	Weight:	1	Score	2

Question 20:	**Perceive**	**Understand**	Navigate	Interact	Contribute
Are all headings on the website labeled correctly?					

	1	No
	2	Most headings are labeled correctly, but some content is also labeled as a heading
	3	Yes

Selection:	**2**	Weight:	2	Score	4

Provisions for Low Vision					
Question 1:	**Perceive**	Understand	Navigate	Interact	Contribute
Is the color scheme of the website accessible to those with color blindness?					

	1	No, impossible to read with one or more forms of color blindness.
	2	Yes, readable with most forms of color blindness
	3	Yes, always readable with alternate color schemes available

Selection:	**2**	Weight:	2	Score	4

Question 2:	**Perceive**	Understand	Navigate	Interact	Contribute
Is all color-based information on the website also conveyed without color?					

	1	No
	2	Yes, in most parts of the website
	3	Yes, always

Selection:	**2**	Weight:	2	Score	4

Question 3:	**Perceive**	Understand	Navigate	Interact	Contribute
Can the size of the text on the website be increased without losing the readability (ie. Text moving behind images)?					

	1	No, absolute size values are used so the layout may not be zoomed
	2	Yes, with some text obstruction
	3	Yes

Selection:	**2**	Weight:	1	Score	2

Accessibility Score			
Blind Only	62.6%	With Low Vision	63.2%

Appendix G: Usability Study Scanned Documents

The following pages are the scanned raw data notes from the usability study. They do not contain any identifying information about the subjects of the interview; they are provided for the reader's reference.

Brail display w/ comp.

1

Usability Study Notes

Participant Consent: ____✓____

Municipality Aarhus

Age 44

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) Advanced

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
- searches around screen w/ JAWS + uses brail display to read - Finds NemID login - Sytem is running VERY slow, so she restarts her computer. - again goes to NemID - this time system easily loads - has NemID call her with her password - easily gets into NemID system login	

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
- searches home page - Finds handicap - Reads thru for hints @ technology. - gets to bottom of page + again navigates up. - finds a link regarding blind usability - has been brought to a 3rd party website - navigates back to borger → handicaps - finally uses search bar finds 50 results! - finds that she needs to apply, but no link! - FOUND IT! 30min	→ Finds a PDF @ ~~screen reader~~ making PDFs accessible must read all tabs before choosing one → this is in gov't subsidies section, what?

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
- starts by using search bar (Divorce + Pension - 9 res.) - Finds a few types of pension. ~~some~~ One that you have when you retire early b/c you cannot work - Finds It.!	→ tough to navigate w/ section symbols

TASK 4: Fill out a tax return form on your Borger.dk.

Annual Statement

Steps Taken	Noted Difficulties
- Used the search bar - Found Skat - navigates thru headings - - Finds a thing @ taxes	

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
	Uses careforyou

Usability Study Notes

Participant Consent: _____✓_____

Municipality CPH

Age 40

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) Intermediate

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
- prompts NemID to call him w/ log-in (seemed relatively) accessible	

GOT ON!

"JAWS can change 100s of things so everyone's settings are different"

- XP not windows 7
- many elements!

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

2

Steps Taken	Noted Difficulties
-Finds his way to handicap using heading navigator -reads thru ~~navigator~~ text to find link ~~tab~~ - uses tab thru headings - found the link! -chose a municipality! Not ~~accessible~~ available for Copenhagen! 10min	

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says. Rights Info. / Law Info.

Steps Taken	Noted Difficulties
-has a little trouble translating - searches for that type of pension in the search bar → NO RESULTS - searches for divorce + pension - finds a section! - reads thru navigating around headings. -opens a new window - section has a sign! -Successfully reads!	→IS GETTING quite frustrated! (gave the hint that spousal pension is a type of pension you have for your whole life)

Annual Statement

TASK 4: Fill out a ~~tax return~~ form on your Borger.dk.

Steps Taken	Noted Difficulties
- goes to skat - tries to navigate but few headings. - navigates out to new window - scrolls thru menus (headings) - asks to log in AGAIN! → unbelievable! - works! but annoying... - form is accessible!	

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
- looks up doctor in email (OUTLOOK) calendar • a bit of trouble navigating → - finds another log-in screen (needs a code he doesn't know) → CAN'T LOG-IN - finds code & tries to log-in - IN!	

Usability Study Notes

Participant Consent: _____✓_____

Municipality __Fårum (Furesø) NW of CPH__

Age ___66___

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) _____ *(is a lawyer)*

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
"Does not use	Before NemID, digital sig (user + pass) ⇒ Worked w/out problems. - Has not started to use NemID where you have to call on the phone. ⇒ Outdated - Uses NemID for Tax system + bank + eBox ⇒ Mostly through consultant from Her actretary. Hard for blind to use these 100% visual security systems

NemID is operational.

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
① Tried to get on search. Found link "link to handicap". Clicked it.	① None yet
② Thought he could use JAWS-F4 to search Alphabetiz.	② This function does not work on Borger.dk.
③ Found handicap section. All about NemID inc. filem for the blind showing how to use it.	③
④ Navigation through links. Clicked "Help in Daily life". Then "Technical Aids"	④
⑤ Difficulty finding "Self Service"	→ Difficult to go through.
⑥ Found it after scrolling through entire page.	
⑦ To identify municipality – tried to click on box	→ Computer went dead
Says Jump to Digital Signature – old system.	See attached →

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
① Under self service – legislation link – entered a more familiar area.	② Search word used was not accepted → no results.
② Link about server w/ all Danish legislation	– Difficulty finding the right key words
③ Searching for this act now.	
④ Dropped out of the site completely.	⑤ Difficult to find it – not showing up
⑤ Back on. Been through pension + now on family and children	
⑥ Went to "separation" under family legislation	⑥ Found nothing
⑦ On a different subsection under "family"	⑧ 4th or 5th sublink from main menu.
⑧ Link for "Separation and Pension"	⑨ Described in general text, cannot find legislation.
⑨ Found some information	

Annual statement

TASK 4: Fill out a ~~tax return~~ form on your Borger.dk.

Steps Taken	Noted Difficulties
N/A – no NemID + Out of time	

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
NA – no time	

JS 24-Apr-12

Final Thoughts

- Always asked to get on a training for any search tools on websites when a JAWS user.

  - has applied
  - once, when less experienced, organized a course (5-6 people)
  - was ~~ok, but~~ did not get anything out of the weekend.

- Uses the internet daily for many things
  - Normally, w/ Google, not difficult to find things
  - Would be able to find w/ Google, not website search. Search is not that good on Borger.dk
  - Much easier to use a centralized search

- No standards for public websites — criticized in the past

Have used Borger.dk for testing accessibility + to get an idea of what is in it (Municipality websites link to Borger.dk).

As a blind person — function to access Wifi
- At Browsers, etc. always extremely difficult

Task 2

- Search by headings - easier to find "Self Service"
- Site is so big w/ so many possibilities that it takes hours to find some things.
- Would never use Borger.dk for this purpose - knows how to use existing functions.

Other functions

- What influence would pay have on pension for disability?
- Is ie 5/10 hr work pr. week, what effect would this have on the pension?

- For information → easy to use

- For forms → More accessible needed.

_____

Conclusion: Could not access PDF form. Moved on →

_____

4

Usability Study Notes

Participant Consent: _____✓_____

Municipality Copenhagen

Age 29

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) Intermediate

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
Cannot Log-In!	

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
- search thru all the headings - quick search of headings - checks the sitemap of borger.dk for easier navigation 11 minutes of searching! - navigates slowly, **1 by 1** 3 minutes @ - Finds it, but since from Copenhagen, it's not available	Keeps missing tab, lots of trouble figuring out what she should click Reads everything looking for hints.

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
- searched - for articles + spousal pension - read around searching thru headlines/links - pressed the wrong button twice + had to start search over again multiple times 26min.-	Too many results Frustrated! must start @ sitemap again for ideas Right - gets stuck in side ads - navigates to bottom navigation somewhere she doesn't want to be. - "I don't know I can find this!"

Annual statement

TASK 4: Fill out a ~~tax retur~~n form on your Borger.dk.

Steps Taken	Noted Difficulties
Couldn't log-ln + no time	

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
Couldn't log-ln + no time	

Usability Study Notes

Participant Consent: _yes_

Municipality _Aarhus_

Age _46_

- Safari
- Uses ZoomText + Contraster
- only uses screen reader sometimes
- Partially sighted - can see a bit.
- Uses eyesight when possible

5

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) _Intermediate_

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
- had NemID call her	- takes some time to find login. - difficult to zoom window w/ nemid - refreshes. - did something wrong b/c there are multiple steps.

Note: Never used search bar!

5

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
- found a section about accessibility, - found some hints, but said, "I am not the sort of person who gives up, but finding some documents can be frustrating. - found accessibility tab on main screen, but searched it and could not find - when she clicks on the links she is led into IT page - "at this point I would give up, have a cup of coffee and say "ugh'!" - GAVE HER HINT TO FIND HANDICAP LINK - Backtracks and clicks forward multiple times trying to find a way through. GAVE UP. - Very close...1 click away!!	→ had to turn on screen reader for searching help. → wanted to give up, but kept finding hints towards where to go... → ZoomText doesn't work for login to NemID - she has a trick for logging in → trouble seeing if still in Borger or moved elsewhere → she wasn't, it had moved. → some folders don't say they are a PDF. → she was VERY frustrated. @ this point, but says it is not logical how she should navigate. - would like to call assistance for help.

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
- started in $ and Insurance tab - went to family + children then partnership + marriage - found a link to pension - found Divorce + Pension - Found link to document + with Zoom Text read screen reader read Section 11.	- takes a long time to navigate links. → tough b/c of symbol.

107

Annual tax statement

TASK 4: Fill out a ~~tax return~~ form on your Borger.dk.

Steps Taken	Noted Difficulties
- finds the link.difficult to locate w/ navigation b/c on far right, but scans page. - says she would normally just go to skat.dk - difficult to find link - Found a link to skat. - navigates around - Finds form! (only takes 7 minutes)	→ navigates over same things to get there, "I think I'm getting a bit annoyed" → wants a sitemap: w/ things in alphabetical order

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
- uses ebox. for all her bills (gets all the PDFs w/ bank info, etc.; easier for her to read) - looks for ebox on main screen - finds Post. link! 15 min!	- still hard to navigate without sitemap! Sundylvester has her doc's info. she knows HOW to do it outside of borger.

Note : Never once touches search bar –

Usability Study Notes

Participant Consent: _____✓_____

Municipality _Århus_

Age _41_

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) _____

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
Searched page	Found login - Can't navigate drop down box for municipality - Can't find form field for log in
Not Accessible	

Note: ████ is using another computer
- Needs some help from ████
- Used to WinXP, this is Windows 7

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
① Searched for Self Service →	Got lost on the page
~~crossed out~~	
② Found Self Service link	
③ Searching for "Apply for Equipment"	
④ Found phone # to call for help using the site	
⑤ Tried the link "disabled people"	
- Related links	→ Frustrated groan - unclear why
- Help in Daily Life	
⑥ Found section for economic support, etc.	
- Clicked Apply link	

Continued on back →

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
Skipped due to time constraint	

Task 2

⑦ Can Apply electronically in many countries → No form, just information.
ↄ Maybe in the Fara kommune
⇒ Try Herlev

⑧ Tried to change to Herlev, ok worked.

⑨ Found link to apply for IT Equipment. → Said it was lucky - just scrolling to the bottom of the page + found it. (b/c it is in another column.)

⑩ Choose PDF, Fara kommune → Need extra help program, follow. link, be logged in.

⑪ Can type + navigate inform.

6

TASK 4: Fill out a ~~tax return form~~ on your Borger.dk.

Annual Statement

Steps Taken	Noted Difficulties
① Search for SKAT	
② Searched for Annual Statement	→43 Results
	↳ more difficult via search than govt. link.
③ Found link	— Easier through SKAT.dk
	— Much more writing than it should be.
④ Tried NemID here	
↓	→ Asked for opinion to improve Borger.dk. — Can't get
Didn't work	out who answering given

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
Cannot Log-In	

Usability Study Notes

Participant Consent: ▓▓▓ ✓

Municipality Frederiksberg

Age 45

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) Advanced

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
- Tried to turn on accessibility. Inaccessible. link to pages. default - PLAIN Ribbon	Didn't work
- must choose municipality before logging in	can't see that 1st b/c it reads top down ERROR
- tries to log into net bank to see if something is wrong.	
- uses notepad to store NemID →	NEMID doesn't work

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
- Tries to get a view of the page.	→ Uses H tag in the wrong way
- Searches but	→ no match
- clicks on Daily life-	→ success!
- Finds correct tab!	
- Reads thru ~~tabs~~ text to find link	
- His municipality has it!	→ uses danish w/ american pronunciation b/c talks faster.
- must be logged in to send it digitally	when you check the radial button, no sign that page is has changed
- missing continue button → Tags missing!	
- enter help section	

VERY STUCK
nav mode
clicks around for a
while
@ 15 min

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
- searches for pension + divorce (added + sign auto.)	
- 9 results - doable	
- jumps by heading → works well	
- goes back and finds a link in legal	
- finds 2 possible options	difficult, must look into both
- finds something in 1, but assumes actual article is elsewhere - NO MATCH	- talks about a special pension were employed for life
	- had to search whole document to see if its right.

came to empty frame → refresh but doesn't help
- keeps reading ads on bottom

PRETENDS IT WORKS BUT THEN FAILS

TASK 4: Fill out a ~~tax return~~ Annual Statement form on your Borger.dk.

Steps Taken	Noted Difficulties
Cannot Log in	

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
Cannot Log in	

Usability Study Notes

Participant Consent: _____✓_____

Municipality Århus

Age 36

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) _____

dyslexic

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
① Search for login ② Suggests to login w/ key card but blind people login w/ phone ③ Went to site w/ info about different login procedures. ④ Back to the login site trying to find an edit box.	- Difficult to find the edit place in the login ② Doesn't support w/my phone - can't know w/o prior knowledge. - 3 min later, still searching for edit. - still searching 10 min. in for the log in box. ④ Speech says no edit box and no buttons on the page.
Noted frustration: user swears	

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader. Given hint: Look for Self Service.

Steps Taken	Noted Difficulties
① Searching headers for things beginning w/ S.	① Self Service menu is a few pages in.
② Used search box to look for "Self Service".	
③ Looking through results of the search.	General difficulty finding the right item on the site.
④ Clicked on a self service section on the search + got to another page.	
⑤ Wants to try another search related to # equipment for disabled persons.	⑥ Problem: Can't activate Herlev, took a little bit to get it to work.
⑥ Asked to choose kommune - chose Herlev. No trouble finding it.	
⑦ Now, will search for "equipment" - Got 3 results	

——→ Over.

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
① Returning to a list of subjects.	→ Comment: Layout is not very logical.
② Trying to find which of 2 links to follow ? pension/society →	↳ Went through "Family + children" to find "Separation and Divorce"
③ Searches for separation - Found "Separation and Divorce"	
④ Tried to search page for pension - 256 results	→ Can't really find
⑤ Searching for "retain"pension"	
⑥ Found the heading for the law	→ No law text - tried to find it but couldn't.

Only has patience because of the study.
- Frustrated because illogical
- Not mad now, but would be if he really needed it.

Task 2:

⑧ Searched on the page for technical equipment.

⑨ Searched for Self Service, found a link.

⑩ Heading called: Search for self service by subject. Looking through this.
— Chose subject "disabled"

⑪ Again, reached list. Clicked daily life.

③ No results.

TASK 4: Fill out a ~~tax return~~ *Annual Statement* form on your Borger.dk.

Steps Taken	Noted Difficulties
① On main site	
② Searches for tax-shit	→ Also word for "treasure" and "darlig"
③ Many results	→ Too many irrelevant results.
④ Searched for annual statement	
⑤ Found link called "annual statement"	
⑥ Found ~~the~~ "tax papers" link	
⑦ Can see own annual statement in self-service thing	

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties

Sighted Study 1

Usability Study Notes

Participant Consent: _____✓_____

Municipality Jutland

Age 30

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) Intermediate

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
-Go to log in -CPR # -Password	

1 minute

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
- Goes to Handicap - then goes to Rights (searches) → - goes to sight for Transport + services - back to Rights should be here - searches for information technology → doesn't find it. → search is nearly useless 8min. - finds Assistive Tech. use in search. - FINDS IT!	→ logically should be here.

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
- Clicks on pension - Clicks on folk pension - finds a link to general conditions - ~~Doesn't link to law~~ links to law	

2 min.

TASK 4: Fill out a tax return form on your Borger.dk.

Steps Taken	Noted Difficulties
- goes to my site - econonomy - finds tax info Less than 1 min.	

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
Does not use e Box	

13 min!

Sighted Study 2

Usability Study Notes

Participant Consent: _____✓_____

Municipality Copenhagen

Age 31

Internet Skill level: Beginner (basic web browsing and email), intermediate (using the internet for your job), or advanced (web design experience or IT) _b/w_ int +advanced

TASK 1: Log into the Borger.DK system using the Java-based NemID.

Steps Taken	Noted Difficulties
① Clicked log in — found annoying popup message ② Put in NemID + password ③ Tried to find NemID code on paper ④ Logged in. Time: 30 seconds	

Task 2: Find the tab to apply for information technology equipment. Choose the Herlev Kommune municipality, and fill out the PDF form for a JAWS screen reader.

Steps Taken	Noted Difficulties
① Went to handicap section	
② Help in daily life section	
③ Help equipment section	
④ Found in Self Service box - right link	
⑤ Picked Herlev, hit continue →	Option to print or digital pick digital
⑥ Got form open, but it was a PDF w/ form fields →	To send in PDF, you can put in your email address, but it has no button to submit.
⑦ Help box says send in w/ NemID but there is nothing about sending. Download + save to send in via eBox.	No sign of submit button ↳ why type email at all.

TASK 3: Navigate to the Act on Retaining the Right to Spousal Pension by Separation and Divorce. Navigate to Section 11 and summarize what it says.

Steps Taken	Noted Difficulties
① Went to front page	On page, have to scroll down + on right bar for "legal documents" section
② Family + Children section	
③ Back to front page. Relationships + marriage section.	
④ Back to front page → pension section	
⑤ Old pension section. Not that one.	
⑥ In pension section → types of pension.	
⑦ Pension is also insurance section.	
⑧ Back to front page + fam + children → Divorce → family + pension → divorce + pension	
⑨ Section on sidebar — Lawgiving →	looked around for a while
⑩ Pension law link	
⑪ Search for marriage, pension legd →	Result #3 - divorce + pension. Same page as above - link in left to insurance, pension, divorce ↓ Takes you outside of Borger.dk →Wants to go to Google + look

Continued, over ⇒

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Task 3

(12) Been linked out of Borger+NemID.

→ Been taken out to 3 different external sites.
- Frustrated at this point.
"How hard would it be for someone with low vision?"

(13) Went into text and started reading since its not put logically in the links, to find different keywords to look for.

→ Gives no idea where to look for it on the site.

(14) Back to page w/ the one law we found

→ Ch 11 + Ch 11 don't have anything to do with spousal pension.

(15) Under law for extra pension. Doing CTRL-F for "divorce" and looking. One result.

→ Not in there, going back.

(16) Chapter 3, section 11 about retaining spousal pension after death

Annual Statement

TASK 4: Fill out a ~~tax return~~ form on your Borger.dk.

Steps Taken	Noted Difficulties
① Back to front page, choice "economy + tax"	Comment: Would prefer to use Skat.dk
② On right column, "My Page" section there is a direct link to Annual Statement	Customized based on NemID
③ Went to "My Site" Accept cookies from Borger.dk, economy link, clicked it.	Took to skat.dk
④ Back to front page, tax → tecm → tax → statement → annual statement	Click so many times on Borger.dk - More verbose/informative, but too much for a regular user - "Going to skat is much easier"

Would use Borger to look up benefits, etc. Borger is more informative, where SKAT would be more "legal" → Borger language is more simple.

TASK 5: Use Digital post to compose a note to your doctor. DO NOT sent this note.

Steps Taken	Noted Difficulties
① Doctor is online so can go through min-læge.dk	Can find prescriptions, contact doctor, etc. through their site. ↳ Uses CPR #, not NemID. Confirm email needs login.
② Back on Borger.dk front page	
③ Health + Illness → Medicine. No, back to prev. → Med. Ins. + choice of doctors	
④ Post tab	
⑤ Log in with NemID	→ Another "Accept Cookies" box
⑥ Get into eBox.	→ No Digital Post yet
⑦ Go into health	→ Doctor, site, phone #, but no direct link.

Appendix H: Focus Group Scanned Documents

The following pages are scanned raw data notes from the focus groups. They do not contain any identifying information about the subjects of the interview; they are provided for the reader's reference.

Focus Group:

Introduction: We are a group of students from Worcester Polytechnic Institute in Massachusetts. We are here working in conjunction with the Danish Association for the Blind to evaluate the accessibility of Denmark's new eGovernment portal, Borger.DK. We strongly believe with your help we can improve the accessibility of Borger.DK, and ensure that future eGovernment sites are accessible for everyone.

Your participation in this focus group is completely voluntary and you may withdraw at any time. Please note that any information you give us may be quoted but your name and identity will be completely confidential. No names or identifying information will appear in any of the project reports or publication. We would like to record this interview to use only for our reference in writing this report. Your participation is greatly appreciated. If interested, a copy of our results can be provided at the conclusion of our study.

Questions:

1. Did you find it simple or difficult to use Borger.DK?
   - Screen reader form difficult to find & be nice if it was a heading on the site." Complex layout.

   a. Can you describe these difficulties?
      - No clear sitemap.
      - Inconsistent, sometimes asks for city, sometimes not.

   b. On a scale of 1-5, where 1 is simple with no difficulties, 2 is simple with few difficulties, 3 is ok with more difficulties, 4 is difficult with many difficulties and 5 is impossible, can you describe your difficulties with Borger.DK?
      - 3/4, depending on what you're searching for.
      - 3 if just searching the site
      - For Fax, normally just go to SKAT site.

   c. Would you say you experienced any frustrations when using Borger.dk?
      2/3/4 No, not frustrated
      1/3 - Very frustrated (between 3 and 4)

d. On a scale of 1-5, where 1 is "you are relaxed", 2 is "you are annoyed", 3 is "you are getting agitated", 4 is "you are frustrated", 5 is "you no longer want to use it" what is your level of frustration when using borger.dk?

- One person says ~~about~~ 4
- Other 2 people, around 3 (b/w1-3) based on what section of the site you are working with.

e. What, if any, parts of Borger.dk do you prefer to access online?

~~The whole~~
- If everything is accessible from Borger.dk, that's fine as long as you can access everything.

2. Which task did you find the most difficult?

- Borger.dk can be difficult to use for all people, regardless of disability. Especially hard for blind people.
- One not necessarily more difficult than the other, more a question of ~~access~~ thinking differently.

a. What were the difficulties?

b. How could they be fixed?

- Good to have a lot of headings. When you search, it says some good lvl 1+2 headings.

Overall, not bad accessibility on Borger.dk compared to some websites like Net Doc.dk.

- In search function, 2-3 lines that don't need to be there before the results. Came up as a <H2>.

- Organization (non-search) very confusing to find things.

3. What task did you find the easiest?

_____
_____
_____
_____
_____

Skip

   a. Were there any issues?

   _____
   _____
   _____
   _____

4. What effect, positive or negative, do you feel Borger.dk will have on people in the community?

+ Ok for the people we are aiming

- Many elderly people who may not be able to cope w/ it.
  ↳ May require assistance.

- People who are mentally less able will also require help.
  ↳ Society need to ensure that these people will get the help they need.

- Need for personal contact when people apply for assistive tech - can't describe these things on paper, must have a person who sees how these affect their daily lives.

Focus Group:

Introduction: We are a group of students from Worcester Polytechnic Institute in Massachusetts. We are here working in conjunction with the Danish Association for the Blind to evaluate the accessibility of Denmark's new eGovernment portal, Borger.DK. We strongly believe with your help we can improve the accessibility of Borger.DK, and ensure that future eGovernment sites are accessible for everyone.

Your participation in this focus group is completely voluntary and you may withdraw at any time. Please note that any information you give us may be quoted but your name and identity will be completely confidential. No names or identifying information will appear in any of the project reports or publication. We would like to record this interview to use only for our reference in writing this report. Your participation is greatly appreciated. If interested, a copy of our results can be provided at the conclusion of our study.

Questions:

1. Did you find it simple or difficult to use Borger.DK?

   Difficult to use search function. Headlines didn't give advice. Lots of space on generic stuff – not consistent w/ headings. Were searching for specific things – not compatible w/ headings. Drop-down boxes.

   a. Can you describe these difficulties?

   Drop-down Box didn't work early in Alphabete. Auto-submission thing – stupid to choose municipality – should all be the same form. Better – Job finding ⇒ lot of forms

   b. On a scale of 1-5, where 1 is simple with no difficulties, 2 is simple with few difficulties, 3 is ok with more difficulties, 4 is difficult with many difficulties and 5 is impossible, can you describe your difficulties with Borger.DK?

   – 3 (3 of them) 4 (1 of them)
   – Ability to navigate site increases as you use it.
   – Same difficulties w/ any new Website.
   – Still general non-user friendly things – glitches, etc. which are not accessible.
   – If you don't use search, layout is illogical. (sitemap not good)
   – Also, <H1> misused for services, not headings.

   c. Would you say you experienced any frustrations when using Borger.dk?

   Yes

d. On a scale of 1-5, where 1 is "you are relaxed", 2 is "you are annoyed", 3 is "you are getting agitated", 4 is "you are frustrated", 5 is "you no longer want to use it" what is your level of frustration when using borger.dk?

2/3 - More difficult than expected
3/4 - didn't get what you wanted.
ie: Can't log on (Nemid), etc. Didn't get anything done.
- Application form not there, no good explanation.

e. What, if any, parts of Borger.dk do you prefer to access online?

- Should move more things onto Borger - hospital, etc.
- Has to be accessible, user friendly.
- Dangerous to put too many things in one place.
(ie:: Crowded search results w/non-relevant hits.

- For user friendly site w/ everything - can learn 1 site well + have it all be accessible + user friendly.
- Have it for other NGOs, etc.

2. Which task did you find the most difficult?

- Logging on.

- Searching using the sitemap (for the law article)

a. What were the difficulties?

Found summary of law, but was not able to find a link to the actual law.

b. How could they be fixed?

- Use of <H1>
- Have to conform to WCAG-AA (not AAA, unmanageable)
- Maybe use shortcut keys, though they may interfere w/JAWS browser
- Should have stuff working. When error, not clear what is wrong. Generic error messages - no reason or how to fix.
- Say "not available right now, but go to ⎯ to find more info"

⟶ they do not

— Form info should be autofilled based on NemID, which you are already logged in with. Then, they will always get app. to the right person.

3. What task did you find the easiest?

_____
_____
_____
_____
_____

Skip

   a. Were there any issues?

_____
_____
_____
_____

4. What effect, positive or negative, do you feel Borger.dk will have on people in the community?

+ Will make people stop printing — more green
+ Should be easy for everyone to use or it will not be used.
+ Good to fill out things by yourself. (Many PDF docs. Inaccessible)

_____
_____
_____
_____
_____
_____

Conclusion: Thank you for your participation. Your identity will be kept completely confidential. If you are interested, again, a copy of our results can be provided at the end of our study. Our e-mail address is dk12access@wpi.edu if you would like to contact us about anything.

- PDF - can make accessible, but always different glitches now
   - To read, not a problem
     to fill out, difficult.

          → Convert PDF to web forms
- 2 or 3 companies in DK delivering IT to govt. Many of their products are not accessible. Difficult to blame webmasters because they don't do it. It's the software they use. For accessibility, would have to do by hand.
   - Not required by law, so who would pay?