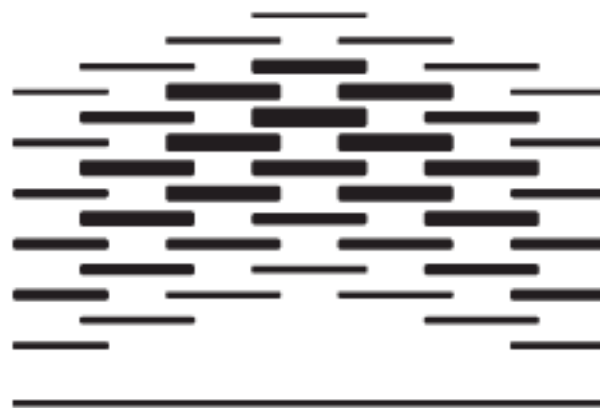


**Master Thesis**  
**In**  
**Universal Design of ICT**  
**2016**

Finding an optimal method for conducting accessibility evaluations of the  
Norwegian Tax Administration Website

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# Preface

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The purpose of this master thesis report is to document a 60p master project on how to ensure accessibility of a webpage by testing. The project was proposed by the Norwegian Tax Administration that was in need of a testing manual they could use for future testing of their website. Further, they wanted to get some insight into what challenges users of screen readers face when they interact with the webpage. Five users of screen readers participated in a user test. Instead of only testing with users and recommending an automated accessibility evaluation tool, based on literature, five tools were evaluated and a manual inspection of the pages was conducted too. Testing for web accessibility is challenging for many developers and testers. The product of this project is an accessibility-testing manual that aimed at meeting these challenges and easing the process of ensuring accessible websites.

There are several people have to thank for helping me complete this project. I would like to thank my supervisor, Wondwossen Beyene, for your marvellous insights on how to properly define a research, and to structure it so that the reader will get a clear understanding of the contents and results. I also want to thank the participants who so kindly let me observe how they used the websites, giving me a foundation for the research. Further, I also would like to thank Cathrine Strand Yttervik and Laura Arlov for initiating the project and for meeting with me and discussing the progress of the project during it. Lastly, I also need to thank Siri Kessel who evaluated the literature review and gave her expert remarks on it.

Benedicte Paulsen Hess  
Master student

## Summary

This research was done in collaboration with the Norwegian Tax Administration who had concluded that they were in need of an accessibility-testing manual that they could use for ensuring accessible contents in their website. During this research an accessibility-testing manual has been developed, the intention for this manual is that it can be utilized by usability experts, testers and developers so that they can be assured that their web contents are accessible. This was done by studying literature about issues regarding accessibility testing, web accessibility and suggestions for solutions. All solutions were included in the final document. Literature about screen readers and automated accessibility evaluation tools was also investigated. No automated accessibility evaluation tool could be recommended solely based on the literature review. Therefore, an evaluation of five potential evaluation tools was conducted; two of these were suggested as supplementary evaluation tools, which testers might utilise, in the final testing manual. The purpose of this research was to find out common challenges and problems faced by users of screen readers when interacting with the website that was investigated. Based on the results some suggestions could be provided, as to how accessibility testing may be conducted in the future. A limitation of the scope was that not all accessibility evaluation methods were included in the analysis of the page. Three of the most common methods for accessibility testing were included.

A qualitative research method was selected for the research. This consisted of user testing with users of screen readers followed by a short interview, evaluation of automated accessibility evaluation tools, and a heuristic evaluation. The participants were given the same tasks that required interaction with several pages and forms. All three methods were used to test one common webpage; the results were compared in a table. The results indicated that the methods could be combined. No method found all accessibility issues; the accessibility-testing manual includes common issues that were easy to find manually that testers might check for themselves, suggestion for use of automated accessibility evaluation tools, and planning in addition to conducting a user test with people with disabilities. The accessibility-testing manual presented to the Norwegian Tax Administration is this research's most important contribution to the field of web accessibility research; it indicates that several accessibility evaluation methods should be mixed for optimizing accessibility testing, there are rooms room for improvements in the field of web accessibility testing.

# Table of contents

<b>1</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	CONTEXT .....	1
1.2	PURPOSE OF THE STUDY .....	2
1.3	RESEARCH PROBLEM AND RESEARCH QUESTIONS .....	2
1.4	OBJECTIVES AND EXPECTED OUTCOMES.....	2
1.5	OUTLINE OF THE MASTER THESIS .....	3
1.6	RESEARCH AREA .....	4
1.7	TAX ADMINISTRATION SERVICES .....	5
1.8	ONLINE SERVICES .....	5
1.8.1	<i>Web pages.....</i>	<i>6</i>
1.8.2	<i>Forms.....</i>	<i>10</i>
1.9	UNIVERSAL DESIGN REQUIREMENTS .....	14
1.10	PROBLEM STATEMENT .....	15
1.10.1	<i>Disability .....</i>	<i>16</i>
1.10.2	<i>Taxpayers with visual impairment.....</i>	<i>16</i>
1.10.3	<i>Tax Administration awareness of the issue .....</i>	<i>17</i>
<b>2</b>	<b>LITERATURE REVIEW .....</b>	<b>19</b>
2.1	WEB ACCESSIBILITY .....	19
2.2	ACCESSIBILITY OF FORMS.....	21
2.3	AUTOMATED ACCESSIBILITY TESTING.....	24
2.4	SCREEN READERS .....	27
2.5	ACCESSIBILITY TESTING.....	33
2.5.1	<i>Including Web Accessibility at an early stage .....</i>	<i>38</i>
<b>3</b>	<b>RESEARCH METHODOLOGY .....</b>	<b>41</b>
3.1	APPROPRIATENESS OF THE RESEARCH DESIGN.....	41
3.1.1	<i>Qualitative research method.....</i>	<i>41</i>
3.1.2	<i>Participant Observation .....</i>	<i>42</i>
3.1.3	<i>Mixed qualitative research methods.....</i>	<i>43</i>
3.1.4	<i>Heuristic evaluation.....</i>	<i>43</i>
3.1.1	<i>Evaluation with automated accessibility evaluation tools.....</i>	<i>44</i>
3.2	PARTICIPANTS AND SETTING.....	45
3.2.1	<i>Obtaining the Study Sample.....</i>	<i>46</i>
3.3	PROCEDURE .....	46
3.4	INSTRUMENTATION .....	48
3.5	DATA PROCESSING AND ANALYSIS .....	49
3.6	ETHICAL CONSIDERATIONS AND BIAS .....	52
3.6.1	<i>Ethical considerations .....</i>	<i>52</i>
3.6.2	<i>Potential Biases .....</i>	<i>53</i>
3.7	SUMMARY .....	54
<b>4</b>	<b>FINDINGS.....</b>	<b>55</b>
4.1	SELECTION OF PAGES AND FORMS .....	55
4.1.1	<i>pages and forms.....</i>	<i>55</i>
4.2	USER TESTING .....	57
4.2.1	<i>Participants .....</i>	<i>57</i>

4.2.2	<i>Tasks given to respondents</i>	58
4.2.3	<i>Results</i>	62
4.3	HEURISTIC EVALUATION	65
4.3.1	<i>Selection of Pages</i>	65
4.3.2	<i>Selection of Guides</i>	65
4.3.3	<i>Results</i>	67
4.4	AUTOMATED TESTING TOOLS	75
4.4.1	<i>Selection of tools</i>	75
4.4.1	<i>Results</i>	77
<b>5</b>	<b>DISCUSSION</b>	<b>91</b>
5.1	RESEARCH QUESTION R0	91
5.2	RESEARCH QUESTION R1	95
5.3	FORMULATING ACCESSIBILITY TESTING-MANUAL	101
<b>6</b>	<b>CONCLUSION</b>	<b>103</b>
6.1	SUGGESTIONS FOR FUTURE RESEARCH	103
<b>7</b>	<b>REFERENCES</b>	<b>105</b>
<b>8</b>	<b>APPENDICES</b>	<b>110</b>
8.1	APPENDIX 1	110
8.2	APPENDIX 2	113
8.3	APPENDIX 3	128

## List of figures

Figure 1 Front page of the Norwegian Tax Administration website .....	7
Figure 2 Hierarchical path to travel deduction calculator .....	8
Figure 3 Special allowance for disability page .....	9
Figure 4 Tax rules for pensioners.....	10
Figure 5 Table that provides the estimate tax.....	11
Figure 6 Application for tax deduction card for foreign citizen's form .....	13
Figure 7 New form for amend tax deduction card/advance tax .....	14
Figure 8 Example from ELMER 2, form input field presents an error.....	23
Figure 9 Picture of VoiceOver Software.....	29
Figure 10 Fundamental test process, Gordón & Moreno (2014) .....	36
Figure 11 Shows that most usability problems can be found with five participants, Proportion of usability problems, Jacob Nielsen, nngroup .....	46
Figure 12 interpreting the results presented by SortSite using a Mind Map .....	51
Figure 13 Travel Deduction Calculator .....	56
Figure 14 Table-based deductions for tax deduction cards 2016 .....	57
Figure 15 Snapshot from the user test .....	60
Figure 16 Web content accessibility guidelines Table of Contents .....	66
Figure 17 Guideline 1.4 with its belonging success criteria.....	67
Figure 18 Days per year input field missing label element.....	69
Figure 19 <i>Table based deductions</i> in high contrast .....	70
Figure 20 <i>Table based deductions</i> with <i>Colour that site</i> plug-in .....	71
Figure 21 <i>Special allowance for disability</i> with changed colours .....	72
Figure 22 Shows the <select> list box needs label .....	73
Figure 23 Evaluation Results from WAVE .....	78
Figure 24 Evaluation results presented by AccessMonitor .....	80
Figure 25 Description of accessibility issues presented by AccessMonitor .....	81
Figure 26 MAUVE's user interface .....	82
Figure 27 Evaluation Results presented by MAUVE .....	83
Figure 28 Evaluation Results presented by SortSite .....	86
Figure 29 Validation Results presented by AChecker .....	89
Figure 30 Accessibility issues presented by AChecker.....	90
Figure 31 Shows all Success Criteria identified in the heuristic evaluation .....	96

## List of Tables

<b>Table 1</b> The participants .....	58
<b>Table 2</b> Participants' challenges and barriers when interacting with the pages and forms ...	91
<b>Table 3</b> Answers to questionnaire .....	93
<b>Table 4</b> Barriers sorted by Screen Reader .....	94
<b>Table 5</b> Presentation of issues found by the tools when analysing the travel deduction calculator.....	96
<b>Table 7</b> Problems detected in Travel Deduction Calculator webpage .....	97
<b>Table 8</b> Issues detected in Travel Deduction Calculator Form .....	98
<b>Table 9</b> Number of problems detected in travel deduction calculator form .....	99



# 1 Introduction

The Norwegian Tax Administration provides a website that contains extensive amounts of important information and services. This chapter presents these services in addition to the context of the project, the purpose, the outcomes, and the outline of the research project. In addition to this, the two research questions that were developed for this thesis will be presented. Next, the context of the research is presented.

## 1.1 Context

Several laws have been passed with the goal of making information and communication technology accessible for all people. The United States has the *U. S. Section 508 of the Rehabilitation Act*, in Europe *EU Mandate 376 ETSI Technical report* has been created, there are also other laws that have been developed with the aim of ensuring universal design of information and communication technology. The World Wide Web Consortium offers a set of guidelines, also referred to as WCAG 2.0; these guidelines must be fulfilled in order for a webpage to comply with the Norwegian anti-discrimination law. As of today, one can utilize several automated software tools in the process of testing whether a website complies with the given accessibility criteria. It is necessary that information systems can be useful and present usability for their users, because this will enhance new forms of participation and influence from the people in public policies, which again will change the very structure of the political organization of society (Guimarães, Silva, Antunes & Formighieri, 2014)

The Norwegian Tax Administration has determined that it is in need of a systematic approach to test for accessibility of their website, which is very large and aims at reaching as many of their users as possible. Because of this, they seek more insights into how users of assistive technologies interact with their pages, for the purpose of this research particularly those who use screen readers. Furthermore, because of the demands of the anti discrimination act, which requires that all public web pages fulfil the level AA of the WCAG 2.0, they needed some protocol for the process of testing the pages to ensure that they are universally designed in the future. As of today there is documentation to support the fact that government agencies, at all levels, have problems ensuring that government websites follow laws related to web accessibility for people with disabilities (Lazar et al., 2010). By

supplementing their already existing testing procedures with a new manual for accessibility testing, the Norwegian Tax Administration hopes to establish the proper framework for ensuring that all of its contents are accessible for users who needs screen readers to access the website.

This thesis starts by illustrating the services provided by the Norwegian Tax Administration to create a picture for the reader about the size and nature of the pages. The literature review was the foundation for how to proceed with solving the research problem. The qualitative methodology that was chosen provided results that are located in the results section and the final analysis of the data is located in the discussion of this document.

## **1.2 Purpose of the study**

The purpose of this research was to understand what challenges users of screen readers face when they interact with the Tax Administration website, and based on the findings and the procedures followed to conduct the research, recommend testing protocols the Norwegian Tax Administration could follow for ensuring accessibility of its web-based services.

## **1.3 Research Problem and Research Questions**

Through this research, an optimal procedure for conducting accessibility testing of the Tax Administration environment was acknowledged. The results from this study were based upon the analysis of the observations of users of screen readers, heuristic evaluations, manual evaluation and a study of relevant and recent research. To meet the requirements of this problem the following two research questions will be answered:

*R0: What problems do the users of screen readers face when they interact with the Norwegian Tax Administrations pages and forms?*

*R1: How should the Norwegian tax Administration formulate a testing protocol that combines automated testing tools, manual inspection and user testing to ensure accessible pages and forms on its sites?*

## **1.4 Objectives and expected outcomes**

As of today, the Norwegian Tax Administrations ICT division is good at ensuring usability of the website. As accessibility has become a requirement by law, they have concluded that they are in need of information about accessibility in relation to their pages. This thesis will provide insight to the Tax Administration about ensuring accessible pages. The results about how users of screen readers interact with their pages, manual accessibility evaluations and evaluations by using tools, will be used to draw some conclusions about how they should test and evaluate their website in the future for enabling an effective way of ensuring accessible contents.

## **1.5 Outline of the Master Thesis**

This chapter will provide an explanation of how the thesis is organized.

### **Chapter 1 Introduction**

The first chapter introduces the research, the research questions, and the research context and background information about services provided by the Norwegian Tax Administration

### **Chapter 2 Literature review**

Chapter 2 presents the literature review, this consists these five topics: Accessibility of websites, accessibility of forms, automated accessibility testing, screen readers and accessibility testing.

### **Chapter 3 Research Methodology**

Chapter 3 describe the methodologies used for this research.

### **Chapter 4 Findings**

Chapter 4 presents the findings of the research.

### **Chapter 5 Discussion**

Chapter 5 presents the data, including the main trends of the results and a discussion of the findings as a basis for recommendations, suggestions for future research and conclusions.

### **Chapter 6 Conclusions**

Chapter 6 chapter presents the final conclusion of this research and suggestions for future research.

## 1.6 Research area

The Norwegian Tax Administration offers its services through an online webpage to the Norwegian people. Their mission is to ensure the funding of the Norwegian society by providing the services that collect taxes from citizens and businesses to fund national infrastructure, education, health and defence, among other services, among other services. The Tax administrations website offers tax cards, helps citizens to check or submit a tax return and to perform other tasks that relates to taxation as a citizen, employee or employer, these services are offered through their website<sup>1</sup>. In Norway, all public and large private establishments have to offer websites that are universally designed<sup>2</sup>. Difi (Agency for Public Management and eGovernment) defines Universal Design as “designing, or accommodating, the main solution with regards to physical conditions, so that the solution may be used by as many people as possible, regardless of disability.” All websites that are created after 1st July 2014 must meet the standards of universal design. If the solution already existed before 1<sup>st</sup> July 2014, then it must meet the standard by 1<sup>st</sup> July 2021.

To ensure universal design of ICT the Anti Discrimination and Accessibility Act has decided that websites has to fulfil level AA of the Web Content Accessibility Guidelines (WCAG 2.0), which are provided by the World Wide Web Consortium. The Norwegian Tax Administration provides many online services which have to comply with these guidelines, this for enabling as many people as possible to interact with the page. This research is based on the expressed need of the Tax Administration for a testing protocol they can follow to ensure accessibility of their webpage for all of their users including those who use screen readers. This research approached the problem by exploring the problems screen reader users might face when utilizing different services provided by the Tax Administration, in a bid to recommend a good testing procedure the Tax Administration may consider adopting. Furthermore, the Tax Administration were also interested in finding out what the most commonly used screen readers were among their users. For the investigation a group of people, all users of screen readers, were observed in order to provide information about challenges, which may occur when people dependent on this assistive technology interact

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<sup>1</sup> [www.skatteetaeten.no](http://www.skatteetaeten.no)

<sup>2</sup> <https://uu.difi.no/krav-og-regelverk/kva-seier-forskrifta>

with the Tax Administration website. Since the Norwegian Tax Administration also wondered which forms and pages needed to be more accessible, this research identified different layout types within the pages, and investigated if the different styles of the forms and pages could represent different accessibility issues for the users. The Tax Administration also requested information on any automated accessibility evaluation tools that they could utilize when testing their pages for accessibility. Therefore, an evaluation of such tools had to be conducted. The tools to be evaluated were identified by reviewing research articles regarding the subject. Next, the services that are provided by the Norwegian Tax Administration will be discussed more in detail.

## **1.7 Tax Administration Services**

The Norwegian Tax Administration is responsible for making sure that tax and fees are properly paid. The Tax Administration is divided into five regions; the headquarter is the Tax Directorate. The Tax Directorate is divided into the following divisions: The Tax Administration Shared Services Agency, Director General's Staff, Regional Department, IT-, Facility, and Administrative development and services and Legal Department. In every region, there are several offices, which are called Tax Offices to the users. In each of these offices, they offer support to taxpayers, for example answering questions to their users. The services that are provided through their website will be presented next.

## **1.8 Online Services**

The Norwegian Tax Administration provides its users with many different services through its website. These services are all strategically incorporated into a design that is clean and consistent. The main menu, which is always visible in the banner of the page, presents the user with four options: Person, Business/Organisation, Advisor, and About the Tax Administration. For this research, the services and forms located under the *person* will be in focus. The person option is also viewed as the main page of the Tax Administrations website ([www.skatteetaten.no](http://www.skatteetaten.no)). The users can select six menu options from under the person option. These are Tax deduction card and advanced tax, tax return, tax assessment, national registry, stocks and value papers and dealing above-board. If the user chooses the first option called "Tax deduction card and advances tax," another twelve menu options appear. Among these are Order a tax deduction card, amend tax deduction card/advance tax, view

information about your tax deduction card, see who obtained your tax deduction card and calculate your tax. If the user continues to click, he/she will be provided with more options, and there are several other alternatives provided under the previous categories that were not selected, this illustrates the proportions of the website, that are very extensive. The Norwegian Tax Administrations webpage is public so it has to comply with the web content accessibility guidelines, which aims at ensuring an inclusive design of websites. This means that the webpage must have a design that is inclusive so that it does not discriminate against anybody.

Altinn is a public web portal for public reporting initiated by the Norwegian Tax Administration, Statistics Norway, and the Brønnøysund Register Centre. This service was created to be a service for providing a common web portal for public reporting in Norway. This portal has been given other tasks as well over the years, and the most used service of Altinn is the one that enables users to hand in tax-return forms electronically. The Tax Administration webpage does not host all the services of taxation; users will often have to log into Altinn for retrieving forms that are to be used when e.g. ordering a tax deduction card. In this document only forms and pages that are provided directly through the Tax Administration environment will be investigated and not those that are hosted through the Altinn portal. Next, the webpage provided by the Norwegian Tax Administration is described more in detail.

### **1.8.1 Web pages**

Overall, the website consists of many different pages whereas some contains forms, as previously mentioned, the main menu contains four options: Person, Business and Organization, Advisor, and About. The front page is equivalent with the *Person* option in the main menu. From here, there are several options where the users can navigate to all topics that relate to those of individuals. Figure 1 shows the options that are displayed when the user enters the main page.

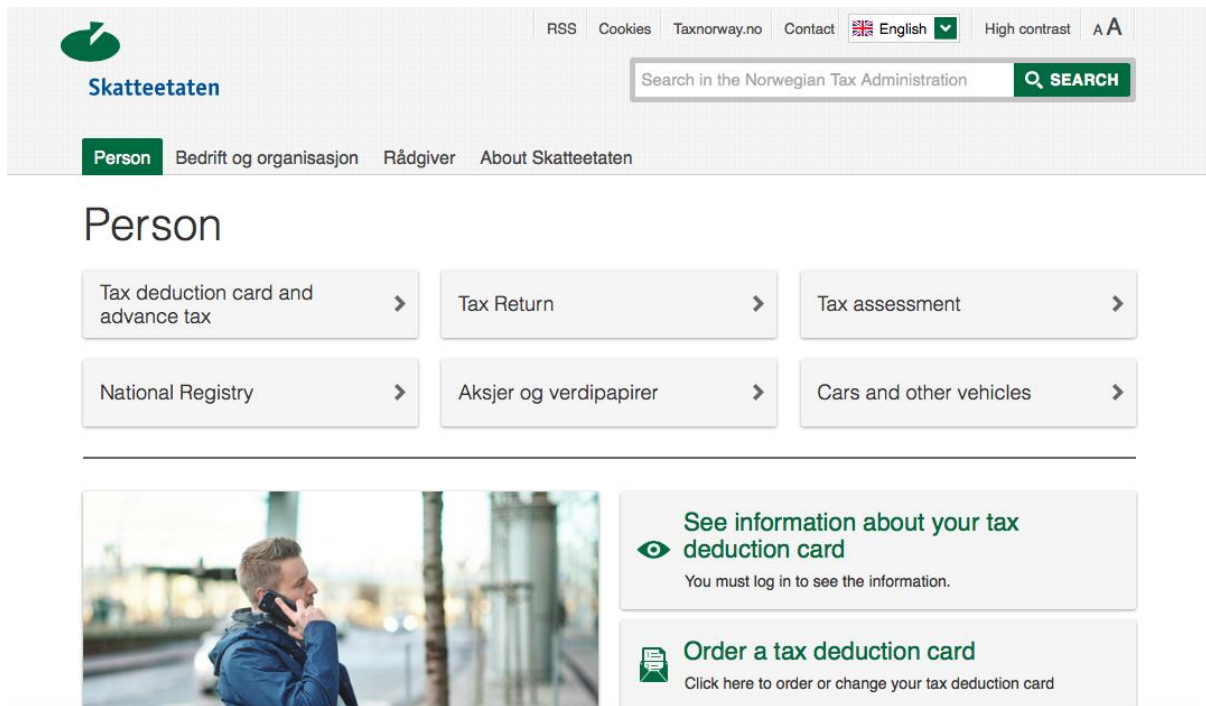


Figure 1 Front page of the Norwegian Tax Administration website

In figure 2, the hierarchical path to the page called “Travel Deduction for travel between home and work” is exhibited, where the upper left image is the start, upper right second, lower right is the third and lower right is the final page. The users will have to click four times, in addition to entering the calculator, to get to his/her destination. All pages provide users with additional options they also can visit. Several of these options will further provide the user with more menu options. It is hereby safe to say that the Tax Administration webpage is large and contains many different sites and services. As we can see by viewing the pages in figure 2, the Tax Administration pages are consistent, meaning that the layout stays the same when navigating from page to page. In addition, the page is always presented with the banner, footer, and margin at the same place and containing the same information. Not all of the individual pages provided by this website will be presented in this document. However, in addition to images of the main page and the pages directing to the travel deduction calculator, a few single pages and services will be presented here.

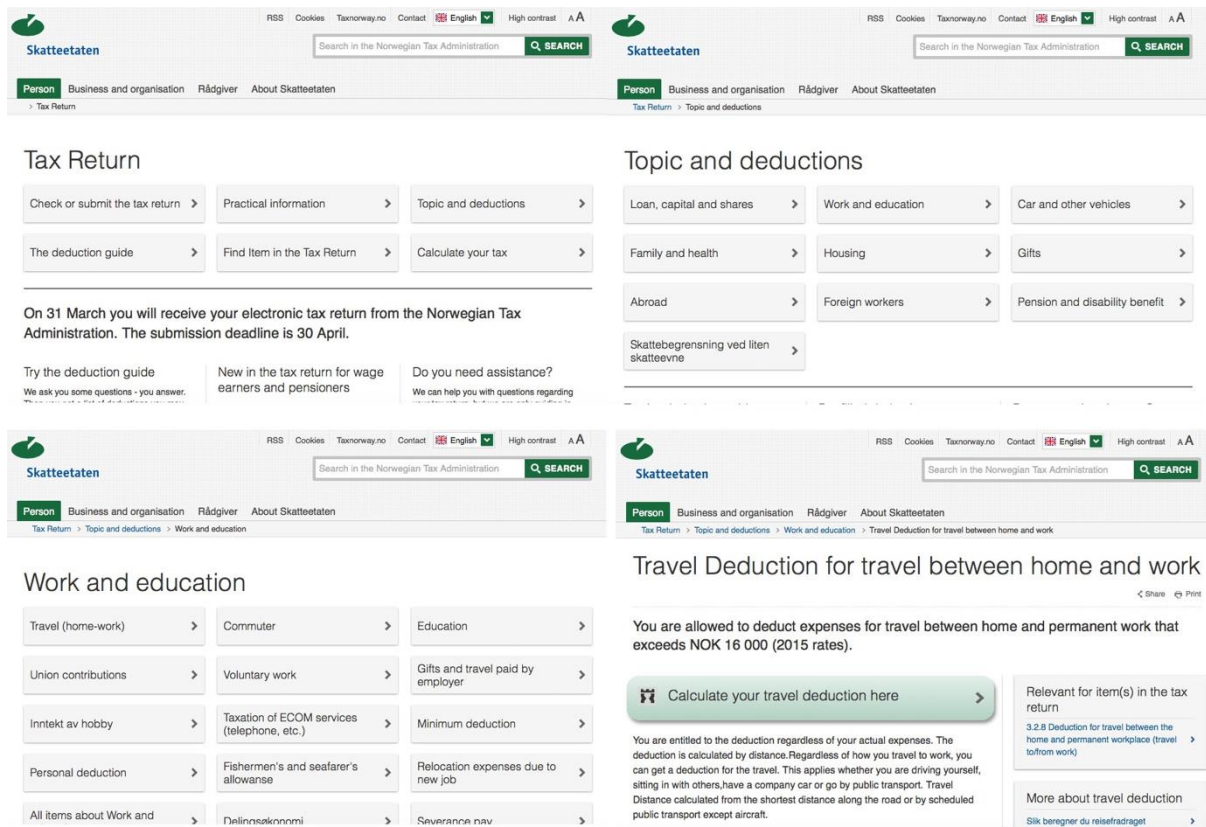


Figure 2 Hierarchical path to travel deduction calculator

When navigating to the menu called “Pension and disability benefit” that features the services relating to this topic, there is one option in the menu called “Special allowance for disability”. This page offers the users with the rates of special allowance for the selected income year. The page shares its page layout with the majority of the pages in this website. The menu is a select menu that is displayed next to a submit button, retraining information from this page will not require much interaction with the page.



The screenshot shows the Skatteetaten website. At the top, there is a navigation bar with links for RSS, Cookies, Taxnorway.no, Contact, and a language dropdown set to English. A search bar is located in the top right corner. Below the navigation bar, there are links for Person, Business and organisation, Rådgiver, and About Skatteetaten. The main heading is 'Special allowance for disability'. A notice states: 'The rules concerning the special allowance for disability have been abolished with effect from 2015.' Below this, there is a section titled 'The rate applies for the income year 2016' with a question mark icon. It says 'If you need rates for the tax return, you must check the rates for 2015'. There is a 'Select year' dropdown menu currently set to '2016' and a green 'SHOW' button. To the right, there is a box titled 'Relevant for item(s) in the tax return' with a link to '3.5.1 Special allowance for disability - transitional rule'. Below that, there is a box titled 'Try the deduction guide' with the text 'We ask you some questions - you answer. Then you get a list of deductions you may'.

Figure 3 Special allowance for disability page

All Norwegian citizens can be viewed as users of the services they provide. By this, their visitors may be users of a variety of assistive technologies. Another example of a page that offers a service to the users is the “tax rules for pensioners.” This page contains information about tax rules that apply to pensioners. This information will be of relevance to people who are elderly. Therefore, it is of utmost importance that information like this is accessible for elderly people. Barriers and challenges may easily occur because of the large amount of information offered by the Norwegian Tax Administration to such an extensive group of people. Senior citizens can often envision modern technologies as difficult to use, they often lack self-confidence and training when it comes to using these technologies. By applying the Web Content Accessibility Guidelines, a website will have made some precautions for enabling the seniors a better user experience.

The screenshot shows the top navigation bar of the Skatteetaten website. It includes the logo, a search bar with the text 'Search in the Norwegian Tax Administration', and links for RSS, Cookies, Taxnorway.no, Contact, English, High contrast, and A A. Below the navigation bar, there are tabs for 'Person', 'Business and organisation', 'Rådgiver', and 'About Skatteetaten'. A breadcrumb trail reads: 'Tax Return > Topic and deductions > Pension and disability benefit > Tax rules for pensioners'. The main heading is 'Tax rules for pensioners', with 'Share' and 'Print' options to the right. Below the heading, a paragraph states: 'Here you will find information about the tax rules that apply to pensioners.' A 'Contents' section follows, listing five items with blue arrows: 'Front page', 'Tax rules for pensioners', 'Old-age pensions and early-retirement pensions (AFP)', 'Tax allowances for recipients of old-age pensions from the National Insurance scheme or AFP', and 'Tax deductions for spouses and spouse-equivalent cohabitants'.

Figure 4 Tax rules for pensioners

Here, a few of the pages are presented. Paragraph 4.1.1 “Selection of pages and forms” describes the pages and forms that was included in this research and these are not presented here.

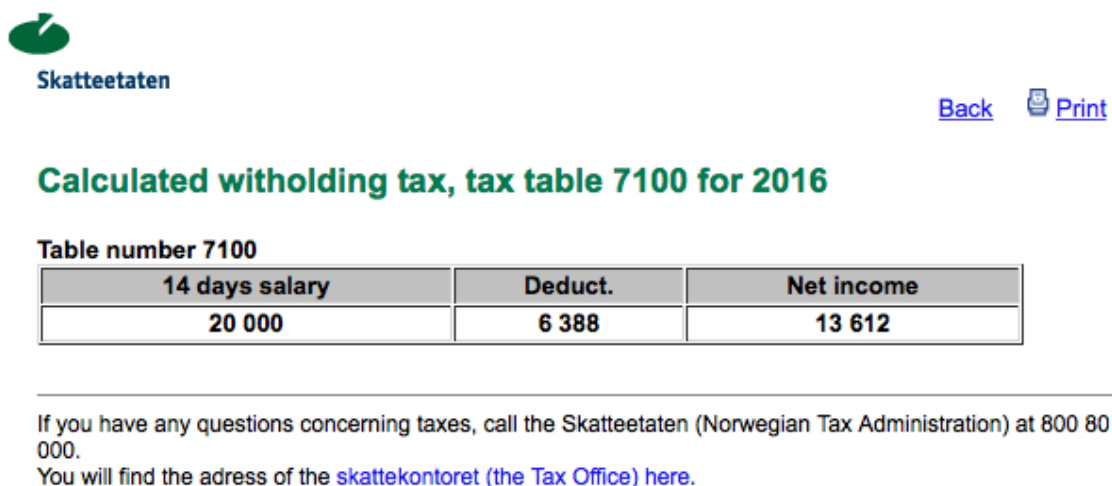
### 1.8.2 Forms

The Norwegian Tax Administrations aims at providing its information in an accessible manner for all of its audience. Some of its most frequently utilized forms are published through Altinn, e.g., forms for checking and submitting tax returns, ordering a tax deduction card, and checking of the tax assessment. The Tax Administration wishes that the forms hosted by its own pages were the ones to be investigated in this project. Forms can play an important part in communicating and providing information to and from the users. Much time and resources are spent on the process of developing forms; of course it is preferred that they manage to serve their purpose. If there is not an alternative to retraining the information provided by the form, users who may not be able to interact with it can become excluded from the service it provides. This causes a barrier for this individual. To avoid barriers like this it will be necessary that the forms are developed in a way that allows them to run smoothly also when utilized by people depending on assistive technologies. Given the

proportions of the website, many people will use it. When many people are utilizing a page it becomes more likely that also some of the users have disabilities.

In this research, a few of the forms provided by the Norwegian Tax Administration will be investigated. There are several layouts and techniques used for the different forms on the webpage. Therefore, different types of forms were included in this evaluation process. By including different types of forms in the research and further comparing the results from the evaluation of these, one will also see if the accessibility of different forms differs. Hopefully this will also contribute to identifying the most effective way to detect the accessibility issues that users may face when interacting with the online forms.

Figure 5 is a table that provides the user with some data. The user has to plot in table number, income type, and period, then the information will be presented.



The screenshot shows the Skatteetaten logo and navigation links. The main heading is "Calculated withholding tax, tax table 7100 for 2016". Below it is a table with three columns: "14 days salary", "Deduct.", and "Net income". The values are 20 000, 6 388, and 13 612 respectively. A footer note provides contact information for the Skatteetaten.

**Skatteetaten** [Back](#) [Print](#)

### Calculated withholding tax, tax table 7100 for 2016

**Table number 7100**

14 days salary	Deduct.	Net income
20 000	6 388	13 612

---

If you have any questions concerning taxes, call the Skatteetaten (Norwegian Tax Administration) at 800 80 000.  
You will find the adress of the [skattekontoret \(the Tax Office\) here](#).

Figure 5 Table that provides the estimate tax

The form that makes up the interface with which user interacts with for retraining these results is called *Table-based deductions*. *Table-based deductions* present the user with how much tax an employer must deduct. This form is described in paragraph 4.1.1 called "Selection of forms and pages." This form does not contain much client side scripting, in contradiction to several other forms provided by the Tax Administration. Having a form that is mostly HTML based, can perhaps compound different results when evaluated by users of assistive technologies like, e.g., screen readers. An example of a form that contains much

dynamic code is a form called “Travel deduction calculator”, this form is also presented thoroughly in paragraph 4.1.1.

“Application for tax deduction card for foreign citizens” is another form provided through the website. This form is in PDF and a Word document, which have to be downloaded by the user. After it is completed, it is supposed to be delivered to the local tax office. Forms that users have to download and then deliver can in many cases induce challenges, because the form is not accessible. There is often a lot of detailed information that is closely nested to each other, which can in some cases, be challenging assistive technologies to interpret. Presenting this information in such a way that all fields and radio buttons are perceivable also to users who have no vision requires punctuality and technique. If a form is universally

designed, then everybody should be able to use it; in this research, it was focused on the accessibility standards of WCAG 2.0 when discussing the forms.

**Skatteetaten**  
**Søknad om skattekort for utenlandske borgere mv.**  
**Application for tax deduction card for foreign citizens and others**  
 Opplysninger ved bruk for forskuddsuttirvingen/Information regarding the withholding tax  
**VENNLIGST BRUK BLOKKBOKSTAVER/PLEASE USE CAPITAL LETTERS**

Etternavn / Family name, first name: \_\_\_\_\_  
 Fødselsdato / Date of birth: Day: \_\_\_\_\_, Month: \_\_\_\_\_, Year: \_\_\_\_\_  
 Kjønn / Sex:  Mann / Male  Kvinne / Female

Adresse i Norge / Address in Norway: \_\_\_\_\_  
 Bostedsadresse i hjemlandet / Address in your country: \_\_\_\_\_  
 Adresse, gatenavn / Street and house number: \_\_\_\_\_  
 Postnr., poststed / Postal code and place: \_\_\_\_\_  
 Postnr. / Postal code: \_\_\_\_\_  
 Land / Country: \_\_\_\_\_  
 Telefon / Telephone: \_\_\_\_\_  
 E-postadresse / E-mail: \_\_\_\_\_

Sivilstand / Marital status:  Ugift / Unmarried  Gift / Married  Skilt / Divorced  Ektemann / Widower

Virke / Profession: \_\_\_\_\_  
 Statsborgerskap / Citizenship: \_\_\_\_\_

Arbeidsgiver i Norge / Employer in Norway - Navn og adresse / Name and address: \_\_\_\_\_  
 Første arbeidstid / First day of employment: \_\_\_\_\_

Oppholder du deg i Norge / Are you working offshore or an mainland?  Ja / Yes  Nei / No  
 Har du vært i Norge i løpet av de siste 26 månedene? / Have you been in Norway during the last 26 months?  Ja / Yes  Nei / No  
 Hvis ja, hvor mange dager? / If yes, how many days? \_\_\_\_\_

Arbeidsdato i Norge / Date of arrival to Norway: \_\_\_\_\_  
 Fødselsdato / Date of departure: \_\_\_\_\_  
 Når / When: \_\_\_\_\_

Har du tidligere arbeidet i Norge? / Have you previously been employed in Norway?  Ja / Yes  Nei / No  
 Tollgrens norsk personnummer / Previous Norwegian personal number: \_\_\_\_\_

Oppholdt du deg i Norge 1. Nov. i 2021 / Did you reside in Norway November 1st last year?  Ja / Yes  Nei / No  
 Hvis ja, oppgi kommune / If yes, in which municipality? \_\_\_\_\_  
 Hvor oppholder familien seg? / The address of the family: \_\_\_\_\_

Ektefelles navn / Spouse's name: \_\_\_\_\_  
 Fødselsdato / Date of birth: \_\_\_\_\_  
 Antall barn under 18 år / Number of children under 18 years of age: \_\_\_\_\_

Har ektefellen egen inntekt? / Does your spouse have income of her/his own?  Ja / Yes  Nei / No  
 Ektefelles forventede inntekt i år / Expected income of your spouse this year: NOK \_\_\_\_\_

Lønn i Norge 2021 i år / Wages/salaries in Norway so far this year: NOK \_\_\_\_\_  
 Forventet inntekt i år (brutto) / Expected income this year (gross): NOK \_\_\_\_\_  
 Uke / Week:  Måned / Month: \_\_\_\_\_  
 År / Year:  Samlet / Total: NOK \_\_\_\_\_

Betalt skatt i Norge 2021 i år / Amount of tax paid in Norway so far this year: NOK \_\_\_\_\_  
 Fradrag i inntekten / Deduction in income: NOK \_\_\_\_\_

Fr. bolig / Free house (Betalt av arbeidsgiver / Paid by employer):  Ja / Yes  Nei / No  Delvis / Partly  
 Fr. kost / Free board (Betalt av arbeidsgiver / Paid by employer):  Ja / Yes  Nei / No  Delvis / Partly  
 Fr. bil / Free car (Betalt av arbeidsgiver / Paid by employer):  Ja / Yes  Nei / No  Delvis / Partly

Spesifiser fradrag i inntekten / Specify deduction in income: \_\_\_\_\_

Sted / Place: \_\_\_\_\_  
 Dato / Date: \_\_\_\_\_  
 Underskrift / Signature: \_\_\_\_\_

Utenlandske statsborgere må møte på skattekontoret og legitimere seg før de kan få utskrevet skattekort.  
 - Utenlandske statsborgere må legge frem gyldig pass eller annet identifikasjonsdokument som er godkjent som reisepapir innen EU.  
 - For nordiske statsborgere er det tilstrekkelig å legge frem gyldig førerkort og en utskrift fra den enkelte stats folketegister som ikke er eldre enn tre måneder.  
 Foreign citizens must visit the tax office and identify themselves before they can get a tax deduction card.  
 - Foreign citizens must present a valid passport or any other identity document that is an approved travel pass within the EU.  
 - Nordic citizens only have to present a valid driving license and an extract from the National Population Register not older than three months.

**Rekvirering av D-nummer** (Født av til bruk for skatteetaten) / For Norwegian tax administration only

Rekvirert kommune: \_\_\_\_\_  
 D-nummer: \_\_\_\_\_

Dato: \_\_\_\_\_  
 Rekvirert: \_\_\_\_\_  
 Dato: \_\_\_\_\_  
 Etter fullmakt: \_\_\_\_\_

SP-12990E 09.13

Figure 6 Application for tax deduction card for foreign citizen's form

Amend tax deduction card/advance tax is another form that is similar to the “Application for tax deduction card for foreign citizens.” Here the users are, as with the other forms, presented with a PDF version and a Word version. As of today, they are developing a new service for amending tax deductions. It is ready in some counties, there the old form is replaced by this one; the old form is still utilized in some regions. The new service provided

can be viewed in figure 7. The requirements for universal design relative to these sites and services are discussed next.

The screenshot shows the Norwegian tax authority website (Skatteetaten) with the title "Ditt skattetrekk 2015". The page features a light blue header with navigation links: "ACTIV MELDINGSBOKS", "NORDMANN KAR", and "LOGG UT". Below the header is a green and white logo for Skatteetaten. The main content area is titled "Ditt skattetrekk 2015" and includes a lightbulb icon and a message: "Skatteetaten lanserer en ny tjeneste for endring av skattekort og forskuddstrekk. Du er blant de første til å ta i bruk tjenesten. Er det noe du ønsker å legge til som du ikke finner? [Gå til gammel løsning](#)".

The form is divided into three main sections: "Inntekt", "Fradrag", and "Formue og gjeld". Each section contains input fields for various tax-related values and a link to "ANDRE TYPER" (Other types).

Section	Field Name	Value
Inntekt	Lønnsinntekt	500 000
	Renter på bankinnskudd	1 000
Fradrag	Gjeldsrenter	20 000
	ANDRE TYPER FRADRAG	
Formue og gjeld	Bankinnskudd	100 000
	Likningsverdi primærbolig	225 000
	Gjeld	1 000 000

Below the form, there is a summary box with the following information:

Field Name	Value
Trekk på hovedlønn	35%
Trekk på annen lønn	35%
Totalt beregnet skatt i 2015	133 157 kr

Figure 7 New form for amend tax deduction card/advance tax

## 1.9 Universal Design Requirements

The need for accessible web solutions is becoming more critical because more and more services are provided through the web. Banks, postal- and tax services, to mention a few, offer their services through websites. When they switch from manual to electronic services, barriers can occur if people are not able to use the online solutions. The cause of these barriers can, for example, be different disabilities that make it impossible for the person to deploy some solutions, which can be caused by the website not enabling communication between the HTML and the assistive technology that the user is dependent on utilizing. These are the same problems as the ones that occur when people face challenges entering buildings and other designed solutions, which are not adapted to a broader audience.

As mentioned, many services are mainly available through websites. If these solutions are necessary for a person to be able to perform everyday tasks, which even might be required according to the law, the solution should be accessible for everybody. In Norway, the discrimination and accessibility act was passed in 2008 and took effect in 2009; through this act, people with any sort of disability are protected against discrimination. This act also specifies that the public should work actively to promote universal design within the organisation; this also goes for private occupations who intend to supply the public with their service. Physical areas should be universally designed, information and communication technology (ICT) is defined as a part of the physical circumstances. The ethical stand that calls for providing equal opportunities for all has for long ceased to be the main argument for ensuring web accessibility (Koutsabasis, Vlachogiannis & Darzentas, 2010). As Tim Berners-Lee famously has noted “The power of the web is in its universality. Access by everyone regardless of disability is an essential aspect” (WAI, sidebar). Next, the problem statement that was created for this research is presented.

## **1.10 Problem Statement**

The Norwegian Tax Administration website should be as accessible as possible to meet the demands of a wide-ranging audience. However, as per the information obtained from the organization, there is no concrete manual. In addition, they do not know how users with disabilities experience their sites. They would prefer having a testing manual that included an automated accessibility evaluation tool that they can use for testing. Further, they need to get some insight into what challenges users of screen readers face when they interact with the webpage.

To be able to investigate how users interact with these web pages, and define a way for the Tax Administration to test its pages in the future, a qualitative research was conducted. This consisted of user testing with users of screen readers followed by a short interview, evaluation of automated accessibility evaluation tools, and a heuristic evaluation. The data consisted of three parts: the results from the user test, the results of testing with the different automated accessibility evaluation tools, and the heuristic evaluation. By analysing the results from the user test, the Tax Administration could get insight into what problems the users of screen readers face when they interact with the web pages. By comparing the

results from the heuristic evaluation to those of the evaluation of the different automated accessibility evaluation tools, it became possible to know which – or if any – of the tools could be included in the Tax Administrations accessibility testing process. A final document was created; this was called “Accessibility-testing manual for The Norwegian Tax Administration.” The aim of testing web pages for accessibility is to create a design that is universal and can be utilized by people with disabilities. More about disabilities is presented next.

### **1.10.1 Disability**

Disability can be viewed as an umbrella term that includes impairments, activity limitations, and participation restrictions. The definition is wide and its meaning can differ from community to community. “Disability” can be understood as many different things and policy-makers must confront complex and often ill-defined problems (ICF, 2013). In Norway, the following definition<sup>3</sup> was utilised by the government in their documents for the disabled in the 1990s: “Disability is a failure to fulfil between the prerequisite of the individual and the environment’s demand for functioning in areas which are essential for establishing independence and social existing.” The government states that the developments of policies relative to the people who have disabilities are entangled with our understanding of what “disability” actually is and what problems it may cause the individual.

According to the World Health Organization, 15 percent of the population has a disability. There are several types of disabilities. One should, however be careful of categorizing disabilities, as there are people who may have combinations and the disabilities may vary. Types of disabilities are visual impairments, physical impairments, hearing impairments, chronic illnesses, memory loss, autism, specific learning disabilities (dyslexia, dysphasia...), speech impairment (disorders of language, articulation, fluency...), intellectual disability, and other impairments (CODI, 2016). Visual impairment among Norwegian taxpayers is presented next.

### **1.10.2 Taxpayers with visual impairment**

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<sup>3</sup> [https://www.regjeringen.no/no/dokument/dep/asd/stmeld/19961997/st-meld-nr-34\\_1996-97/2/id191144/](https://www.regjeringen.no/no/dokument/dep/asd/stmeld/19961997/st-meld-nr-34_1996-97/2/id191144/)



Worldwide, 285 million people are estimated to be visually impaired, out of these, 39 million are blind and 246 have low vision (WHO, 2014). There are four levels of visual function, according to the International Classification of Diseases: normal vision, moderate visual impairment, severe visual impairment, and blindness. In Norway, it is estimated that there are approximately 4,000 people who are totally blind and ca. 10,000 people who are visually impaired (Store Norske Leksikon, 2015). Some of the services provided through the Norwegian Tax Administration website are relevant to all citizens in Norway, like e.g., submitting a tax return. Its user group therefore automatically includes those who utilize screen readers because of problems with their vision (in addition to people using them for other reasons). Because of this, the Norwegian Tax Administration wanted to know more about the problems faced by these users of screen readers when they interact with its pages. For this investigation, the people at the Tax Administration wanted at least three different screen readers included in the user test. People who have other impairments may also utilize screen readers for interpreting the content of a website; however, for this research, it was focused on the users that have some level of visual impairment.

“ICT for all” provides a list<sup>4</sup> of which screen readers that have been handed out by NAV in 2006-2012. This list also contains screen magnifiers and upgrades; the list does not provide the answer to exactly how many screen readers of what brand are being utilised in Norway, but it gives an indication. In the literature review of this document, more information about screen readers is presented. The Norwegian Tax Administration is conscious about accessibility and has already developed contents that are accessible to many people. More about this is discussed next.

### **1.10.3 Tax Administration awareness of the issue**

In 2012, the Tax Administration received something called the innovation prize for universal design for its website<sup>5</sup>. The goal of this prize was to lift up innovative solutions that are usable for all, and is delivered by the Norwegian Design and Architecture Centre. The Tax Administration has since then re-launched its sites in 2012, all through their development process; the people working on their webpage listened to their users through user studies,

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<sup>4</sup> [http://iktforalle.no/virtuell-hjelpemiddellab/hjelpemiddel\\_statistikk.html](http://iktforalle.no/virtuell-hjelpemiddellab/hjelpemiddel_statistikk.html)

<sup>5</sup> <http://www.pressenytt.no/nor/Artikler/Teknologi/Skatteetaten.no-faar-innovasjonspris>

workshops, and feedback provided by caseworkers. The web environment is heavy and contains much information; presenting all of this information in such a manner that it is easy for the user to grasp is a challenge, this has been tackled nicely.

As of today, the Norwegian Tax Administration has a successful usability lab. It is excellent at conducting user tests for collecting valuable information for enabling development of a user-friendly web environment for its visitors. In addition, it is service oriented towards its users, and it is important for it that the pages are intuitive and as easy to use as possible. Because accessibility recently has become a common part of web development, this also because of legislation, the Norwegian Tax Administration wants to make this an included part of its environment. It wants all user groups to be able to access its pages, and by this, it wants to test its web pages with the aim of testing for accessibility. It is aware that it needs a testing manual, which it can use in the future to conduct this type of testing.

# 2 Literature Review

## 2.1 Web Accessibility

Web accessibility means that people with disabilities can use the Web. More specifically, Web accessibility means that people with disabilities can perceive, understand, navigate, interact with and contribute to the Web (WAI, 2005). Web accessibility also benefits others than those with disabilities. Among these are the elderly with changing abilities due to aging. The World Wide Web Consortium's Web Accessibility Initiative (WAI) has developed guidelines for creating accessible web pages e.g. Web Content Accessibility Guidelines (WCAG) and Authoring Tools Accessibility Guidelines (ATAG). One should consider several things when creating an accessible website, for example, heavy use of multimedia can be a barrier to those who has problems with vision or hearing. In addition, using colours for feedback purposes, and pages where the HTML content is not labelled or tagged properly can become impossible to interpret for users of assistive technologies that depend on these attributes.

There do exist different perceptions and several definitions about web accessibility. Petrie, Savva & Power (2015) posed a unified definition of web accessibility and argues that web accessibility means, "All people, particularly disabled and older people, can use websites in a range of contexts of use, including mainstream and assistive technologies; to achieve this, websites need to be designed and developed to support usability across these contexts". Another definition that is somewhat similar is presented by Persson, Åhman, Yngling & Gulliksen (2014), web accessibility is "The extent to which products, system, services, environments and facilities are able to be used by a population with the widest range of characteristics and capabilities (e.g. physical, cognitive, financial, social and cultural, etc.), to achieve a specified goal in a specified context." Furthermore, the Italian Parliament defines a website as accessible if it "deploys services and information so that they can be exploited with no discrimination also by disabled persons." ISO defines a website as accessible if "it is usable by people with the widest range of capabilities". Brajnik (2008) suggests that accessibility can be distinguished from usability by having accessibility aim at non-

discriminating users in terms of what they can achieve; accessibility should focus on website's capability of providing equal levels of effectiveness, security and safety in specified contexts. Clearly, there exist different approaches to define the phenomenon of web accessibility, as the above examples illustrate. Next, more about the WCAG 2.0 guidelines is presented.

In Norway, private and public establishments have to create ICT solutions that are universally designed. As mentioned, earlier the Norwegian regulation for universal design of ICT demands that the websites meet the level A and AA of the WCAG 2.0 success criteria. The *Web Content Accessibility Guidelines (WCAG) 2.0* covers a wide range of recommendations for making Web content more accessible. By following these guidelines, the contents of a website will often become more usable in general (Caldwell, Cooper, Reid & Vanderheiden, 2008). The guidelines are grouped into four major principles: Perceivable, Operable, Understandable and Robust. All principles contain several guidelines; these guidelines consist of the success criteria that have to be met in order for the guidelines to be completed. In the WCAG 2.0 guidelines, it is documented many techniques, that can be used for meeting the success criteria. There are also advisory techniques.

While the focus of accessibility is disabilities, research and development in this field bring benefits to everyone, particularly for users that find themselves in a situation that brings about limitations. There is an overlap between designing for accessibility and designing for situational limitations, addressing one set of needs does not provide us with the best solution for other needs. A research conducted by Henry, Abou-Zahra & Brewer (2015), aimed at explaining the importance of "Accessibility continuing to focus on people with disabilities". In their research, they listed different interests among product managers and designers. One example was meeting the needs of aging web users. For people with disabilities, accessible technology is essential for providing equal access to our digital world. Just as accessibility solutions do not solve all problems for situational limitations, solutions for specific situational limitations do not solve all of the accessibility problems. Accessibility should focus on the disabilities, one should not broaden it to address other situations, this will have researchers encouraged to continue the work on optimizing the solutions for these specific needs. Accessibility is starting to become more integrated into web development processes that are being assessed today (Henry et al., 2015). Responsive web design is an

example of this; its approach is to provide an optimal viewing experience. This by constructing sites and making it easy to read, understand and navigate. By including people with disabilities into the web development process their experiences and challenges regarding the design will be reported, by this necessary means can be initiated by the developers in order for the design to become more adapted to this user group.

The current set of tools and specifications for ensuring accessibility is not especially simple to understand unless you have some sort of expert knowledge or a highly technical orientation. Koutsabasis, Vlachogiannis & Darzentas (2010) has reviewed the types of tools and specifications available for accessibility testing, they further presented a practical methodology for web accessibility evaluation that demonstrated how these tools and specifications can be utilized. After conducting an evaluation of a larger e-commerce website, they proposed a holistic approach to ensure web accessibility where the following should be included: identification of user requirements and setup of accessibility goals, web accessibility evaluation and redesign process and an establishment and follow up of an accessibility policy. The success criterion is not always sufficient for guaranteeing that all users will be able to perform all task provided by a website. Therefore, one will have to evaluate if there are groups, e.g. groups that need assistive technologies that will require something more from a given process of the system. User testing of accessibility was mentioned as a part of the web accessibility evaluation and redesign process, among tool-based accessibility conformance to guidelines and expert accessibility inspection. As for the last, website owners need to establish a web accessibility policy that will be applied during the design, development and operation of the website to ensure maintenance of accessibility. The policy will need to define systematic procedures, checks and tools for content updating. Next accessibility of forms provided through the website is discussed.

## **2.2 Accessibility of Forms**

“Forms can be visually cognitively complex and difficult to use, accessible forms are easier to use for everyone, including people with disabilities” (W3C, 2013). When electronic forms are designed to be completed online, the form shall allow people using assistive technologies to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues (Lazar & Greenidge, 2006). Forms

are one of the greatest sources of potential accessibility issues. Because of this, WCAG 2.0 has created many specific guidelines to ensure that forms can be created in such a way that everybody can access them. Forms can for example be PDF files that contain form fields, or text input fields where some kind of information is required, such as name, address, social security number etc. To make forms accessible it is important to properly structure the fields. The Windows based screen readers can be used in two modes, one browsing mode and one for using forms. The form mode unbinds some of the functionalities and facilitates the user to be able to enter information into the form fields. An example of a challenge is a screen reader that has problems identifying form labels. The most common issues associated with web forms are wrong labels, fieldsets and legends (Stringer, 2010). HTML provides different elements and attributes so that form labels can be marked up correctly.

The Agency for Public Management and e-Government, also called Difi, aims to strengthen the government's work in renewing the Norwegian public sector and improve the organization and efficiency of government administration. One of their main tasks is to make public information and services more accessible to citizens and public agencies. To ensure accessibility within the public sector they have defined mandatory and recommended standards for the Norwegian public sector. Difi provides many guidelines on how to create accessible web contents; one is a set of directions and guidelines for universal design of electronic documents<sup>6</sup>. It contains information about the online electronic documents, the users need, structure of the documents, visual contents and the accompanying concerns, standards, tools for text processing and templates.

Others who have created guidelines for insurance of accessibility in forms are W3C and Web Accessibility in mind (WebAIM). The Web Accessibility Initiative (WAI) has created a tutorial that illustrates how the web developer can create accessible online forms. WebAIM provides a detailed article on how to create accessible forms on their website<sup>7</sup>. It presents different aspects of the form, e.g. text inputs, checkboxes, text areas, JavaScript jump menus and more. They explain to the reader how to ensure accessibility when utilizing these features. Other actors have published information regarding accessibility of forms as well: one

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<sup>6</sup> <https://uu.difi.no/artikkel/2015/07/skjema>

<sup>7</sup> <http://webaim.org/techniques/forms/controls>

example is adobe acrobat, which is private. ELMER 2<sup>8</sup> (Simplification of public forms) is a project that has developed examples toward a comprehensive set of principles and specifications for the design of Internet-based forms. Business organisations, governmental bodies, usability experts and form developers were invited to contribute with suggestions and take part in the process. ELMER 2 is free and provides guidelines for user interfaces in public online forms in Norway. It also provides with some suggestions for how to make sure that the form is accessible. Figure 8 is an example from ELMER 2, the form provides feedback to users that some error occurred.

1.1.1 Egen andel av utgiftene ? - 340 000 kr

**Feil utfylling av felt**  
Det gis ikke fradrag for beløp over 300 000 kroner.  
Kontroller beløpet på nytt.

Figure 8 Example from ELMER 2, form input field presents an error

E-Government services provides the citizens with an easy way to conduct different tasks online, making it possible to save time and accomplish the tasks anywhere at any time. To ensure accessibility and usability of services like these is crucial, because the services provided are usually positioned in web forms. The information provided by such forms may be very important. Not being accessible to users may cause frustration and increased dropout rates (Faries, Khalifa, Razgan & Duwais, 2013). This is why it is important to ensure that online public forms of E-Government services should grasp the concept of accessibility. There are many barriers related to online forms, an example is time restrictions, which in some forms can pose extra barriers to for example people who are dyslexics or those with learning disabilities. By integrating international accessibility standards and usability guidelines developers can create forms in their web pages that are accessible to more users. More about testing web pages and automated accessibility evaluation tools is presented next.

<sup>8</sup> <http://www.elmer.no/english/>

## 2.3 Automated Accessibility Testing

Automated accessibility testing is to measure if web content meets any given/required criteria by running a web application or HTML contents through a software program that detects errors within the code. In an age of rapid development and increasingly complex environments, automation is a key factor in achieving a good level of test coverage (Nagowah & Roopnah, 2010). The errors detected are different aspects of the semantics that are not compatible with the WCAG 2.0 guidelines. A tool like this can be an effective way to detect errors during the process of development and/or after deployment. As of today, there are almost fifty web accessibility evaluation-tools available through the Web Accessibility initiatives, 38 of these are aimed to meet the WCAG 2.0 criteria. Not all of these tools are continually updated; according to Schiavone & Paternò (2015), 50 percent of the available tools are not compliant with the latest WCAG 2.0, which was designed so that it would be easier to test it than its predecessor WCAG 1.0 (Vigo, Brown & Conway, 2013). Much research exists about evaluation of different automated accessibility testing tools that test for WCAG 1.0 success criteria. For this research, relevant tools had to evaluate websites for level AA of WCAG 2.0.

Several considerations that can be made when choosing an automated accessibility-testing tool. In an article written by Carl Groves (2014) it is presented 13 questions one should ask when finding an automated-accessibility testing tool. For different systems, the relevance of the questions may vary. For websites with more than one developer involved in the operation of the system, it can be necessary that the tool is user-friendly. Further, does the tool provide high quality, reliable results and does it offer the ability to spider? Often when web contents are being tested in the browser, the testing tool will only test a single page at a time. After finishing a website, a testing tool that has the ability to test large scale can be most beneficial, and rather testing one single page during the development process. Another key factor when choosing a testing tool is the quality and reliability of the results. Further one will have to decide if one wants a web based tool or program running locally.

Since ICT is a relatively new phenomenon, where accessibility is even a newer one, research and studies are still working towards the goal of finding the best way to create accessible web contents. In this process, researchers are in the wind of testing the different tools. In a



study conducted by Ivory and Chevalier (2002), 137 respondents were asked about their use of automated accessibility evaluation tools. The majority did not think that using automated tools produced better sites. This was because they did not think the tools had adequate functionality or support or that they were easy to use. The most commonly used tools among the respondents were WatchFire Bobby (47%) and the W3C HTML Validator guideline review tools (43%), the DreamWeaver 508 Accessibility Suite (16%), AnyBrowser (11%), WAVE (9%) and LIFT for Dreamweaver (9%). When asked what tool the users found to be the best, Bobby was the tool that was most selected (27%). It should be mentioned that this was the only one they knew of or had used. WatchFire Bobby is used to validate websites for WAI and Section 508 (U.S. legislature). Furthermore, the research found that the tools helped the developers identify a larger number of potential problems than they could identify on their own. However, the developers did not always know how to interpret the data and how to apply the guidelines. The study conducted by Ivory & Chevalier (2002) indicated that neither automated tools for accessibility, nor guidelines alone, are adequate for insuring accessibility for disabled users.

There are several free automated validation tools available online. Some of these meet the minimum requirements i.e. compliance with WCAG 2.0 AA criteria. Pivetta, Saito, Flor, Ulbrich & Vanzin (2014), identified seven accessibility evaluation-software solutions. The following software solutions were listed as software that was not outdated from this list of Accessibility Evaluation Tools list presented by WAI: Access Monitor, AChecker, ASES 2.0, TAW3, WAAT, WAVE, WorldSpace and FireEyes. They only selected two out of these tools for evaluation in authenticated environments, these WAVE and ASES. They chose only to proceed with testing the ASES evaluation tool, which is free software that runs the code of the pages to determine if they meet the WCAG 2.0 criteria and e-MAG 3.0 documents. It also consists of a CSS validator, HTML (4.01 and XHTML) validator, screen reader emulator, low vision descriptor, alternative content script and object tags among other facilities. The analysis showed that the validator was somewhat challenging to use and several problems in relating to access for the user. This was found to be an obstacle. They found that one should have some knowledge of computing for better understanding of the tool in addition to some coding knowledge.

Not all guidelines are easily translatable in a way that is executable by a computer, meaning that only a subset of the guidelines is considered in the validation performed by these tools. This again implies that a human validator (Schiavone & Paternò, 2015) should perform the final control of the remaining guidelines. The automatic tools will be able give some information about existing accessibility issues, however one cannot be certain that the accessibility evaluation tool will guarantee that the final report generated by it will include all of the issues that actually exists within the contents of the pages. When checking the previous version, WCAG 1.0, researchers Cooper and Rejmer (2001) found that only 23% of the WCAG 1.0 criteria could be automatically checked by the formerly tool Bobby. The research also detected that the other available tools at that time was not able to automatically verify all WCAG 1.0 checkpoints.

Schiavone & Paternò (2015) presented MAUVE as an example of an accessibility evaluation tool that is not tied to any particular guidelines. It is rather a general tool with the ability to describe various types of guidelines. It utilises LWGD, which is an abstract language for defining guidelines and its associated interpreter. It can then validate pages according to the preferred guidelines. Validation can be performed through the command line, a browser extension or a web interface. It is possible to perform validation with pre-defined sets of guidelines intended by the LWGD. A benefit one gets from MAUVE is the ability to validate the version of a website specific to a certain type of device, e.g. a smart phone, tablet and computer. Mainly the environment has been designed to validate one webpage at a time; however, it is possible to extend this to entire sites.

There are many automated accessibility-testing tools available; some of these are presented in the Web Accessibility Evaluation Tool list from W3C. There are considerations that should be taken when deciding what tool to use when evaluating a website. Nagowah et al. (2010) proposed a list of features that they believed an automated testing tool should contain. First, they stated that novices and all people, who do not have much knowledge of web development and testing in general, should be able to use the testing tool. Therefore, it is of utmost importance that the testing tool is user-friendly. Throughout the process, the user should be able to receive some sort of guidance from the software. Another thing they featured was that the user should be able to view the results in an understandable format that is suitable for printing. In addition, an important feature is flexibility, which enables the

user to skip some of the steps so that testing of, e.g., unfinished sites will run smoothly. Further, the system should be able to run the automated test by getting the data from the source directly.

It should be mentioned that many tools exist that are not mentioned in the web accessibility-evaluation-tools list, which can offer useful functionality for evaluation of specific issues of accessibility of websites. Accessibility evaluation tools can assist the accessibility quality-assurance; process, however, none of them will replace evaluation by skilled humans. The user needs to be aware of their limitations and will need a strong understanding of accessibility issues and the implications for people with disabilities in order to interpret the reports and the accessibility issues or potential issues flagged by the software tools (Faulkner et al., 2000). The tool measures only the code and not the design in itself (Ivory et Al., 2002). Therefore, it is important to integrate the testing with the automated tools into the whole of the process. In particular, the part that aims to meet accessibility requirements, rather than relying solely on the automated tool for ensuring that the webpage is accessible. Relying on guidelines alone leaves out a number of issues, as it was found guidelines do not cover the whole spectrum of accessibility problems, they only seem to cover around 50% of accessibility problems encountered by users (Power, Freire, Petrie & Swallow, 2012).

Brajink (2008) claims that automated testing tools should not be considered as an evaluation method. This because they solely rely on heuristics to determine violations of several checkpoints, and the quality of these heuristics is not satisfying enough. False positives can be up to 33% and false negative has shown to 35%. As W3C/WAI states “Web accessibility evaluation tools cannot determine the accessibility of websites, they can only assist in doing so.” However, they work fast and can be helpful when evaluating many pages. Using them will not ensure accessible web pages, but they will help clean out some of the common issues users with disabilities may encounter. Next, the assistive technology screen reader is presented.

## **2.4 Screen Readers**

A screen reader is an assistive technology that helps the user by reading the contents on the screen and sending the voice to the computer speakers or connected headphones. The

device is also known as text-to-speech. It can also provide tactile feedback if the computer has the additional equipment called Braille display. It is usually possible to customize these voices, giving the user the freedom to choose a faster or slower voice and to adjust the volume of it. Screen readers are good at providing access to the three most widely used applications on personal computers, Word-processing, Internet browsing and emailing. This type of technology is not only suitable for people who are blind, but also people that have problems reading the text displayed on a digital screen. As of today users have several screen readers from which they can choose. NVDA (Non-Visual Desktop Access) is an example of a free screen reader. JAWS (Job Access with Speech) is a widely used screen reader which is proprietary. Apple products have built-in accessibility functionality that also includes a screen reader called VoiceOver. Microsoft offers a screen reader service that is called Windows-eyes, an office license is necessary for accessing it. These are only a few examples of the screen readers that are available, mainly there are the types that transform text to braille and speech, mostly used by blind persons, and those who transform text to speech and in addition use a magnification software, these are more common among people with low vision. Examples of screen readers that also include screen magnifiers are Zoom Text, Supernova, LookOUT and WinZoom. A screen magnifier is software that displays enlarged contents versions of the content to the user. As mentioned the screen magnifier can be very helpful for people with low vision, for example many elderly use this assistive technology.

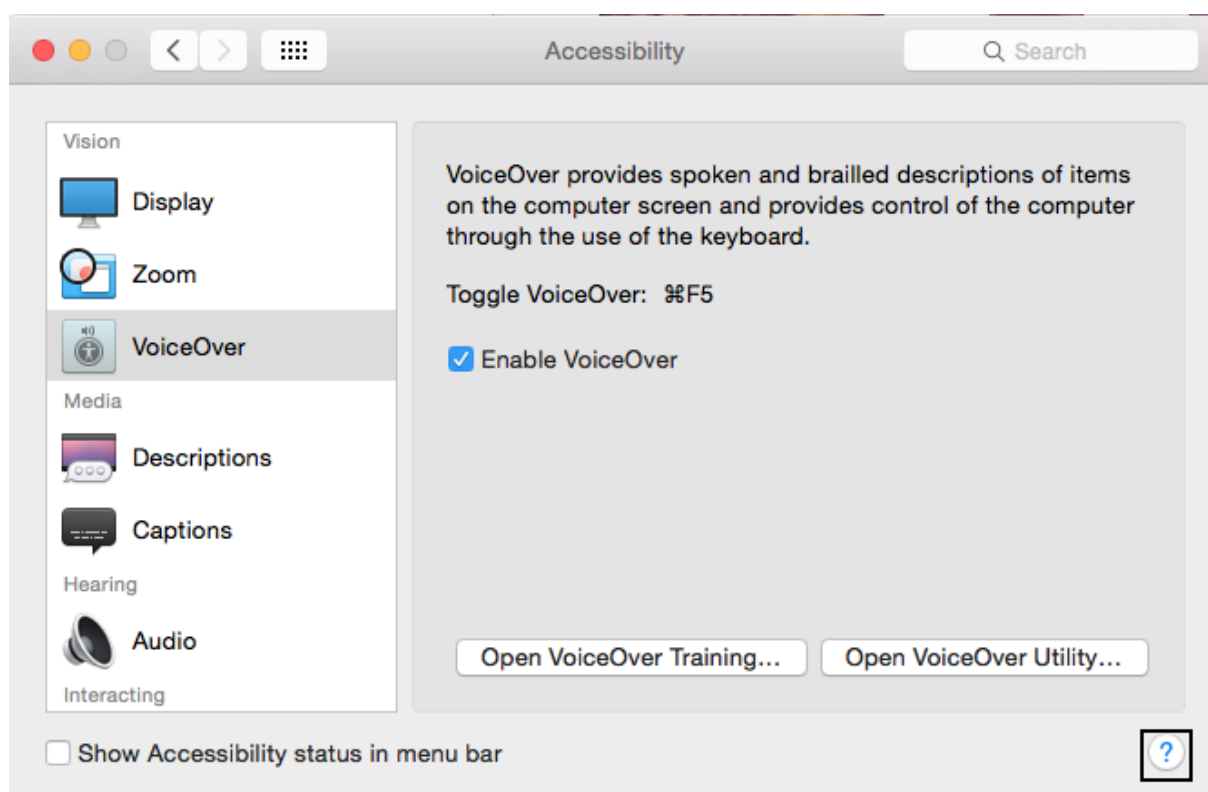


Figure 9 Picture of VoiceOver Software

Research has shown that people with disabilities are most at risk of being excluded from access, and in particular people who are blind or visually impaired and use assistive technologies such as screen readers (Brophy & Craven, 2007). As of today few developers are implementing the current version of WCAG, and even after implementing the guidelines there seems to be few indications that people with disabilities will encounter fewer problems (Power, Freire, Petrie & Swallow, 2012). Even though all of the success criteria of WCAG 2.0 are met, users of screen readers will still be met with challenges when using the web. Users of screen readers that are blind often have memorized the keyboard, this shows that most errors are related to output and not input. Most causes of frustration for screen reader users, such as inappropriate form and graphic labels and confusing page layout can be relatively easy to fix if web developers and web designers focus on these issues (Lazar, Allen, Kleinman, & Malarkey, 2007). However, the screen reader developers will, best manage frustrations regarding technical issues like those of screen reader crashes and conflicts.

Even though the user has a lot of experience using a screen reader, it is not certain that he or she will easily access all web pages. All though it may sound like it, the voice of the screen

reader does not interpret the content the as humans do. Where most visitors of a website can skim the sites in an instant, screen reader users cannot. They will on the other hand have to progress through the website in an orderly manner. This by using the tab key for being able to skim the site, but if the site contains elements without proper tags or alternative text etc., they unfortunately will not be able to perceive it. A good way for developers to ensure accessible websites for their blind audience is to focus on the accessibility standards. Further, listening to the content rather than reading it, will often be a revelation to many developers (Power et al., 2012). Different screen readers can react differently to the same contents, if a developer only tests with one screen reader and it works ok, he/she is not guaranteed that other screen readers will perceive the contents in the same way. However, screen readers and browses are paying more attention to standards today, making the users experience more consistent no matter what technology they prefer (Webaim, 2014).

Among the most common challenges faced by blind users on the web are page layouts causing confusing screen reader feedback, conflict between screen reader and application, poorly designed/unlabelled forms, no alternative text for pictures and a 3-way tie between misleading links, inaccessible PDFs and crash of the screen readers. This was found in a study conducted by Lazar et al. (2007). The participants reported that they on an average lost 30.4 percent of their time due to these common “errors”. When the challenges are due to inappropriate forms, labels and page layout, the errors are relatively easy to fix. The study also concluded that the most frequent causes of frustration for the screen reader users are relatively easy for the web designers to fix. Labelling of forms, improve the labelling of links, appropriate alternative texts for pictures (e.g.), improvements of the clarity of the page layout and accessible PDFs are all possible to do without having to remake much of the HTML content.

The use of screen readers is helpful to better understand and to reinforce the concepts of web accessibility. The ever-growing use of the web as a platform for e-Government, among many other services, makes it an important target for universal design. Freire et al. (2007) found that by using assistive technologies, developers could better understand accessibility issues. This was in particular essential to screen readers because the developers could now understand how the blind user experiences the web. When the developers were blindfolded

and then were set to use the screen reader themselves, they clearly understood the obstacles related to the inadequate use of tables to layout, use of not self-explained forms and other problems. The study showed that participants when not using screen readers only perceived a number of accessibility problems as they did when they used one. They praised the use of screen readers among developers to perform the evaluation of their websites. This shows that having a checklist is not always enough to truly meet the accessibility needs of the users. The reason for the users of screen readers being so helpful in identifying accessibility violations is that they help point out where the webpage is not accessible for keyboard-only use, this also impacts how people with motor impairments interact with the pages and services (Lazar et al., 2013).

Multi-stage human inspections of web pages, involving screen readers such as JAWS and Voiceover, are considered the most accurate form of accessibility evaluation when utilized by people who are blind, have low vision or has some print-related disability (Mankoff, Fait & Tran, 2005). The accuracy increase when all individuals included in the testing process evaluate the same sites and services (Lazar et al., 2010). A test with a screen reader should not replace a user testing with a real blind person, but it can be a great way to get to know the website from a different angle. Experience shows that providing compatibility with one screen reader does not necessarily ensure compatibility with other screen readers from other vendors. Testing with screen readers is an effective way of finding many accessibility issues; however, it will not guarantee finding all of the issues. Therefore, it is necessary to test websites and other programs with different assistive technologies, to ensure accessibility for all users of assistive technologies (Fuglerud, Halbach & Skotkjerra, 2014).

When selecting a screen reader to use there are several things that one can consider, e.g. what the user wants to accomplish, what environment the user operates on, support for custom-made applications and of course the price. JAWS and Window-Eyes have the highest installation rates among people with vision impairments. There has been a significant decline in primary use of JAWS over the last few years. Still, 85 out of 101 respondents reported that they used JAWS regularly, while 40 used NVDA regularly in a comparative study of the two screen readers done by McCarthy, Pal & Cutrell (2012). The researchers found that many of the interviewees dropped NVDA very soon after their first attempt at using it because of the quality of the voice. When listening to a voice for, possibly, many

hours a day it is understandable that the user wants it to be a comfortable one. As opposed to NVDA, JAWS is equipped with a natural voice. JAWS however charge a license fee. NVDA is open source; this seems to be favourable for the users and probably has something to do with its increase in popularity (McCarthy et al., 2012). Furthermore, one feature that makes NVDA particularly attractive to users is that it can be used with a portable USB stick. This enables the user to bring it wherever whenever, without having to bring any additional software or hardware.

The Norwegian Labour and welfare administration (NAV) is the current Norwegian public welfare agency in Norway. Any citizen with impairments can apply for assistive technologies in Norway, and the state covers the costs. Licenses for 251 screen readers from JAWS were handed out to the Norwegian population in the years 2006 to 2012 in contradiction to 81 Window-Eyes licenses. NAV now operates with the Cobra Braille for Windows, SuperNova Screen Reader (Windows), JAWS and Window-Eyes. For 2014 and 2015 48 JAWS, 12 Supernova, 4 Window-Eyes and 4 Cobra Braille were ordered through NAVs order system, these are the latest numbers. The screen readers that are most used in Norway are JAWS, Supernova and Window-Eyes (Kvalvik, 2013). Supernova Screen Reader is delivered by Dolphin Computer Access, which is working to combat the impact of visual print impairments. In 2014 + 2015, JAWS and the Supernova screen readers has been the most popular. Zoom Text has been very popular in previous years. NAV does not provide their users with technologies for Mac, this is because there is an availability functionality built into operating system, and this functionality provides the users with a screen reader in addition to other accessibility features. It is assumed that many people use Apples screen reader, Voiceover; however, there are no statistics or numbers confirming the amount of users.

Being dependent on assistive technologies to be able to render information that in many cases is meant for the users to see or read can be challenging. There are several things on a page that has to be in order for it to be interpreted perfectly by the assistive technologies. The top causes of frustration among blind users of the web are: (a) page layout causing confusion screen reader feedback; (b) conflict between screen reader and application; (c) poorly designed / unlabeled forms; (d) no alt text for pictures; and (e) 3-way tie between misleading links, inaccessible PDF, and a screen reader crash. (Lazar et al., 2007). Some of these conflicts are easy to fix, labels and alternative text for the images can be edited



without having to change anything fundamental about the webpage. If there are problems with a confusing page layout however, more work can be required for it to become perceivable to everybody. Changing the page layout after it is launched can become costly, because of this it can be a good idea to test also with real users, during the development of the webpage. Next, there will be more about accessibility testing.

## 2.5 Accessibility Testing

As of today, there are many automated accessibility evaluation tools that has been developed that can be utilized for automatic or semiautomatic testing for accessibility of web pages. In addition to this, W3School<sup>9</sup> provides a list of Accessibility Testing scenarios; this list contains information about manual testing, semi automated testing, and fully automated testing. The World Wide Web consortium<sup>10</sup> also provides a list on how to test a website for accessibility; most of its contents are taken from the usability testing method. They suggest that the testers include real users with different disabilities when assessing the accessibility evaluations, further they state that defining “groups” of disabled people can be problematic, however they state that one should include users who has the most common types of disabilities. User testing seems to be a favourable way for developers and testers to ensure the accessibility of web pages, in a research conducted by Brajnik (2008) 45% of the problems faced by a user group when interacting with a webpage were not detected by any of the checkpoints from a conformance review conducted of the same page. As per there are still many accessibility issues to be identified in public web pages, a reason for this can be that web developers have little or no accessibility experience, also they seem to lack accurate information about the best way to quickly and easily identify accessibility problems within websites (Mankoff et al., 2005). Due of lack of professionals in software testing, several organizations that offers certifications have emerged, such as Global QA, QAI Global Institute and International Software Testing Qualification Board. In today’s software development industry, software testing is one of the most important processes, because it allows one to ensure the quality of the software products, one can also, and should, ensure that it meets the necessary requirements for universal design (Gordón & Moreno, 2014).

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<sup>9</sup> [https://www.w3.org/wiki/Testing/accessibility#Accessibility\\_Testing\\_Scenarios](https://www.w3.org/wiki/Testing/accessibility#Accessibility_Testing_Scenarios).

<sup>10</sup> <http://www.w3school.com>

Not all developers are familiar with accessibility, and not everybody understands the challenges users with disabilities may face when they encounter the website. A way for the developers to get to know these users can be to use personas. These personas describe the target audience, by being descriptions of hypothetical users with disabilities. The persona has to include a name, a description of the daily routine, devices, and technologies this user need for accessing the webpage. Several studies have shown benefits from using personas for an accessibility evaluation (Henka & Zimmermann, 2014). Benefits can be e.g. helping author focus on the user and raises awareness for the specific interaction between people with disabilities and web applications. Mankoff et al. (2005) reported that web developers who used a screen monitor together with a screen reader were able to detect many of the issues found by a comparable conformance review. As previously mentioned, web developers can be able to detect some of the accessibility issues by using a screen reader. This method would rely heavily on the evaluator's level of experience in using the assistive technology and would rarely match the level of experience of real users.

Brajnik (2008) states in his research that a good accessibility model is missing, he further suggests a model that contains the main components: Properties, Context and Methods. Properties define what accessibility is and what properties should be central in its notion. Context will ideally address the "who", "what" and "how" questions, while Methods provides what methodologies is used to evaluate, asses and manage the accessibility. In his research Brajnik (2008) evaluated a few existing methods for accessibility evaluation. First he presents the subjective assessments, which is low in cost and do not require experienced evaluators. However, it is very unsystematic and different users with different experience levels will report different things about the same page. Further the barrier walkthrough is presented, which is based on the heuristic evaluation method, only difference that the evaluator is able to define a few possible barriers and then evaluate the page and report when these barriers occur. This method is reported being more effective than conformance reviews in finding more severe problems, however it is less effective in finding all the possible accessibility problems. The last method presented was user testing, here it is emphasised that users use assistive technologies that they are familiar with. A benefit from user testing is that real users face the usability problem; this enables detection of the issues right away. Drawbacks with this method is that it is high in cost, also problems detected

does not include description of what the defect is, recruitment of the given group that are to represent the target audience can be challenging

Section 508<sup>11</sup> treats assurance of accessibility not as something achieved by testing towards the end of the development phase, but as requirements gathering and a series of testing made throughout the life cycle of the product. It makes recommendations for: gathering requirements from disabled users; creating an accessibility-testing plan; accessibility testing methods; post-launch programme of accessibility testing (Gordón & Moreno, 2014). To be effective and efficient, test plans should also include time to be spent on planning the test, designing test cases, preparing for execution and evaluating results. It has been the perception of web developers that methodologies are needed which incorporate web accessibility throughout the entire development process (Lazar, Dudley-Sponaule & Greenidge, 2004). Automated accessibility evaluation tools have been presented earlier in this document, this is a very common method used to conduct an accessibility evaluation, design guidelines and user studies are also common, or a combination of these (Mankoff et al., 2005). There is however little research that defines exactly how a page becomes accessible through testing.

The execution is the most visible part of the testing. The planning of the testing should also include time to be spent on planning the test, designing test cases, preparing for execution and evaluating results. As of today, there is still a very diverse understanding of what testing is and what its objectives really are. In different contexts and domains, the testing processes may vary; people with domain expertise will be of importance because they know how to test better than others do (Gordón & Moreno, 2014). We have different types of testing: Functional Testing, Non-functional Testing, Structural Testing and Re-testing and Regression Testing. Non-functional Testing includes accessibility testing (Gordón & Moreno, 2014). Figure 10 presents the fundamental testing process; first, there is the planning, then the testing process, which should include analysis, design, execution and evaluation. Further figure 9 suggests activities that can be incorporated into the testing process, e.g., planning, define goals, test plan, analysis and design, implementation, evaluation and test closure.

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<sup>11</sup> <http://www.section508.gov>

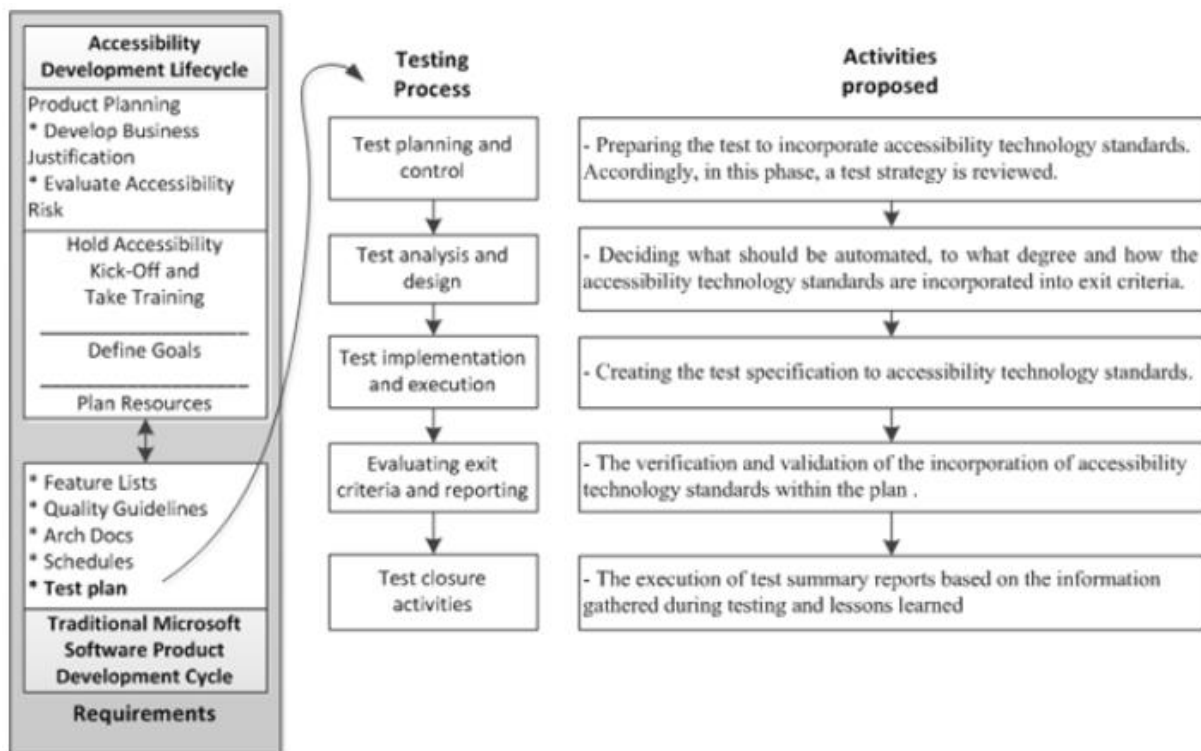


Figure 10 Fundamental test process, Gordón & Moreno (2014)

When planning for a usability test the planning steps are essential. Testing for accessibility contains some of the same elements, here is a list presented by Barnum (2011) that contains the key elements for planning an accessibility-testing plan:

- Scheduling the planning meeting, in which you:
- Establish test goals
- Determine how to test the product
- Agree on user subgroup(s)
- Determine participant incentive
- Draft the screener(s) for recruiting participants
- Create scenarios based on tasks that match test goals
- Determine quantitative and qualitative feedback methods
- Set dates for testing and deliverables
- Writing the test plan
- Writing an informal test plan
- Writing a formal test plan

Dick & Jewett (2009) researched the evolution of the Web Accessibility Testing Protocol; they suggested the following list of goals, which are intended to be included in a testing manual that aims at ensuring accessible web pages:

- It should readily identify the most important barriers to use of a webpage by persons with a wide span of disabilities. These barriers should be demonstrable to a wide range of audiences
- It should be useable by developers with a wide range of experience, but does not need to function (in fact, should not function) as a complete accessibility tutorial
- It should be consistent with both legal standards (such as the discrimination and accessibility law) and best development practices, but again does not need to provide a tutorial on these topics
- It should compliment, not duplicate, the use of automatic testing tools – effectively filling in the information that cannot be provided by those systems
- It should be adaptable to various organizational requirements and to rapid changes in web technology and standards
- It should be designed for use every day in new website development, not just for occasional checking of legacy sites. (In fact, often a prioritized replacement of sites is far more cost-effective than repair of old, inaccessible ones.)

As discussed earlier no definition exists on how many, and what users should be included in a user test to ensure accessible web pages exist. It has been proposed that three users (or more) from “each group” should be included. Preferably, to be able to ensure that web pages were accessible to as many people as possible, more people should be included in the user test. The fact that people are different makes it hard to define “groups” of people, there exist combinations of disabilities, which can be rare and perhaps hard for testers to predict. Because of the fact that people might have more than one disability, the combinations can be endless. Testers have to consider how many resources they have at their disposition, including three or more users with all types of disabilities can perhaps become excessive in comparison to what was initially intended. In addition, what users are they able to find? This can be a question arising in the processes of finding the participants, it is not given that a person with the “right disability” is possible to locate at all times.

There exist different types of disabilities e.g. physical disabilities, sensory disabilities and intellectual disabilities. As mentioned, the executors of the test will have to evaluate how many users they are able to fit into the accessibility testing process, a wide range of different users can provide developers with information about several aspects of usage. Based on the current literature on this topic one can start with raising the awareness around the topic of accessibility in the whole of the development team for ensuring that pages also comply with the users with disabilities. This means that not only the testing experts, who know the common problems, but also developers, should be informed about the users and their needs. This requires more awareness around the topic of accessibility from the start of the development process, in contradiction to something that one checks after the product is finished. There are many ways and approaches to test for web accessibility. Most people involved in software businesses agree that testing is important, but there is still diversity in the understanding of how it is preceded and what it should include. For future research, there is a lot of room to define how and when to best conduct these tests during what phases etc. for ensuring accessibility of the product. Next literature about the process of incorporating accessibility evaluation at earlier stages in the development process is presented.

### **2.5.1 Including Web Accessibility at an early stage**

Conducting testing during the development of a webpage can help save a lot of time at later stages. Testing is an important part of the iterative sprints in a developing team. However, when it comes to web accessibility web developers often consider it at the end of the development process, making it the last “check” before they publish the website (Gunderson, 2009). Because retrofitting a software product for accessibility can be extremely costly and even sometimes impossible, accessibility development will require attention at the early stages of the development process. Thus, the accessibility testing should be a part of the development process from the beginning. (Gordón & Moreno, 2014).

There are tools that can be used during the development that emphasis on testing the code for common accessibility issues. By choosing technologies that can find some of the issues at an early stage in the development process, they will not have to be detected after the product is finished and then be edited for suiting the accessibility requirements. According

to Xiong, Farenc & Winckler (2007) ensuring to conform to accessibility should be a concern at each phase of the development process and consequently it should be integrated as soon as possible in the lifecycle. The lifecycle of the development process may become longer, but the costs of rendering accessibility issues at a later stage can become challenging and even impracticable (Moreno, Valverde & Pastor, 2013).

Illinois Centre for Information Technology and Web Accessibility has created something called HTML best practices<sup>12</sup>. The practices are designed to give web developers the markup techniques they need to make web resources functionally accessible to the users that has disabilities; it tests for compliance with their own standards in addition to section 508 and WCAG. Unfortunately, only WCAG 1.0 has not been incorporated, however, this method is an example a methodology that aims at helping the developers incorporate accessibility into earlier stages of the development process. At the website they state that “The accessible repair approach commonly taken to improve the accessibility of web resources often results in web resources becoming more technically accessible but still remaining functionally unusable by many people with disabilities.” They aim at avoiding that problem by focusing on the functional requirements that rather improve access to all users, including those with disabilities. The Best Practices’ emphasis is placed on separating content from styling and creating semantically meaningful markup.

Several tools can be utilized when developing accessible web pages, they do not guarantee that all users can access the website, but it offers the developers some tools and support for making the process of creating an inclusive design a little easier. Accessibility Tools framework (ACTF) is a subproject of the Eclipse Technology Project, it is a framework that serves as an extensible infrastructure upon which developers can build a variety of utilities that help to evaluate and enhance the accessibility of applications and content for people with disabilities. WebAIR<sup>13</sup> was created as a part of a research conducted by Swallow et al. (2014). WebAIR stands for Web Accessibility Information Resource; its purpose is to assist developers in the creation of accessible websites and applications. It is a prototype information resource for helping web developers learn about accessibility and supporting

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<sup>12</sup> <http://html.cita.uiuc.edu>

<sup>13</sup> <https://www.cs.york.ac.uk/hci/webair/>

them in the process of creating accessible web pages. For web pages that contains JavaScript, React is offered as an open-source JavaScript library that includes accessibility features. These are examples of tools that are available for developers; they may also utilize the automated accessibility evaluation tools directly on the code to evaluate their contents. These tools may not guarantee the developer that the design is universal, but it can ease the process of getting to know the concept of universal design of ICT in addition to that washing away a few accessibility issues at an early stage of the development process.



## **3 Research Methodology**

In this chapter, the methodology that was chosen for this project is presented. For attaining the research questions, three different data collection methods had to be utilized. This chapter describes the appropriateness of the research design, and then introduce the chosen methods. Further, the study sample obtained is to be described and then the procedure of the participant observation, heuristic evaluation, and evaluation of the automated accessibility evaluation tools are presented. The instruments that were utilized and how the data were analysed are discussed in the end. Followed by the ethical considerations and potential biases regarding this research.

### **3.1 Appropriateness of the Research Design**

Several research methods that can be applied in a dissertation. For this research, the qualitative method was chosen. A typical qualitative study aims to provide an in-depth examination of a phenomenon (NSF, 1997). When doing a case study, one can use both quantitative data; and qualitative data, in a qualitative research; one can only use qualitative data. Qualitative methods typically examine a phenomenon from a person's perspective and examine how the world is experienced through his/her eyes. Quantitative research typically examines an observable phenomenon via statistical, mathematical or computational techniques (Atlasti, n.d.).

#### **3.1.1 Qualitative research method**

The objectives of this research is to provide insights as to what accessibility issues exists within the selected pages and forms, with emphasis on the users of screen readers' perspective, and how to test pages and forms in the future. This research aimed at understanding of the phenomenon and by this answer the research questions. When conducting a quantitative research, it is common to aim at determining whether the predictive generalizations of the theory hold true (Creswell, 1994). For example, if this research were investigating if user testing with real users increased the accessibility of web pages, then a quantitative approach would be more suitable. However, this study was supposed to understand the problems from the humans' perspective, especially for the first research question that asks what problems users of screen readers face when interacting

with the Tax Administration webpage. The research was conducted in a natural setting with the goal of building a holistic picture of the phenomenon that was investigated.

When investigating the most suitable way for the Norwegian Tax Administration to conduct accessibility testing of its webpage, it was valuable to gather insights into the already existing methods that are common for this type of testing. It is recommended by the web Accessibility Initiative<sup>14</sup> (WAI) to involve real users with disabilities when evaluating web accessibility, the manual walkthrough using heuristics is also a common way for inspecting web pages for accessibility<sup>15</sup>. The nature of this research was qualitative.

For answering the first research question, *“What problems do the users of screen readers face when they interact with the Norwegian Tax Administrations pages and forms?”* It was decided to conduct a participant observation. Next, the reason for this choice is presented:

### **3.1.2 Participant Observation**

When investigating the problems users of screen readers face when they interact with the pages and forms, a theory was to be generated. The theory was used as a generalization of the problems that the users of screen readers face when they interact with a webpage.

When a research aims at generating a theory, qualitative data is appropriate (EIPPEE, 2016). There are several research methods that provide qualitative data, e.g., focus groups, case studies and participant observation. A very common qualitative method is interview. This method provides insights about how people perceive a given phenomenon, and it is probably the most common qualitative research method. Observation is another method that is useful “when you are trying to understand an ongoing behaviour, process, unfolding situation or event” (Taylor-Powell & Steele, 1996). This research aimed at understanding the process of interacting with the Norwegian Tax Administrations webpage when utilizing a screen reader for perceiving the contents, by understanding this process insights were gathered as to what problems these users may face. By having the participants complete the tasks and report the results themselves, the reporting could have differed because they might view the same features in a different way and report thereafter, this could have provided unclear results (Brajnik, 2008). Because of this, it was necessary to observe the

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<sup>14</sup> <http://www.w3.org/WAI/eval/users.html>

<sup>15</sup> See Brajnik (2008)

process of the interaction with the web pages, this for granting the same issues with the same description.

### **3.1.3 Mixed qualitative research methods**

More data was necessary for providing an adequate answer to the next research question, *“How should the Norwegian tax Administration formulate a testing protocol that combines automated testing tools, manual inspection and user testing to ensure accessible pages and forms on its sites?”*

As of today there do not exist a distinct way of testing a website for accessibility. Different evaluation methods differ in terms of their validity, usefulness, reliability, and efficiency (Pivetta et al., 2014). Among some of the methods that can be utilized when investigating the accessibility of a webpage are manually inspections using heuristics, testing with automated evaluation tools and user testing with users with disabilities. For presenting a recommendation that the Tax Administration might consider utilizing in the future, several data collection methods were applied. The literature review provided insight into the phenomena under investigation. Information about how to execute an accessibility test was provided; this material was used as a foundation when developing the accessibility-testing manual. This aimed at including instruction for user testing, automated accessibility evaluation and the considerations regarding accessibility evaluation of a webpage. Furthermore, the literature review identified the automated accessibility evaluation tools that were suitable to be included in a further evaluation, for providing a suggestion for a tool that could be included as a part of the accessibility evaluation strategies.

### **3.1.4 Heuristic evaluation**

As previously mentioned, using heuristics is a commonly used method for inspecting the usability of designs and websites. The website is examined by checking if it complies with a given set of criteria (the heuristics). Heuristics can be used in various ways for inspecting a user interface, it can “act as mnemonics for the evaluator’s existing knowledge that can be applied to the analysis of the accessibility issues” (Pivetta et al. 2014). The heuristic method for analysing websites is low in cost and low in time consumption. It can be performed in a normal room and even be used for evaluating prototypes where the interface has been designed; the analysis will offer information from experts of the manufacture team based on

good principles for accessibility (Custódio et al., 2015). This type of evaluation requires few resources; therefore, it is cheap, effective, and usually applied when the equipment is under post-development review. The evaluation does require moderate level of training.

For this research, the *Web content accessibility guidelines 2.0* were used as heuristics . This method was used for identifying the problems that are associated with the user interface of the website. Because of the second research questions expressed need for knowing what combination of methods the Tax Administration may consider utilizing, three methods were included. The heuristic evaluation might be well equipped for some aspects of the accessibility testing strategy; the analysis indicated what accessibility issues it can find. In general, the heuristic evaluation method can be difficult to do because one person has a smaller chance at finding all accessibility issues in the interface; having more than one person included in such, a process might be beneficial.

### **3.1.1 Evaluation with automated accessibility evaluation tools**

Several tools were identified as suitable for an accessibility testing process through the literature review. It was not possible to know what tool was best based on the retrieved information. As of today, there exist many tools that can run an accessibility test. World Wide Web Consortium (W3C) hosts a web accessibility evaluation tools list<sup>16</sup>. How these tools work vary, some of them measure the WCAG criteria and other may perhaps use other metrics for the evaluation.

To be certain of what tool was the most beneficial, all five tools were compared to one another. In this case the results they reported were compared with one another, in addition to this the user experience of the tools were evaluated. A comparative research is the act of comparing two or more elements with a certain view for discovering something about one or all of the things being compared. The view in this case was that the accessibility issues of a webpage had to be identified. The result from the tools was compared, these were also compared to the results from the other evaluation methods (participant observation and heuristic evaluation).

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<sup>16</sup> <http://www.w3.org/WAI/ER/tools/>

One can evaluate these tools in several ways. For this research, the main important thing is that they present their findings in an orderly way and are easy to use (Groves, 2014) in addition to detecting the accessibility issues. The tools that were included had to check for at least level AA of the WAI conformance levels. In Norway, websites are only required to conform to conformance level AA to meet the requirements of the legislation. However, the level AAA criterion can give valuable feedback to the developers, testers and designers. When the Tax Administrations team wishes to provide accessible pages to their users then it can be of value to include testing of level AAA criteria, even though this is not required.

By investigating previous literature, the tools that were identified as suitable were: AChecker, ASES, MAUVE, WAVE and SortSite. Other tools that were identified as suitable through the literature review were not included because they were either outdated or required license for usage. Because of the emphasis on the user experience of the tools, a narrative way of presenting the data was utilized rather than just using numbers. The only numbers that were provided by this comparison were the amount of issues detected and reporting of false positives.

## **3.2 Participants and Setting**

The scope of selection was limited to participants living in or close to Oslo, due to logistics and time constraints. All participants were able to decide where they felt most comfortable executing the user test. Three options were given: at the Norwegian Tax Administration lab, at Oslo and Akershus University College of applied sciences or a place of their own choice. Two of the participants chose to conduct the test at the university colleges' lab, two chose their own house and one chose to conduct the user test at the work place. It was essential that the participants utilized their own equipment so that the observation would be similar to a real situation of them interacting with the page.

The participants that were investigated for this research were users who utilize screen readers. All users in this research were totally blind; because of this, they are dependent on using a screen reader when interacting with a computer. In previous literature regarding user testing with people with disabilities it is commonly suggested that user tests of this kind should include three or more users from each "group" of impairment, W3C recommends this and states that testing for accessibility can be done similarly as testing for usability. No clear

definition on how to test for accessibility is provided. For this research, five participants were included in the user test. Three users are enough according to W3C, however, five participants will often be better when conducting a usability test (see figure 10). Since only one “group” of disability were included in the user test the number recommended for usability testing was used, so that the test could find enough accessibility issues. Because of time limitations, only one type of impairment was tested for this participant observation.

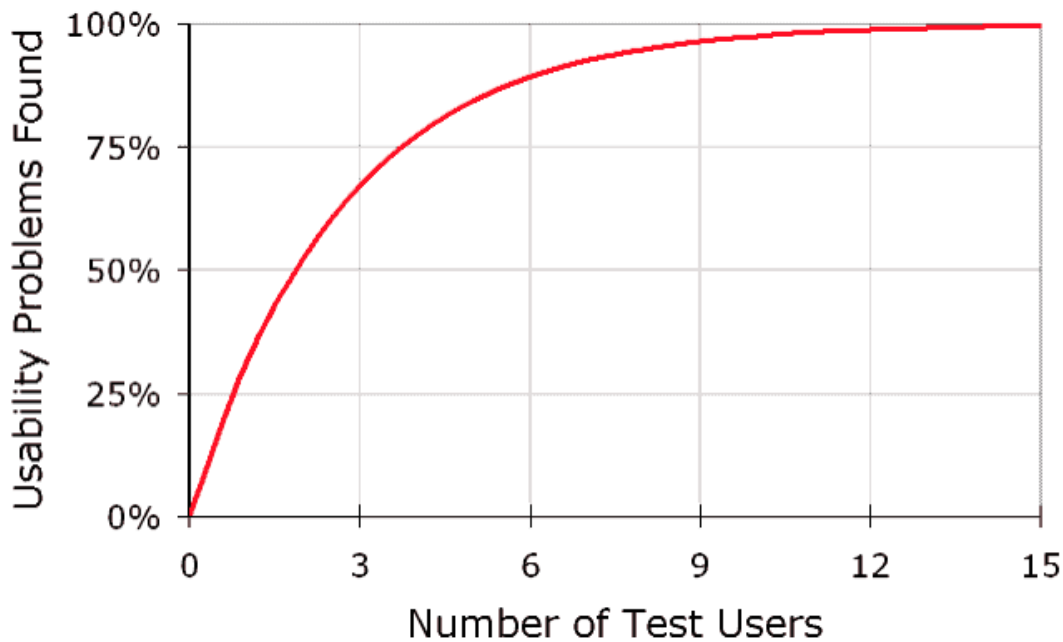


Figure 11 Shows that most usability problems can be found with five participants, Proportion of usability problems, Jacob Nielsen, nngroup

### 3.2.1 Obtaining the Study Sample

The research aimed at including users of screen readers and the help of several organizations was sought to recruit participants for the research. One of them was the Norwegian Blind Association who was willing to post the announcement on their webpage. All five participants were found through the Norwegian Blind Association.

## 3.3 Procedure

After obtaining the study sample, the participants were contacted for making the arrangements of the observation. Each participant was contacted by e-mail; the consent form, which is attached to this document, was included in the e-mail. The consent form contains information about the background and objectives of this study. The form also informed the participants about how the data would be dealt with, and what the

participation in this research entailed. It also made it clear to the participants that it was voluntary to take part in the study, and that if they regretted their participation then all data would be deleted if they wanted that. All participants were given the same tasks, (please see Appendix-2 for further details). All participants agreed to having the session recorded using a recording device, they used their own laptops and screen readers, signatures were required before proceeding with the test. The execution of the user test was explained to the participants before proceeding with the tasks. The nature of this user test was “think aloud”, meaning that they were encouraged to comment what was happening during the test, signatory took notes during the observation and gave hints when the participants were uncertain of the correct navigation path to the end page/form. The tasks were designed as if the participants had real objectives for visiting the page.

The heuristic evaluation was conducted by signatory, WCAG 2.0<sup>17</sup> was used as metrics for the evaluation, and all criteria were checked manually. Some of the guidelines did not have to be included, e.g. those relating to video contents. Each criterion has several techniques, which can be used to meet the requirements of the success criteria. These techniques often describe how one can utilize CSS, HTML, elements, aria-labelledby etc. in order to make the contents accessible. The webpage that was investigated was quite large, identifying the correct element within the contents can be very time consuming. When issues were identified within the contents, a description of the problem was noted in addition to the success criteria it related to. For this research the *Travel Deduction Calculator*, *Table Based Deductions* and *Special Allowance for Disability* were evaluated. However, only one out of these was used for further analysis.

When conducting the testing with the different automated accessibility evaluation tools the *Travel Deduction Calculator* was evaluated with all five tools. When the evaluation tool presented the results from the accessibility evaluation, the issues detected were noted. If it was clear that there were duplicates, then they were overlooked. Many of the issues were false positives, for ensuring that the issues were real accessibility issues the HTML content of the webpage had to be inspected. By inspecting the HTML content and searching for the issues that was presented by the tool, one can see if the code lies in the user interface or if it

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<sup>17</sup> <http://www.w3.org/TR/WCAG20/>

is code that is not relevant for a user. All issues presented by the tools were investigated and the ones that could have some relevance for the user experience were noted and included further in the investigation. Next, the instruments that were utilized for this research are presented more in detail.

### 3.4 Instrumentation

There were several instruments that were used in this research: user test, observation protocol and the thematic descriptive approach for analysis. The user test protocol was developed so that all participants would proceed by completing the same tasks (please see Appendix-2 in 8.2 for further details). The user test protocol was divided into four main tasks. It was preferable that the participants ought to search a bit through the web pages, therefore the tasks were designed so that they would have to interact with the pages for being able to navigate to the end pages. The tasks in the user testing protocol were the same for all if participants, for ensuring validity of the results.

Tasks were designed in a way that they would include several form services in addition to pages. The tasks required that the participants visited several pages in order for navigating to a final page where a form or service required some level of interaction. It was a natural way of testing since tasks were made as “real” as possible. The intention was to be able to observe the users as if they were seeking a specific service and so that one could detect what challenges the search maybe include, in addition to problems faced when interacting with the dynamic content.

The Norwegian Tax Administration proposed including the *Travel Deduction calculator* in the user test. It is a highly dynamic form that requires several input fields to be filled. As with all of the tasks, the users had to find the page by searching through the webpage first. The next task was also navigation to a form, this form is called the *Table-based deduction for tax deduction cards*, the reason for including this form as one of the four main tasks is because it differs from *Travel Deduction calculator*. It is not as dynamic and it was more HTML based, these types of forms can sometimes be easier to use for people utilizing assistive technologies. In the introduction part of this document, a page called *Special allowance for disability* and the form *Application for tax deduction for foreign citizens* were introduced. Both of these services are included in the testing, the users had to find the pages where the



forms are hosted and then complete the task by interacting with them. *Special allowance for disability* is a page that contains minimal dynamic content. It is relevant for people with disabilities, and was therefore included as a part of this test.

For the Heuristic evaluation the Web Content Accessibility Guidelines 2.0 were used as metrics. All contents were checked according to all of the criteria. The reason for checking against the level AAA criteria also is because these will help the web pages become more accessible. The Norwegian Anti-Discrimination Act has defined that for a page to be universally accessible it has to comply with the level AA of these guidelines, because of this these are the guidelines used in this research.

For conducting the automated accessibility evaluations, the tools that were included were tools that were found through the literature study. Testing all of the tools available would require too much time. Therefore, only tools that according to existing literature seem to contribute with valuable results were used in this research. WAAT<sup>18</sup>, was identified through the literature review could unfortunately not be attained; therefore it was not included in the evaluation. WorldSpace<sup>19</sup> was also excluded from the testing because it requires a license.

### 3.5 Data processing and Analysis

The nature of both research questions were qualitative, the first one was investigated by conducting a participant observation, which generated qualitative data. Analysis begins with identification of the themes emerging from the raw data, this process is sometimes referred to as “open coding” (Strauss & Corbin, 1990). “Because each qualitative study is unique, the analytical approach used will be unique” (NFS, 1997). When analysing the data generated from the participant observation common occurrences were identified. The data was collected during the observation, by observing and recording the user tests. The participant observations were conducted either at the HIOA lab or at in the participants’ house. Essential for collecting the data was to arrange the user test in a natural environment. The

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<sup>18</sup> <http://www.accessible-eu.org/index.php/waat.html>

<sup>19</sup> <http://www.mitsue.co.jp/english/service/accessibility/worldspace.html>

notes of the participant observation were written exactly as it was observed, no assumptions were made, the events should be described in as much detail as possible.

For the participant observation, it was essential to identify the problems that the users encountered when they interacted with the Norwegian Tax Administration webpage. In addition to identifying the common problems, the most frequent issues were outlined. Before identifying these issues, the masse of data had to be organized and reconfigured, all notes from the user tests were inserted into one common Word document, also, all recordings of the participant observations were carefully listened to in order to be certain that all details were included in the final document. Qualitative data analysis can be fundamentally viewed as an iterative process, the data might have to be revisited many times as additional questions may emerge when new connections are identified along a deepening understanding of the material (NSF, 1997). Qualitative data can be analysed in several ways; two common methods are coding and recursive abstraction. Coding is especially suitable when the researcher is analysing highly structured data.

For this research, the recursive abstraction method in addition to coding was applied. Recursive abstraction is the process of analysing the data by summarizing it; the result is a summary that provided details describing the phenomenon that was investigated. Common themes in the transcripts were identified by utilizing the thematic descriptive approach. Coding usually involves assigning a word, phrase, number or symbol to each coding category. The method allows researcher to summarize and synthesize what is happening in the data (NSF, 1997). One coding category was created for the analysis of the participant observation; this was the category of problems that were faced by the participants during the user test. Microsoft Word was the tool that was used for assessing this data process and analysis. Because of the nature of recursive abstraction, the data was presented in the form of a summary; in addition to this, the errors that were identified were presented in a table in order for the distinctions of the different evaluation methods to become clear for the reader.

All of the automated accessibility evaluation tools provide the users with a report that contains all of the accessibility issues that was detected. The reports provided were not sufficient, the errors they reported were inspected, and it was decided if they were actual



For conducting the heuristic evaluation of the pages, Microsoft Word was utilized for annotating the potential accessibility issues. The web pages were inspected by using the web browser safari and Firefox, the inspect element function in the browser was utilized for investigating the structural elements. The data was collected at HIOA by signatory. Word documents were created for all pages that were evaluated. All Web Content Accessibility Guidelines were used as heuristics, if an issue was detected this was inserted into the document, a simple list containing all detected issues was created. The reason for choosing all of the guidelines as heuristics instead of composing some tasks was to ensure that the evaluation intended to find all accessibility issues of the interface just like the other two evaluation methods. The data set was analysed by identifying what problem in the user interface the issue related to and then summarise it. The accessibility issues detected in the heuristic evaluation were presented in a table together with the issues identified in the other two inspections. The reason for presenting the data in this manner was for enabling it to be compared to the results from the participant observation and the evaluation with the different automated tools. When conducting a research there are ethical considerations and potential biases that the researcher has to be aware of. Next, the ethical considerations and potential biases are presented.

## **3.6 Ethical Considerations and Bias**

### **3.6.1 Ethical considerations**

There are several ethical considerations that occur through the process of conducting a research. When including participants, it should aim at (a) minimising the risk of harm; (b) obtaining informed consent; (c) protecting anonymity and confidentiality; (d) avoiding deceptive practices; and (e) providing the right to withdraw (Lund Research Ltd, 2012). Ethical principles may vary, and there are a number of basic principles. This research included all of the principles mentioned above for ensuring that the research do not collide with any ethical standards. No ethical boundaries were crossed; it was decided to obtain a consent form, which is required by NSD for conducting a research of this kind. The Norwegian Centre for Research Data (NSD) did approve of the methods that were utilised for collection of the data generated by the participant observation. All participants were informed that they at any time were able to draw their commitment or having the data

anonymized at once, if they wanted data could also be deleted. All data collected from the participant observation was anonymized, therefore it is not possible to recognise the participants in the final report. In the findings of this research, the participants were presented with the assistive technology they utilized, gender and level of experience, because of the potential of recognizing any of them details like age was left out. It was important when conducting the research that the participants felt comfortable and safe during the user test.

For a sampling strategy, it was selected methods that had been utilized by previous researchers, and recommended for use when conducting research of this kind. Sometimes researchers may have his/her own preferences on what sampling techniques that ought to be utilized for collecting the data, however, for the research the techniques selected was methods that were identified through reviewing literature. Furthermore, this research produced an accessibility-testing manual with the aim at supporting the Norwegian Tax Administration testing for accessibility. Web accessibility and universal design of ICT are relatively new topics, due to this there has not yet been conducted enough research on the topics in order for a precise definition on how one can ensure that the webpage is inclusive for everybody. Therefore, it was important not to state that the accessibility-testing manual, produced from this research, was a final blueprint on how to ensure accessible web contents, but rather a suggestion that includes key elements.

### **3.6.2 Potential Biases**

Humans will always be disposed of embracing information that confirms their preconceptions and to reject information that contradicts them. When collecting the data for the literature review, researchers will be disposed for selecting data that support their beliefs. When searching for information for the literature review several keywords were used for searching through different research databases for trying to find the most relevant information, keywords selected were selected by the researcher, this can definitely impact the outcomes of the search. When selecting the information from the research papers the main findings of the researchers were presented, not information that might not be fully supported. The literature review plays an important part in the further development of the research methodology, by having read through extensive amounts of relevant research

papers the researcher aimed at including enough information to not let the human bias be noticeable on the results presented.

Constructing the tasks for the participant observation was done solely by the researcher. This is a bias because the research decides the tasks that he/she finds suitable. The researcher also selects all of the methods, participants, instruments and decides how the data is analysed, based on this the final conclusion is made. For this research, the instruments, method and participants were selected because they were suitable for the research. The researcher is aware of potential biases, presentation and interpretation of the qualitative data were presented as objectively as possible.

### **3.7 Summary**

The qualitative research design utilized for this research was selected through reviewing literature and other similar research projects investigating similar phenomenon. The research design consisted of a combination of participant observation, heuristic evaluation and manual evaluation, where five participants were included in the study, its main objectives was to inform whether the methods should be utilized or not by in the future and how. The data obtained were analysed by comparing the results presented in tables in addition to reporting key features from the participant observation. The findings that were collected through this research design are presented next.

# 4 Findings

This chapter presents the results from the user test, heuristic evaluation and the evaluation of the automated testing tools.

## 4.1 Selection of Pages and Forms

In this section, the participants, the pages and forms they were introduced to, and the tasks they were given are presented.

### 4.1.1 pages and forms

As mentioned in the introduction section, the Tax Administration website consists of a large selection of different pages. The navigational path to all of the selected pages and forms that were selected for the user test began at the *person* page. They provide many different forms, here forms that were included in the user test are presented.

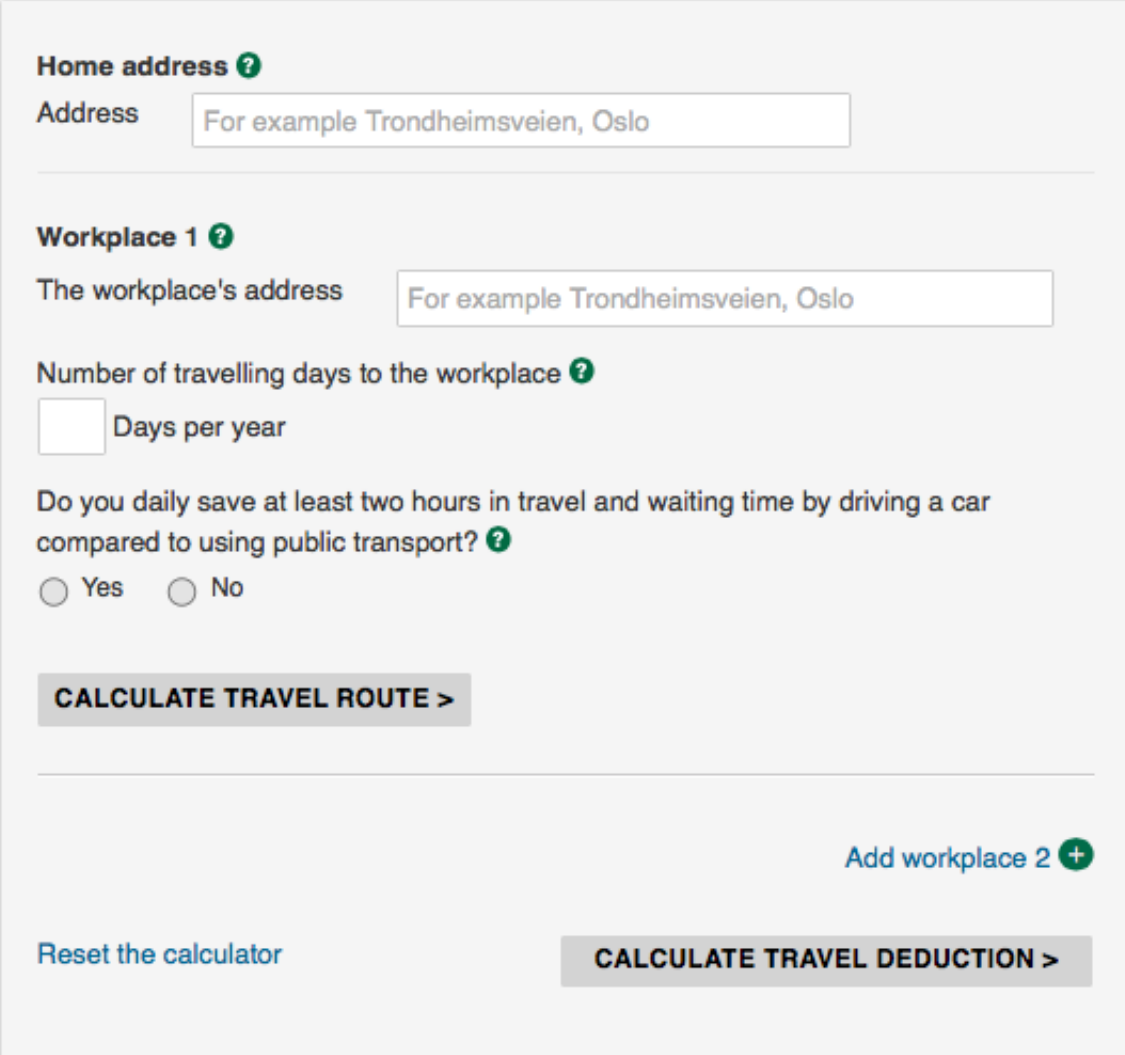
#### **Travel deduction calculator**

The *Travel deduction calculator* is a form that calculates if people are entitled to travel deductions. This calculator provides the users with information about the post he or she can edit in the tax return, and what data to insert. If the users are not entitled to tax deduction then the calculator will announce that the user can include zero NOK, at the the given post.

The user has to type home address and work address into the calculator (see figure 13). This form is dynamic; it contains much client side scripting.

## Travel deduction calculator

This will calculate how much you can claim in travel deduction be



The image shows a web form for calculating travel deductions. It is titled "Travel deduction calculator" and includes a sub-header "This will calculate how much you can claim in travel deduction be". The form is contained within a light gray border and has the following elements:

- Home address** ?: A section header followed by a text input field labeled "Address" containing the placeholder text "For example Trondheimsveien, Oslo".
- Workplace 1** ?: A section header followed by a text input field labeled "The workplace's address" containing the placeholder text "For example Trondheimsveien, Oslo".
- Number of travelling days to the workplace** ?: A text input field labeled "Days per year" with a small square input box.
- Do you daily save at least two hours in travel and waiting time by driving a car compared to using public transport?** ?: A question followed by two radio button options: "Yes" and "No".
- CALCULATE TRAVEL ROUTE >**: A gray button with white text and a right-pointing chevron.
- Add workplace 2** +: A blue text link with a plus sign icon.
- Reset the calculator**: A blue text link.
- CALCULATE TRAVEL DEDUCTION >**: A gray button with white text and a right-pointing chevron.

Figure 13 Travel Deduction Calculator

### Table-based deductions for tax deduction cards

Another type of service provided by the website is the *table-based deductions* form. This service is an electronic version of the deduction tables. This deduction table simply shows how much tax an employer must deduct. This service requires input from the user. The form



is a HTML form in the browser, it contains one input field, two drop-down lists, radio button option and a submit button. The form generates a table that contains the output to the user.

The screenshot shows the Skatteetaten website interface. At the top left is the Skatteetaten logo. To the right are links for 'Bokmål', 'Nynorsk', and 'Help'. The main heading is 'Table-based deductions for tax deduction cards 2016'. Below this, there is a text prompt: 'Enter the table number, type of income and deduction period to display the complete tax deduction table.' The form includes three input fields: 'Table number' with a dropdown menu showing '7100', 'Income type' with radio buttons for 'Salary' (selected) and 'Pension', and 'Deduction period' with a dropdown menu showing 'Month'. A 'Display table' button is positioned to the right of these fields. Below this section, there is another text prompt: '...and the deduction basis to calculate withholding tax'. This section has a 'Deduction basis' input field with the value '0' and a 'Calculate withholding tax' button. At the bottom, there is a horizontal line followed by contact information: 'If you have any questions concerning taxes, call the Skatteetaten (Norwegian Tax Administration) at 800 80 000. You will find the adress of the [skattekontoret \(the Tax Office\) here.](#)'

Figure 14 Table-based deductions for tax deduction cards 2016

In addition to these two services, two of the services presented in paragraph 1.8 were also included in this user test, these were *Special allowance for disability* and *Application for deduction for foreign citizens*.

## 4.2 User Testing

### 4.2.1 Participants

Table 1 presents the participants. They are presented by their gender, age group, level of experience using the technologies and the screen reader they used. They decided themselves what level of experience they thought was appropriate.

**Table 1** The participants

<b>Gender</b>	<b>Level of experience</b>	<b>Screen reader</b>
<b>Male</b>	Expert	Voiceover
<b>Female</b>	Intermediate	JAWS
<b>Female</b>	Novice	JAWS
<b>Male</b>	Expert	SuperNova
<b>Female</b>	Intermediate	JAWS

Age was left out of this table so that it is not possible to recognize any of the participants.

#### **4.2.2 Tasks given to respondents**

The participants were given four main tasks, all of these included navigation of the pages, this by having them find the destination within the pages themselves. The importance of this test was to see if the pages were accessible, hence seeing if the assistive technologies worked well with the pages and getting feedback from the users. For this research it was chosen not to measure the time it took the different users to complete the task. Because there are several methods they could use to reach the goal. The users were given hints during the test if they did not manage to find the correct way.

Four main tasks were constructed for this user test. These four tasks were somewhat alike given in that they all required navigation through several pages within the website. The first research question that was defined for this thesis was: "What problems do the users of screen readers face when they interact with the Norwegian Tax Administration pages and forms?" For best being able to define what problems the users of screen readers face when they interact with these pages, different types of forms were chosen for the test. Preferably, the testing would include all different forms and pages; this, however, is quite time consuming and could therefore not be preceded.

Using screen recording software for the user test would have given detailed information about the test. By using software that captures all activity during this process it would be possible to view the screen in addition to hearing the comments of the participant and reading the notes of the observer. However, for this research it was decided that the

participants were to use their own equipment. Installing screen recorder software on all these computers was not an option for this research. In future testing processes, where the actual test will take place on a computer that belongs to the organization that is arranging the test, software that captures screen, both audio and video, can be a valuable asset. For this user test, notes of the session in addition to audio recording of the “think aloud” user test was utilized.

### **Task one**

In the first task, the participants were given the mission to find the *travel deduction calculator* and then interact with it. They could choose what information to insert into the calculator, before submitting it. The hierarchical path to the travel deduction calculator was noted down systematically and used as a structure for the user test by the observer. There are also several ways one can navigate to the form, e.g. by using the search field or Google. The step-by-step navigation was used to have for taking notes of the observation. The participants were encouraged to navigate through the sites in the way that was most natural for them.

Figure 15 is a snapshot from part one of the user test. The navigational steps to the main part of the task were listed, all with the belonging attributes time, agility, challenges, error and comment. If something special occurred, for example a button that did not respond properly, then this was noted here. The participants’ comments during the tasks were noted here too. Please see appendix 2 for further details about the user test protocol.

### Part 1

This task consists of interacting with the website

Enter the Norwegian Tax Authorities Web page:

1. Choose "person" an enter option:

Time:

Agility:

Challenges:

Error:

Comment:

2. Choose "Tax Return":

Time:

Agility:

Challenges:

Error:

Comment:

Figure 15 Snapshot from the user test

To get information from the *travel deduction calculator*, users had to fill in the home address, workplaces address, and number of travelling days to the workplace and select no/yes on one question. The users choose what information they wanted to inserted into the form. When these details had been properly entered, then the users were supposed to find out if what their expected travel deductions were, if any. The users then had to submit the information and press the "calculate travel deduction" button.

### **Task two**

In this task, the users were given a mission to find the form called *table-based deductions for tax deduction cards 2016*. This task is similar to task one. The users had start at the main page and then search for the form. There are only three navigational steps needed for finding the *Table-based deductions* form, if they path from the main menu is selected. When

the users arrived at the *Table-based deduction* page, they must press a button to open the form. Here the users were supposed to interact with the form and retrieve relevant information. This form does only contain one input field, in addition to two <select> menus, one radio button and a submit button. This form is different from the one in the task 1.

### **Task three**

This task did not include a form like the two previous tasks. Here the participants also had to start at the beginning of the webpage and then navigate to the given destination, which was *Special allowance for disability*. On this page, the users only had to select year 2014 and list the belonging information. This was the that where the participants ended up at a page rather than a form. To complete this task, the users had to interact with the page by simply using a list box and then press a submit button. Then the page presented some information that they were supposed to get.

The participants all commented aloud during this task. If users navigate to this page by using the main menu, then it will require five clicks. This is a long path and it requires some level of understanding regarding the context of the form. The participants experienced some level of uncertainty when it came to finding the right way to the page. Unfortunately, not all participants managed to complete this task. There did occur some problems, one participant had to press the button twice in order for it to respond, another participant did not get any response from the button at all.

### **Task four**

For this task, the users have to download a document and then fill in some information. This document is the *Application for tax deduction card for foreign citizens*. When arriving at the page the users are provided with two options, either a PDF or Word document. For finding this page page users had to click five times (if they used the main menu). Participants appeared to find this path ok; some confirmations about the direction were given. All of the users managed to download the document. However, no participants were able to fill in the in whole form, they were not able to perceive the text input fields. Because of this, none of the participants managed to complete the task.

### **Interview**

The interview consisted of four main questions. The participants were asked to think aloud and comment during the tasks. Therefore, most of their opinions about the session were already registered. Because of this, the interview was short.

### 4.2.3 Results

Here the results obtained from the user tests are presented. The results are divided into two main parts, the issues that relates to the individual pages (including the menus), and the issues that related to the forms.

#### Pages

Not all users were sure of what the right menu option was at all given times. A menu option that was commented by almost all of the participants was the “work and education” selection in the “topic and deductions” menu. Here four out of the five users made remarks that they thought it was hard to know that this was the right option for finding the *Travel deduction calculator*. The Travel (home-work) selection was commented as challenging to perceive as well.

When searching for the *special allowance for disability* page, two of the participants chose to find it through a search engine. One used Google and the other used the web pages’ own search engine. The participants had to navigate through “topic and deductions” if they choose to use the menu, here it was noted that they had some problems with agility. It was commented that it did not seem logically placed, two of the participants spent much time on this part. Further, “pension and disability benefit” were surpassed by one of the participants, it was commented: “context is hard”. As mentioned earlier, *Special allowance for disability* is a page that contains a select menu and a submit button (in addition to some text). One of the participants was not able to immediately detect the select menu and the submit button, this led to the user listing a lot of information; before facing some problems with the “show” button. Two users found it problematic to interact with the show button, one of them did not manage to complete the task at all, and the other participant got the information when the button was pressed twice.

In general, navigating through the pages was ok. Sometimes it was troublesome to intuitively know the right option in the menu. However, the menus were clear,

misunderstandings due to titles only happened a couple of times, and the screen readers were able to read all contents of the menus. The users of screen readers were able to communicate well with the menu, making navigation smooth; this implies that the pages can be accessed by users who depend on this type of technology. Proper names and titles is important for ensuring usability, especially when these names and titles are presented in a large menu. There did occur some confusion regarding names and titles, but overall the users found managed to access most of the contents.

## **Forms**

The *Travel deduction calculators* first input field requires the users to insert a home address; here the users faced some challenges understanding that this was an input field. The input field was not presented in a way that made it clear for the users that they should insert their address here. The same problem occurred with the next input field, the users all managed fine to write into the input fields. The form also requires that the users fill in a number in *days per year*, here the users faced some challenges. The users were confused about where in the form they were located, further there appeared to be much information presented that the participants did not understand. The *Days per year* input field did not contain proper information, so that the participants could know where they were and what they were supposed to do. When the users were going to “calculate travel deduction”, they had to press “calculate travel route” first. Some participants were confused by this and found it challenging to understand where the feedback was presented and what they had to do next. The button “calculate travel deduction” can only be pressed after the calculation of the route. Two participants did not get any response and could therefore not complete the tasks, one participant reported having to press the button twice in order for it to work. All participants were able to insert their data into the input fields and everybody was able to access most of the form controls; however, some confusion did arise regarding purpose, feedback and function.

All participants managed to complete task 4, in this task they had to type information into the *Table-based deduction* form. The page was down due to maintenance during one of the user tests, this means that one participant could not interact with the form and complete the task. In this form, the screen readers managed retrieve the information and communicate it to the users. The only thing that led some of the users to confusion was the

fact that a table called “whole table” was presented in the middle of the form. One of the participants entered this table and believed that this was presentation of the submit values. It was commented that users have to know what they are doing. All of the four participants understood the information presented in the table that appears when the submit button is pressed.

The last task, task four, required navigation to the *Application for tax deduction cad for foreign citizens*, the participants were supposed to download and fill in this form. The users were allowed to choose between a PDF or Word document, both contain the same information. It was commented among users that the process of downloading the documents was surprisingly simple. Further, some sort of feedback when it actually was downloaded could be beneficial. The main problems with this task occurred when the users started interacting with the forms. The participants were able to tab into the fields, but there was no announcement of current field. Because of this the participants did not know what to insert into the fields. A few of the fields were perceivable, “country”, “age” and another which was not spelled correctly. The form contains a lot of information and there were many input fields that were not perceivable for the users. None of the participants were able to fulfil this task. There exist applications that can be used for creating accessible forms. Another option is to create an HTML form, which automatically generates a PDF form that does not require any input, this was commented by one of the participants.

### **Interview**

All of the users commented and shared their reflections during the user test. The users answered six constructed questions at the end of the test. Since they were encouraged to think aloud during the test, many of their reflections had already been remarked. The users were asked: “How do you think this went?”, “What was OK?”, “What was difficult?”, “What can be improved?”, “Anything else to add?” and “Overall Impression?” All of the participants had petite answers to the questions, there was little need to ask follow-up questions. Overall, their meeting with the pages was ok, they appreciated the simplicity, for example example, not containing video material, still the content can be somewhat complex and challenging to locate, “You have to know exactly where to go”. It was remarked that there were too many aria landmarks, creating an unnecessary information stream at times. For improvement, they answered that the form fields could be easier to find, “To enter



information into the forms was hard, the first one was the hardest.” Another improvement is shortening of the path to the different “end goals”. One user suggested that pages should be able to function without JavaScript. Overall, the pages are operable for the users of screen readers, still they seem to agree that it is an advantage to know the contents of the pages to best be able to find the correct page or forms. The events of the user test, e.g. challenges and barriers are presented more thoroughly in the discussion chapter.

## **4.3 Heuristic Evaluation**

### **4.3.1 Selection of Pages**

The results found through the participant observations referred to issues in the user interface while the results found through evaluation with automated accessibility evaluation tools found issues in the markup language, the heuristic method was a tool for gathering insight into the code behind the issue in the interface. In addition, it is a common method for inspecting a website.

### **4.3.2 Selection of Guides**

All of the web content accessibility guidelines were checked manually. In some cases, the issues were not real accessibility issues. For example, a link that is also an image has no description, if this link is truly insignificant it becomes uncertain as to if this truly is a potential barrier for anybody. A person evaluating the page might eliminate some issues from the results, while an automatic accessibility evaluation tool will include them. Some of the success criteria that were checked are presented. There are examples of violations and successes.

As mentioned in the introduction of this thesis, the Norwegian Ant-Discrimination- and Accessibility Act requires that public web pages in Norway are universally accessible. A universally designed webpage is defined as accessible by fulfilling the double A criterion of the WCAG 2.0. These Web Content Accessibility Guidelines are available on the World Wide Web Consortium webpage. They were used as the heuristics for this evaluation. There are four main principles of WGAC 2.0: Perceivable, Operable, Understandable and Robust. The guidelines are presented under the principles; all guidelines are divided into success criteria.

In this heuristic evaluation, the pages and forms were manually checked by checking if the code complied with all of these success criteria.

The guidelines are presented as a list, where it is possible to navigate directly to guidelines from the table of contents. In this study, the full list of the success criterion was used as heuristics. To fulfil the standards of the guidelines these success criteria has to be met.

## Table of Contents

- [Introduction](#)
  - [WCAG 2.0 Layers of Guidance](#)
  - [WCAG 2.0 Supporting Documents](#)
  - [Important Terms in WCAG 2.0](#)
- [WCAG 2.0 Guidelines](#)
  - [1 Perceivable](#)
    - [1.1 Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language.](#)
    - [1.2 Provide alternatives for time-based media.](#)
    - [1.3 Create content that can be presented in different ways \(for example simpler layout\) without losing information or structure.](#)
    - [1.4 Make it easier for users to see and hear content including separating foreground from background.](#)
  - [2 Operable](#)
    - [2.1 Make all functionality available from a keyboard.](#)
    - [2.2 Provide users enough time to read and use content.](#)
    - [2.3 Do not design content in a way that is known to cause seizures.](#)
    - [2.4 Provide ways to help users navigate, find content, and determine where they are.](#)
  - [3 Understandable](#)
    - [3.1 Make text content readable and understandable.](#)
    - [3.2 Make Web pages appear and operate in predictable ways.](#)
    - [3.3 Help users avoid and correct mistakes.](#)
  - [4 Robust](#)
    - [4.1 Maximize compatibility with current and future user agents, including assistive technologies.](#)

Figure 16 Web content accessibility guidelines Table of Contents

Figure 16 contains one out of thirteen guidelines. The guidelines are defined with a blue background colour, there is also linked information about how to understand the guideline on the right side of the text. As shown in figure 17, the success criteria are divided as subsections under the guidelines. Next to every success criterion, there is provided a box that links the users to information about how to meet the success criteria and how to understand it. This information contains explanations and some examples of how the HTML, and other contents, should look like.

**Guideline 1.4 Distinguishable: Make it easier for users to see and hear content including separating foreground from background.**

[Understanding Guideline 1.4](#)

**1.4.1 Use of Color:** Color is not used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element. (Level A)

[How to Meet 1.4.1](#)  
[Understanding 1.4.1](#)

*Note:* This success criterion addresses color perception specifically. Other forms of perception are covered in [Guideline 1.3](#) including programmatic access to color and other visual presentation coding.

**1.4.2 Audio Control:** If any audio on a Web page plays automatically for more than 3 seconds, either a mechanism is available to pause or stop the audio, or a mechanism is available to control audio volume independently from the overall system volume level. (Level A)

[How to Meet 1.4.2](#)  
[Understanding 1.4.2](#)

*Note:* Since any content that does not meet this success criterion can interfere with a user's ability to use the whole page, all content on the Web page (whether or not it is used to meet other success criteria) must meet this success criterion. See [Conformance Requirement 5: Non-Interference](#).

**1.4.3 Contrast (Minimum):** The visual presentation of text and images of text has a contrast ratio of at least 4.5:1, except for the following: (Level AA)

[How to Meet 1.4.3](#)  
[Understanding 1.4.3](#)

- **Large Text:** Large-scale text and images of large-scale text have a contrast ratio of at least 3:1;
- **Incidental:** Text or images of text that are part of an inactive user interface component, that are pure decoration, that are not visible to anyone, or that are part of a picture that contains significant other visual content, have no contrast requirement.
- **Logotypes:** Text that is part of a logo or brand name has no minimum contrast requirement.

**1.4.4 Resize text:** Except for captions and images of text, text can be resized without assistive technology up to 200 percent without loss of content or functionality. (Level AA)

[How to Meet 1.4.4](#)  
[Understanding 1.4.4](#)

Figure 17 Guideline 1.4 with its belonging success criteria

For this study, the heuristics were a list of the success criteria. This list was a Word document, next to each success criteria a description of the issue, if there were any, was noted. This list was kept simple to make sure it would run smoothly to retain and compare data at a later stage of the process.

### 4.3.3 Results

This section presents the findings of the heuristic evaluation. The possible challenges were described. This paragraph presents some pictures from the evaluation, in addition to some examples. Some of the examples are potential accessibility issues and some of the examples are contents one the pages that do comply with the criteria.

#### Travel Deduction Calculator

The first page that was evaluated was the *Travel Deduction Calculator*. The manual walkthrough implied twelve errors that might be accessibility issues.

Label elements and links purposes could beneficially be added. Navigating through a page with the tab key can be difficult or impossible if tab index for example is missing. In many cases, it is important for the user that the links, forms controls and objects are presented in a logical tab order. The tab order is not always the same as the order of the textual content.

This can create misunderstandings for users who need to access the content from keyboard. The tab order of the information in the travel deduction calculator is logical, but the tab key does not work in the last part of the form, the user becomes trapped. Users who rely on keyboard interface to use the Web can face problems accessing the content; this group includes people who are blind and people with physical disabilities.

A criterion 2.4.1 *A mechanism is available to bypass blocks of content that are repeated on multiple Web pages* is a criterion that is met by using ARIA landmarks. Because of the grouping of blocks by using ARIA landmarks this is not visible as if there were some visible link in the banner that allowed users to skip the information. This criterion aims to allow people who navigate several times through the content, faster access to the content of the webpage that they are seeking. Examples of “blocks of content that are repeated on multiple web pages” are heading information, e.g. links, advertisement and language menu. A sighted person will easily be able to skip this information and direct the attention to the preferred content. By using landmark role attributes, different regions of the page get its navigational landmark and the content can be skipped. Examples of these roles are banner, navigation and search.

“All functionality of the content is operable through a keyboard interface without requiring specific timings for individual keystrokes, except where the underlying function requires input that depends on the path of the users’ movement and not just the endpoints” is *success criterion 2.1.1* under the guidelines 2.1. “Make all functionality available from a keyboard.” There is more than one sufficient technique for meeting this criterion. The travel deduction calculator meets the technique by applying the technique H91 “Using HTML form controls and links.” However, two user interface elements, submit button and one of the text input fields (*Days per year* input field, see figure 18), could beneficially be marked with the proper attributes. These form controls are important for assistive technologies so that they again can present proper information to the user.

```

▼ <input name=
"ctl00$ContentMainWrapper$ContentMain$UcArbeidssted1$txtAntReisedagerPendl
erboligArbplass" type="text" id=
"ctl00_ContentMainWrapper_ContentMain_UcArbeidssted1_TxtAntReisedagerPendl
erboligArbplass" size="3" class="workPlaceDays-1 controls text">
  ▼ Shadow Content
    <div contenteditable="plaintext-only"></div>
  </input>
  <span>Days per year</span>
  <div class="errorMsg error"></div>
</li>

```

Figure 18 *Days per year* input field missing label element

Guideline 4.1.1 is about parsing; this guideline requires the page to make sure that elements within the mark up languages have complete start and end tags. *Success criterion G134: Validating Web pages provides a list of validators that can validate HTML and XHTML.* The travel deduction calculator was validated by using the W3C Mark up Validation Service; this allows users to validate HTML and XHTML files by using the URL. In this validation, 21 errors and 6 warnings were detected. Among these were some duplicated IDs, most of the errors are similar and refers to form attributes that must refer to non-hidden form controls.

### **Table-based deductions for tax deduction cards 2016**

This page only consists of the form that arranges for the users to find out their deduction basis. The analysis of this form using heuristics detected fourteen potential accessibility issues. Several of these were level AAA, this means that not all issues were analysed further. Selecting proper attributes for form controls is something that is repeated in the guidelines, meaning that one issue might alert more than one success criterion. Because of this, making small changes in the contents can improve several of these occurrences of issues.

Guideline 1.2 *Time-based Media*, aim at providing alternatives for time-based media. Several success criteria belong to this guideline. Since the webpage does not contain any time based media, pre-recorded audio or video etc. not any issues were detected here. Further, some criteria relate to the contrasts and texts of the page. In figure 19, the page is presented with different CSS. The heading is not visible and the links has the same original colour, other contents of the page also disappear by not changing the colour. Foreground colour should be able to be changed so that it can be visible for the users who depend on other colours for perceiving the page. In the image bellow, the webpage's own high contrast option was applied to the site.

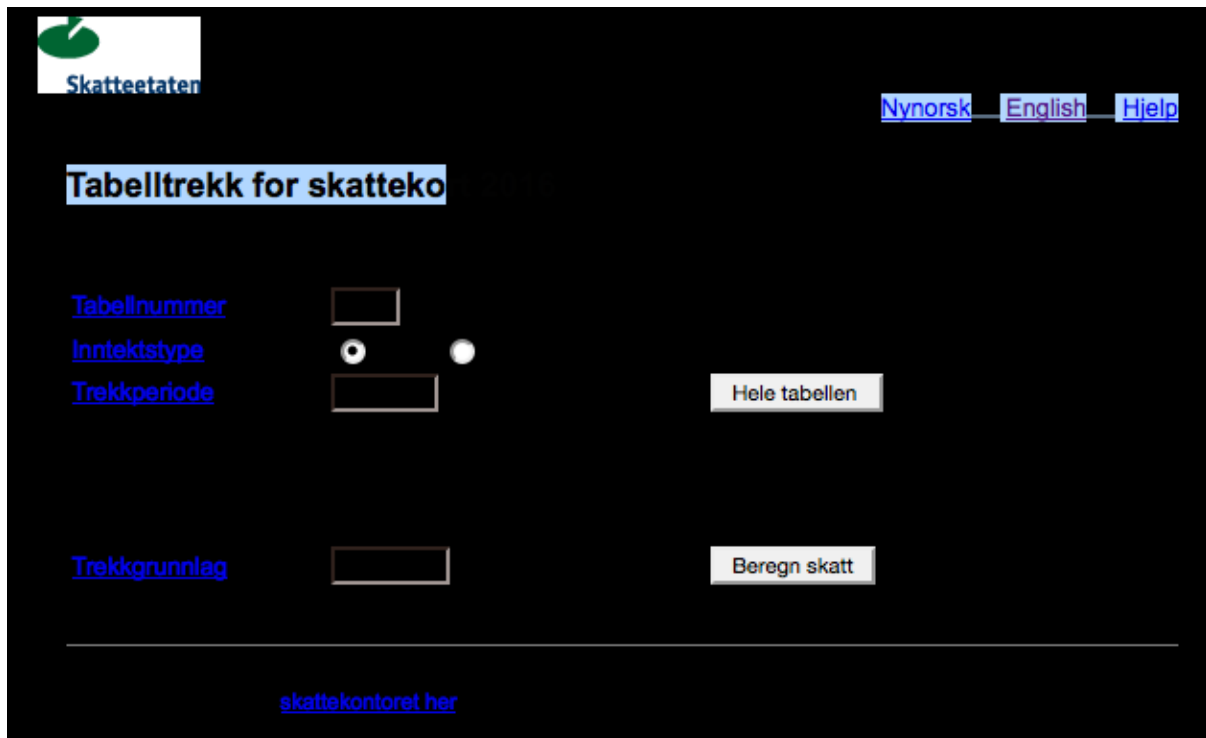


Figure 19 Table based deductions in high contrast

Figure 20 presents the same site, only with different foreground and background colours. For making these changes, the add-on "Colour That Site" for Firefox was used. The criteria 1.4.8 "For visual presentation of blocks of text, a mechanism is available to achieve the following: 1. Foreground and background colours can be selected by the user." As presented in both images, background colour and text can be changed, but the links will not display a new colour.

Skatteetaten

[Nynorsk](#) [English](#) [Hjelp](#)

## Tabelltrekk for skattekort 2016

Oppgi tabellnummeret, inntektstypen og trekkperioden for å se hele trekktabellen

[Tabellnummer](#)

[Inntektstype](#)  Lønn  Pensjon

[Trekkperiode](#)

...og trekkgrunlaget for å finne skattetrekket

[Trekkgrunnlag](#)

Har du spørsmål om skatt, ring Skatteetaten tlf 800 80 000.  
Du finner adressen til [skattekontoret her](#).

Figure 20 Table based deductions with Colour that site plug-in

For this form, there were some problems with the attributes of the different form controls. When using the tab key to navigate through the page the user is able to navigate to the end of the form, and therefore the user reaches the finish line. However, by not applying the proper form controls the user will not be able to tab onto all relevant elements of the form. The user will also have problems by knowing what he or she interacts with if the attribute that is supposed to announce it is absent. The criterion 2.4.6 requires labels or headings for it to be met. By ensuring meaningful labels and headings, this criterion helps users of screen readers and may help users with low vision that can see only a few words at a time.

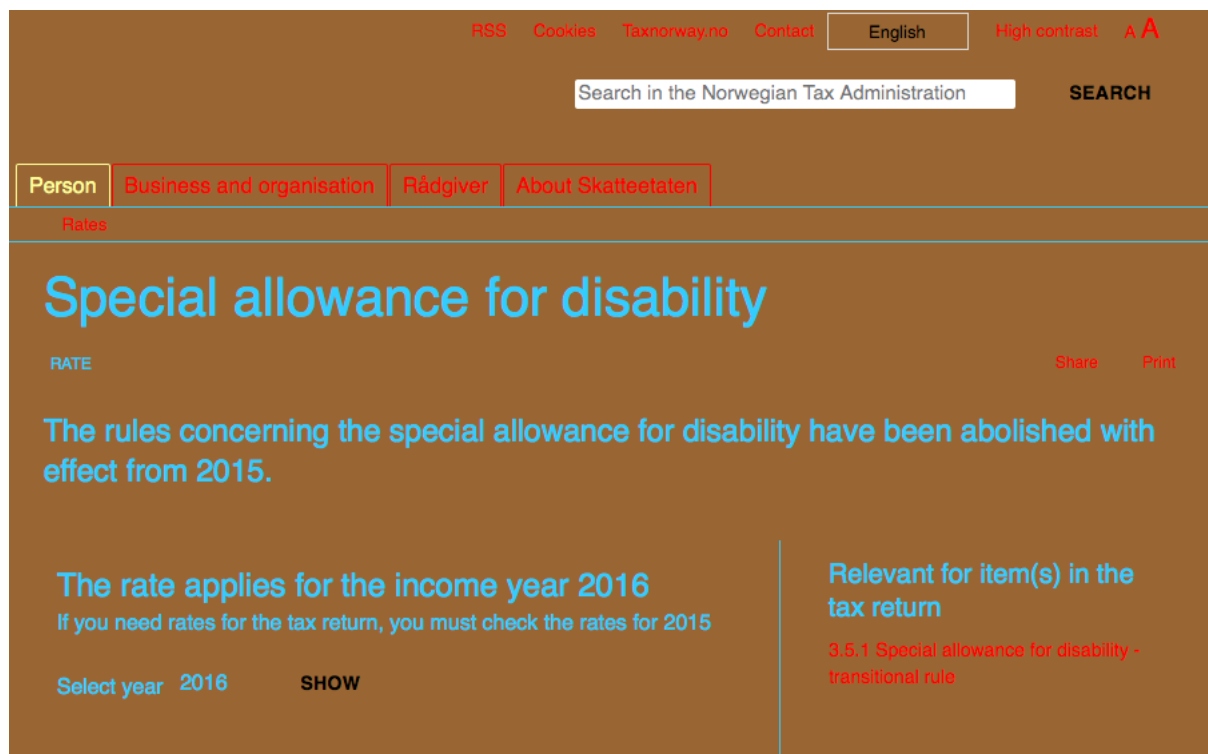
Users who rely on keyboard to operate this page will be helped by being visually able to determine what component the operator he/she is interacting with. Meaning that when a link is in focus it becomes highlighted, or when a button is in focus it is highlighted by, e.g. adding visible lines around it. Visible focus of the form control can be set by using scripting and CSS, among others. Not only people who relies on the keyboard to be able to interact with the page can benefit from component focus, but also people with short term memory limitations, limitation in executive processes, or attention limitations. In the Table-based deductions form there are controls that are highlighted when they receive focus. The links of the page are already has lining, these lines could perhaps be only visible when they received

focus. The success criteria 2.4.7 describes how the form controls can be given focus by using several techniques. In addition, WCAG specifies that the width should not be more than 80 characters on a website, the pages exceeds that list. A few other issues were identified as well. Next, the evaluation of the *special allowance for disability* page is presented.

### Special allowance for disability

The special allowance for disability is the page within the web-environment that can be described as a consistent sample of what most of the pages look like. This page contains few elements. By observing how this page complied with the success criteria, it was possible, to some extent, to get hints on how the pages in general comply with the criteria.

Figure 21 shows the webpage with new colours of the text, background visited- and unvisited links. People with cognitive, language and learning disabilities and some with low vision can have problems perceiving the text if it is not presented to them in the way that it is possible for them to read. Some users have to be able to set their own colours in the browser. These combinations will vary a lot from person to person, depending on what that person's situation is. Users who need other colours to be able to perceive the site will be able to change them. (The colours used for figure 21 has no specific meaning.)



The screenshot shows the top navigation bar with links for RSS, Cookies, Taxnorway.no, Contact, English, High contrast, and a font size selector (A A). Below the navigation is a search bar with the text "Search in the Norwegian Tax Administration" and a "SEARCH" button. The main navigation menu includes "Person", "Business and organisation", "Rådgiver", and "About Skatteetaten". The "Rates" section is highlighted. The main heading is "Special allowance for disability" in light blue. Below the heading, the word "RATE" is displayed. The main text states: "The rules concerning the special allowance for disability have been abolished with effect from 2015." There are "Share" and "Print" links. A section titled "The rate applies for the income year 2016" includes the instruction "If you need rates for the tax return, you must check the rates for 2015" and a "Select year 2016 SHOW" button. A sidebar section titled "Relevant for item(s) in the tax return" contains the link "3.5.1 Special allowance for disability - transitional rule".

Figure 21 *Special allowance for disability* with changed colours



Proper labels, id attributes and values are not always present for form controls in web pages. As mentioned earlier in this evaluation, accessibility APIs will extract the accessibility information, like these values, names and roles. If the accessibility API cannot find all information users who rely on this service will not be able to know what the form control represents. On the page of special allowance for disability, there is a list box and a button. List boxes are the HTML element `<select>`, it is required by the Web Content Accessibility Guidelines to have a `<label>` or title for such an element. The criterion *2.1.1 All functionality of the content is operable through a keyboard interface without requiring specific timing for individual keystrokes*, describes how form controls should be marked by using role, name and value. The proper labelling of elements also relates to criteria 4.1.2 and 1.3.3. Figure 22 shows the list box that needs a label element.

```

▼ <div class="yearSelect">
  <label class="inline">Select year</label>
  ▼ <div class="selector" id="uniform-
    ctl00_ContentMainWrapper_ContentMain_DdlYears">
    <span>2016</span>
    ▼ <select name="ctl00$ContentMainWrapper$ContentMain$DdlYears" id=
      "ctl00_ContentMainWrapper_ContentMain_DdlYears" style="opacity: 0;">
      <option selected="selected" value="2016">2016</option>
      <option value="2015">2015</option>
      <option value="2014">2014</option>
      <option value="2013">2013</option>
      <option value="2012">2012</option>
      <option value="2011">2011</option>
      <option value="2010">2010</option>
      <option value="2009">2009</option>
      <option value="2008">2008</option>
      <option value="2007">2007</option>
      <option value="2006">2006</option>
      <option value="2005">2005</option>
      <option value="2004">2004</option>
      <option value="2003">2003</option>
      <option value="2002">2002</option>
      <option value="2001">2001</option>
      <option value="2000">2000</option>
    </select>
  </div>

```

Figure 22 Shows the `<select>` list box needs label

The different criteria relate to each other, and as mentioned above, one problem can alert more than one criterion. Counting errors can therefore give an impression that is not perfectly accurate of the given websites' situation. Overall, this evaluation found ten potential accessibility issues; one of these errors was a duplicate, meaning that the same errors were detected when checking several criteria. One issue, can because of this, induce several errors in the results. Four of the other issues detected were of level AAA, the pages

that were tested is not required to fulfil these. One of the criterion that was marked with an “OK” got a comment for improvement, failing one of the techniques is not necessarily equivalent with the success criterion not being satisfied.

### **Application for tax deduction card for foreign citizens**

A form called “Application for tax deduction card for foreign citizens” is available on the website. Here the users are given the option between a PDF and a Word document, which provides the option to fill in the information electronically. For this heuristic evaluation, these two forms were manually checked. For the PDF form, the Web Content Accessibility Guidelines suggests that for testing forms a screen reader can be utilized for simply listening to the contents. Voiceover was utilized for listening to the contents of the forms for this evaluation.

The first document that was tested with the voiceover screen reader was the PDF version of the document; this document opens directly in the web browser, for this investigation, the safari browser was utilized. Voiceover lists most of the contents in the beginning of the document, the headlines it presents quite well. However, the screen reader does not include some of the elements, and it stops in the middle of the document with the comment “dimmed”. Using tab to navigate was not possible. The same problems occurred using Google chrome. The Word version of the document must also be downloaded before filling it. When opening the document Voiceover read the headings as with the PDF version, it further introduced the tab group. However, the form fields were not announced. All fields were available for the user, but no input field descriptions were provided. This form is not accessible for screen reader users.

Three pages were inspected manually using WCAG 2.0 as heuristics. The last form was not tested using the heuristics because it was not accessible with a screen reader. Some of the violations were unclear and the researcher had to decide if they were significant or not. The evaluation of the three pages detected a total of 16 success criteria that were violated. The analysis part will present a list of these success criteria. The *Travel deduction calculator* was evaluated more thoroughly than the other two pages. Therefore, these three evaluations were not compared or evaluated further. The results will only indicate some success criteria

that are easier to check manually. The results from the testing with the automated accessibility evaluation tools are presented next.

## 4.4 Automated testing tools

As mentioned previously, the tools that were evaluated in this study had to be able to check for WCAG 2.0. Because of time limitations not all tools presented on the W3C website was tested, but rather tools that were identified through reviewing literature about automated accessibility evaluation tools. The tools were evaluated by viewing how many accessibility issues they managed to find, how many false positives they reported and the overall usability of the software. More information about the tools is presented next.

### 4.4.1 Selection of tools

It was attempted in the literature review to discuss issues related to automated accessibility evaluation tools, which could give hint on issues that need to be considered while choosing some of them for accessibility testing. For the purpose of this research, the following tools were chosen: WAVE, MAUVE, SortSite, AccessMonitor and AChecker. WC3 presents a list with 75 web accessibility-evaluation tools. There exist tools that are not provided in this list. Initially this research tried to find information about the tools, and based on the information decide which were the best. However, five potential tools were identified through the literature review as ok. These tools test for WCAG 2.0 and are free. They were compared so that the best one could be recommended. The five automated accessibility evaluation tools are presented next.

#### **WAVE**

WAVE<sup>7</sup> is an accessibility evaluation tool developed by WebAIM, also known as Web Accessibility in Mind, which is a non-profit organisation. In addition to this evaluation tool, WebAIMs services include accessibility training, website monitoring & reporting, certification, accessible site design, consulting and accessibility repairs. WebAIM has a website where their services are hosted in addition to information for web developers, webmasters and others who are interested in accessibility. The accessibility evaluation tool is also available as a chrome extension, WAVE also offers an accessibility API that can be

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<sup>7</sup> <http://wave.webaim.org>

downloaded. The API will evaluate the webpage and then report back to the user data about how accessible it is.

### **AccessMonitor**

AccessMonitor<sup>20</sup> is a tool that is being used by the Portuguese Public Administration. The page that hosts AccessMonitor contains an input field where everybody can insert an URL and get a validation for free. This software is in Portuguese, the results are presented with links to both code and visible feedback directly on the pages' interface. AccessMonitor checks single pages and can check for both WCAG 1.0 and WCAG 2.0.

### **MAUVE**

MAUVE<sup>21</sup> is short for MultiguideLine Accessibility and Usability Validation Environment. As mentioned in the literature revive MAUVE is not tied to any particular level of conformance. The service allows the user to check it against custom, visually impaired, Stanca act or WCAG 2.0, the conformance level is optional. MAUVE is an online tool that is free, it can validate by URL, file or by direct input.

### **SortSite**

SortSite<sup>22</sup> is a desktop application that checks websites for accessibility; it is available for Mac and Windows and is available as a web application. It is delivered by PowerMapper, they provide their customers with tools for mapping, testing and analysing websites. SortSite was released in 2007, it can check WCAG and Section 508 guidelines, further it can also test broken links and spelling errors, and further optimize for Google, Bing and Yahoo. SortSite offers several products to choose from, a free trial is available on their website. For this evaluation, the Free Trial desktop version was used.

### **AChecker**

AChecker<sup>23</sup> evaluates the HTML content for accessibility problems either by entering the webpage URL, uploading the HTML file or by pasting the complete source code from the webpage. Users will have to create a user account for login to be able to proceed with the

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<sup>20</sup> <http://www.acessibilidade.gov.pt/accessmonitor/>

<sup>21</sup> <http://giove.isti.cnr.it:8080/MauveWeb/>

<sup>22</sup> <http://www.powermapper.com/products/sortsite/>

<sup>23</sup> <http://achecker.ca/documentation/index.php?p=checker/index.php>

testing, this is free and not very time consuming. AChecker evaluated WCAG 2.0 and identified three types of problems: known problems, likely problems and potential problems.

#### 4.4.1 Results

In order to get results that can be used for comparison to the previous results the selection of pages for the different evaluations had to be consistent. Not all of the pages from the user test and heuristic evaluation were chosen for this evaluation, the *Travel Deduction Calculator* was selected to be tested with all tools, where the results were analysed in the discussion chapter. The most important objective of the testing with the different tools was to see what errors they manage to detect, if there were any false positives and if there are features that were missed. In the end it was decided, what tools may be suggested to become an included part in the accessibility-evaluation manual. Contrast checking was not a part of this investigation; contrasts are not very relevant for the users who are blind.

#### WAVE

When using the WAVE extension on the *Travel deduction calculator* it reported finding 54 errors and 21 alerts. In addition to this the evaluation tool reports 12 features, 118 structural elements, 11 HTML5 and ARIA, and 3 contrast errors. Eight out of the 54 errors were missing form labels. Figure 23 is a screenshot taken from the pages after it was evaluated by WAVE. The margin on the left side contains several red squares these represent the different errors. The eight squares on the top represent eight missing form labels. However, only one of these squares links to an actual visible error on the page, which is the form label of the input field "Number of travelling days to the workplace." Many of the reported issues may perhaps be occurrences of false positives. This error can be related to four WCAG guidelines, three of which is level A and one AA. When investigating the other "missing form labels" detected by WAVE, there were no errors, therefore these were not included further.

The next ten issues were called "Empty form labels" they did not show any actual errors when pressing the squares or trying to "inspect element." It was not possible to include them further in the process. The last 37 errors detected in this evaluation represent empty links; four out of these squares shows information about an actual empty link in the contents. This error relates to *guideline 2.4.4* called "*Link purpose (In Context)*", it contains

the importance of having a purpose of each link. The four problems associated with links are the four question marks that provide the users with help regarding the calculator.

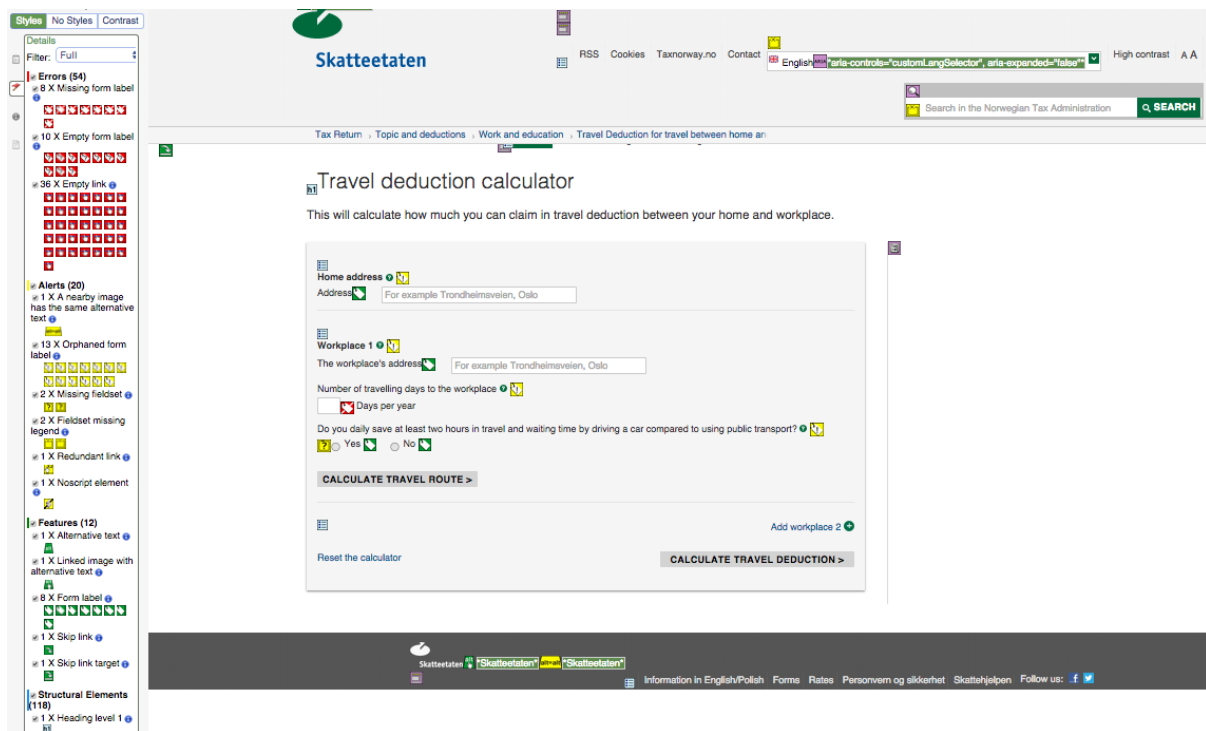


Figure 23 Evaluation Results from WAVE

Furthermore, there were several alerts discovered by the evaluation tool. The first alert was about two images with the same alternative text, this is a level A criterion *1.1.1 Non-text Content*. However, it did not show more than one actual picture, it is the logo of Tax Administration that also redirects the user back to the front page, this issue was not included further because no other element with the same label were detectable in the results presented.

The next thirteen alerts were called “Orphaned from label”, only four out of these could redirect to a concrete accessibility issue. Orphaned from label means that there exists a form label, but it is not associated with the form control in the right way. This relates to several guidelines, *1.1.1 Non-text Content*, *1.3.1 Info and Relationships*, *2.4.6 Headings and Labels* and *3.3.2 Labels or Instructions*. In this case, the help buttons triggered it. Furthermore, there were two alerts presented because of a missing fieldset, only one of these redirected to an element on the page, which was the “yes” radio button. This alert relates to success criteria *1.1.1*, *2.4.6*, *1.3.2* and *3.3.2* all of these are level A and *2.4.6* is level AA.

The next two alerts regard a fieldset missing legend; this means that a group of controls should be presented with a legend, this legend will be repeated to screen reader users for each form control within the fieldset area. These two alerts refer to the language menu on the top and the search engine. The alert relates to the guidelines *1.1.1*, *1.3.1*, *2.4.6* and *3.3.2*, all of these are level A except *2.4.6*, which is double A, it can be fixed if a higher-level description is necessary for the user to understand the function or purpose of the controls within the fieldset. Furthermore, 12 accessibility features were outlined, these were not detected as issues, but rather as the contrast error detected.

Overall, this evaluation presented 54 errors, six of these referred to elements that were possible to find in the contents. Out of the 20 alerts, eight contained information that referred to concrete elements on the page. In addition, it was detected that the contrast between the foreground and background were very low this generated three contrast errors. Seventeen accessibility errors were detected in this evaluation.

### **Usability of WAVE**

WAVE presents the errors visually; this is quite pleasant for the person conducting the evaluation. The user has to click on the error in the interface and an explanation is provided. It also presents relevant success criteria. A drawback with WAVE is that it is not consistent in all browsers. It reported different responses when using Firefox; this study used the chrome extension. For this evaluation of WAVE, the chrome extension was used. WAVE did report many false positives, it is not certain if these are actual errors that are not presented properly, or if it is content not relating to the interface, or duplicates etc. WAVE does not require much interpretation of each error, the user only has to click it and get an explanation provided, because of this, the evaluation is effective.

### **AccessMonitor**

AccessMonitor presented the results in a simple table, representing all of the issues that the tool was able to detect. This evaluation found six level A issues, one level AA and one level AAA; a total of 8 errors.

**II. Detalhe dos testes realizados**

Elementos HTML encontrados na página	Erros		
	A	AA	AAA
+ <a href="#">Texto alternativo em imagens</a>			
+ <a href="#">Uso de Javascript</a>	1		
+ <a href="#">Marcação de cabeçalhos</a>			
+ <a href="#">Marcação de Links, menus e texto dos links</a>			1
+ <a href="#">Links para contornar blocos de informação</a>			
+ <a href="#">Marcação de formulários</a>	3		
+ <a href="#">Standards W3C: (X)HTML + CSS</a>	2		
+ <a href="#">Elementos e atributos de apresentação/obsoletos</a>		1	
+ <a href="#">Metadados (título, navegação, redirecionamento, reinicialização)</a>			
+ <a href="#">Marcação do idioma principal da página</a>			

Figure 24 Evaluation results presented by AccessMonitor

When pressing the “Elementos HTML encontrados na página” the table presents information about the accessibility issue. Here there appeared some red links that directs the user to the HTML content where the issue is located, it also displays the user interface with a description of the issue directly on the user interface. The first issue of this evaluation was a WCAG failure, F59, here the evaluator reacts to and object tag, this technique is however *informative*, meaning that it is not acquired. The next issue relates to criterion 4.1.2 *Name, Role, Value*. AccessMonitor means that the search field and language selection menu needs additional description. Next, it introduced the 2.4.9 *Link Purpose Only*, it detected 24 links that can be displayed on the interface, and overall it detected 78 links within the contents. Several of the links however were properly described using technique G91: *Providing link text that describes the purpose of a link*. Further, it also detected that the input field “days per year” lacks a label; it also wanted some explanation about the radio buttons. Further it presented two warnings, it asks for a submit button, this already is present, it also presented a previously announced issue.










Elementos HTML encontrados na página	Erros		
	A	AA	AAA
<b>+ Texto alternativo em imagens</b>			
<b>- Uso de Javascript</b>	1		
<p><b>Foi identificado 1 caso em que se associam eventos a elementos não interativos</b></p> <ul style="list-style-type: none"> <li>Manipuladores de eventos: <b>3</b>   </li> <li>Eventos associados a elementos não interativos: <b>1</b>   </li> </ul> <p>Os elementos genéricos como &lt;div&gt; e &lt;span&gt; não têm um papel pré-definido. Quando se faz uso destes elementos genéricos para criar controlos de interface de utilizador em HTML, as tecnologias de apoio não dispõem de informação suficiente para descrever e interagir com os controlos.</p> <p><b>+ Documentação WCAG 2.0 de referência:</b></p>			

Figure 25 Description of accessibility issues presented by AccessMonitor

### Usability of AccessMonitor

AccessMonitor is easy to understand even though it is in Portuguese. The issues detected can also be viewed directly on the interface of the webpage, just like the WAVE tool. It also links to the relevant success criterion for the issue detected. It is possible for the user to hide the description of the issues that are not being investigated, making the presentation very simple. As mentioned, AccessMonitor is in Portuguese, however, the guidelines relating to the issues detected are presented next to it, making it possible to retrieve information in English from W3School<sup>24</sup>. Further, it also displays the issue on the user interface, this make it possible to understand it without knowing the language. In addition to this, the user will see the HTML code where the issue is, it is therefore ok to understand without any specific language skill.

### MAUVE

In this evaluation, the *Travel Deduction Calculator* was tested for the level AA conformance level, running it through a test for checking level AAA provided the same results. The total amount of errors found were 26, all were level A. Figure 26 shows MAUVEs user interface.

<sup>24</sup> <http://www.w3.org/TR/UNDERSTANDING-WCAG20/Overview.html#contents>

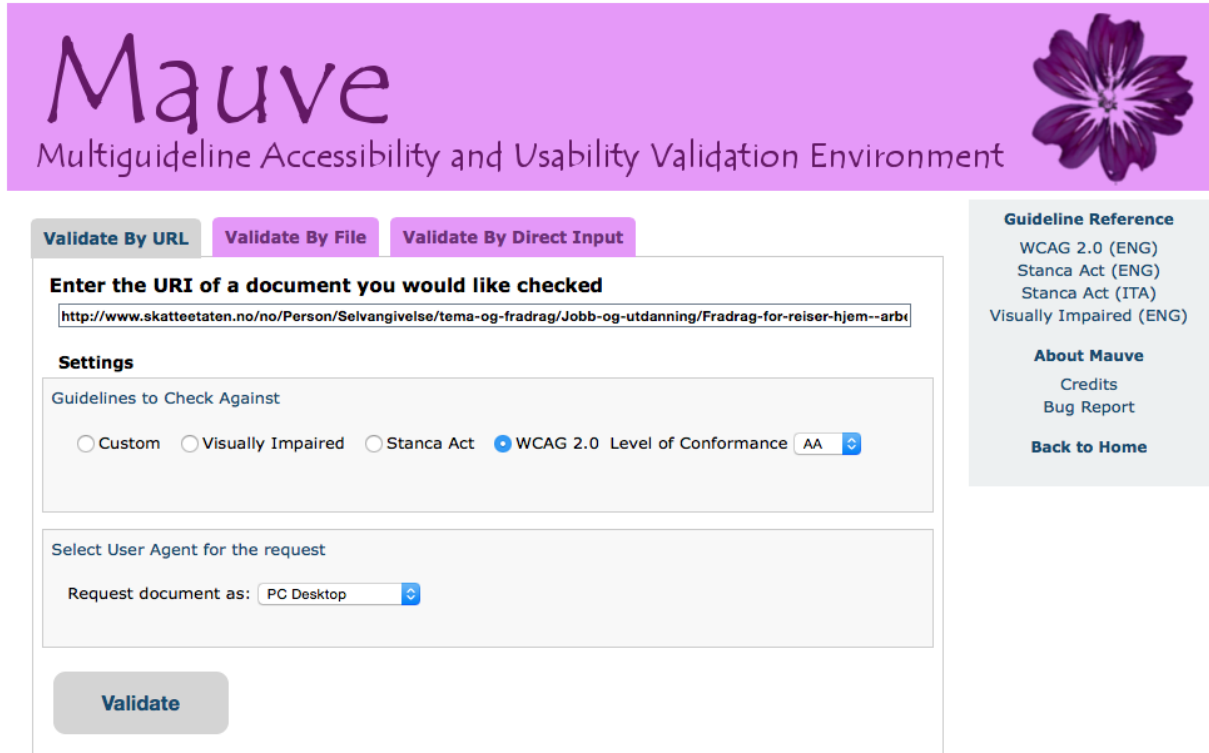


Figure 26 MAUVE’s user interface

Figure 27 shows how MAUVE presented the results. All lines of code are listed and the line that relates to the accessibility issue is highlighted in red. The issue is presented with the belonging technique that can fix the issue. It is not given that a page violates the requirements just because some technique is not met. There are several techniques that can be used to fulfil the requirements of the different criteria.

```

88 <header class="clear" role="banner">
89 <p id="logoSkatteetaten">
90 <a href="/en/Person/">Skatteetaten</a>
91 </p>
92 
93 <div id="supportMenu" class="desktopOnly" role="navigation">
94 <nav>
95 <ul>
96 <li>
97 <a href="/en/Stottemenyer/RSS/"> RSS </a>
98 </li>
99 <li>
100 <a href="/en/About-Skatteetaten/Personvern-og-sikkerhet/personvern-pa-skatteetaten-no/"> Cookies </a>
101 </li>
102 <li>
103 <a href="/en/International-pages/"> Taxnorway.no </a>
104 </li>
105 <li>
106 <a href="/en/About-Skatteetaten/Contact-us/"> Contact </a>
107 </li>
108 <li class="language">
109 <span data-custom-language-selector-large-sceen-anchor=""></span>
110 <div data-custom-language-selector="">
    H71 [WCAG 2.0 (A)] Providing a description for groups of form controls using fieldset and legend elements
111 <fieldset>
112 <div>
    F36 [WCAG 2.0 (A)] automatically submitting a form and presenting new content without prior warning when the last field in the
form is given a value
    H44 [WCAG 2.0 (A)] Using label elements to associate text labels with form controls.
    H65 [WCAG 2.0 (A)] Using the title attribute to identify form controls when the label element cannot be used
113 <select name="cti00$cti05$cti00$cti00$DdlLanguages"
onchange="javascript:setTimeout('__doPostBack('\cti00$cti05$cti00$cti00$DdlLanguages'\,\''),
id="cti00_cti05_cti00_cti00_DdlLanguages">
114 <option value="nb-NO|36459|nb-NO">Bokmål</option>
115 <option value="nn-NO|36461|nn-NO">Nynorsk</option>

```

Figure 27 Evaluation Results presented by MAUVE

Line 110 present a level A issue that describes a group of form controls that needs a description by using <fieldset> and <legend> elements. Searching the HTML of the travel deduction calculator for the code a div tag was found, as shown in the picture above, there is provided a <fieldset> tag under the language selector div. The error refers to technique H71 that in addition to the <fieldset> tag requires the <legend> tag, this so that users can understand the relationships of the form controls and interact with them as effectively as possible. Form controls that are related should be given the <fieldset> tag; within this fieldset, the <legend> tag is the first element that provides a label or description for the whole group. H71 states that “When a group of related radio buttons or checkboxes includes clear instructions and distinct selection, the use of the <fieldset> and <legend> is not required.”

The three next issues relate to the same code. The first issue referred to is the only warning this evaluation detected, the warning is the technique F36 marked in yellow, line number 112. When going to line 112 in the code of the Tax Administration web page it presents the script code for a form. In the results from the evaluation the issue is highlighted under a

<div> tag, viewing line 112 no <div> is to be found. When looking at the <div> tag presented under the last error, which matches the code on line 200 in the actual code, one finds code that matches the results from MAUVE. F36 is called *Failure of Success Criterion 3.2.2* due to “automatically submitting a form and presenting new content without prior warning when the last field in the form is given a value.” It refers to the language selector menu.

The next error detects that there are no labels for the form controls. However, the languages in the select menu are links; all of these links has a belonging description, so adding a label to this would duplicate the information. In addition to this H65 is also highlighted, “using the title attribute to identify form controls when the label element cannot be used”. This technique suggests that title tags can be added to the language selectors, if the label is not used. The next issue presents technique H71, *providing a description for groups of form controls using fieldset and legend elements*. The search engine on the site consist of an input field and a submit button. Here the <fieldset> tag is used, but there is no <legend> tag within it. There is however a label providing the users with descriptive information about the search field. The submit button has a value, providing the users with descriptive information about it.

Next to “Home address”, H93 is highlighted. It describes that id attributes should be unique on a webpage. The id is used more than one time in the code by creating a div class in addition to a link; all of the id tags are still referring to the same feature. Two errors refer to the same occurrence of the same id tag. The next four errors refer to H44 *Using label elements to associate text labels with form controls*. The objective of this technique is to use the label tag explicitly to associate form controls with the label tag. The first error displays the div code of the workplace input field, further it reacts to the HTML code of the input field called “days per year” input field. In addition to these two, MAUVE has highlighted the line where the label for "tollFerryHelp-2" is placed, it seems that the evaluator wants the form control to be associated with this label by using id="tollFerryHelp-2". There exists only a label element but no associated element. The next error is the same type of issue and refers to the distanceHelp id; it has a label associated with it.

The last error is associated with technique G140 *Separating information and structure from presentation to enable different presentations*. There seems to be an error occurring with a

span tag in a div class. Span tags are used to group inline-elements in a document; it can be used to add a hook to a certain part of the text or document. The tag contains the number zero and km, *G140* requires that structural information like this and functionality are explicitly provided and is logically separated from presentational information. The next four errors that the evaluator found were related to the technique *H44*, this technique has been mentioned previous in this paragraph. It describes how label elements should be explicitly associated with a form control. These four errors relate to the same elements as the last four labels detected. MAUVE also detected some issues relating to technique *H53* that were not visible.

### **Usability of MAUVE**

Overall MAUVEs user interface is understandable and intuitive. When the HTML code is validated it is presented to the users, the issues are outlined in red. The presentation of data could perhaps have been simpler. There are many duplicates and after checking some issues, it starts getting complicated to keep track. There is also much content that are reported as issues that the user will not interact with. Finding the issues that are relevant to the user interface is rather time consuming. The total amount of accessibility errors from this evaluation was nine.

### **SortSite**

When checking the travel deduction calculator, SortSite presents both WCAG 2.0 and Section 508 issues. Level A issues are listed first as priority A, "Accessibility users will find it impossible to use some pages." Level AA is number two as priority AA, "Accessibility users will find it difficult to use some pages." Last, we have priority AAA, "Accessibility users will find it somewhat difficult to use some pages." For this evaluation, only the issues relating to WCAG 2.0 were included. When the *Travel Deduction Calculator* was evaluated, SortSite announced that the total amount of issues found was thirteen, some of the issues relates to both WCAG and section 508. Nine of these issues were classified as "Priority 1 issues", Level A. Furthermore, when the user clicks on the belonging description to one of these issues a list of all code from the site is presented. Here the user can view the error, which are marked in red. In figure 28 the results from the SortSite-evaluation is presented. The issues are listed on the left side, they are sorted after their level of priority, and the right margin contains links to the WCAG 2.0 description of the relevant issue and a link to a page with the HTML.

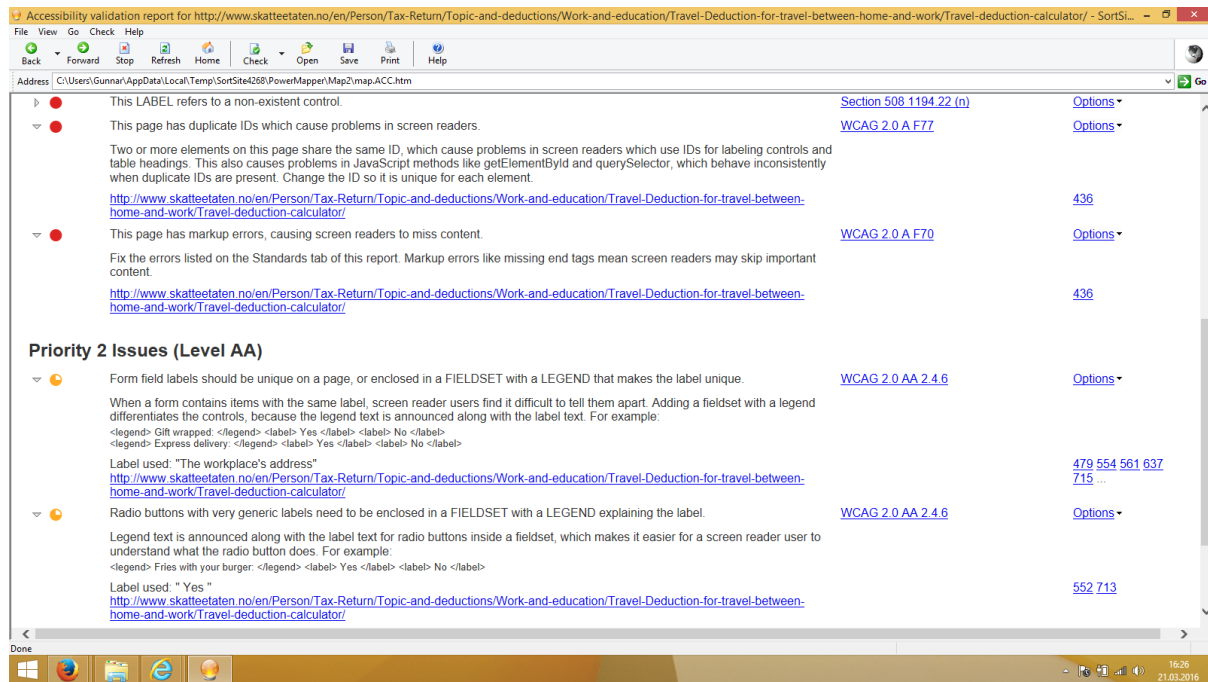


Figure 28 Evaluation Results presented by SortSite

The first issue did not comply with H71, “Providing a description for groups of form controls using fieldset and legend elements.” It reacted to a fieldset element that had no legend element attached to it; the fieldset tag is wrapped around the language class, which provides the users with the language selection for the page. As mentioned earlier, this is important for users so that they can better understand the relationship of the different controls or options and then again be able to interact with them efficient. Next F89 was presented, Failure of criteria 2.4.4, 2.4.9 and 4.1.2 “Due to not providing an accessible name for an image which is the only content in a link.” Here it is referred to the link called “homeAddressHelp”, help button for “Home address” that is a question mark. Further, two issues are detected that relates to success criterion 4.1.2, “Name, Role, Value” the first one “LABEL elements should be attached to the controls they label” generates five alerts of the same problem. All of these cases are classes with a label, meaning that they are not labels of a control. The feedback generated from the evaluator states that a different element could be applied if these are not control labels.

The second issue relating to 4.1.2 is called “LABEL elements should not be blank” here five issues were found. The first issue directs to the issue of <label class=“deduction”>, here it is stated that the “Label elements should be attached to the controls it labels”. As for the previous occurrences of this type of situation, the label is referring to a class, and not a form

control. The next issue concerns the label class for taxReduction, viewing the HTML contents of the page there seems to be no controls that belong to this label as well, therefore this label also did not need to describe its function to the users. The next two issues are the same type of problem, the label class for “section”, also a control that is no form control. If the intention is to make a label for these elements, this can be done by adding a label description like this: `<label for=“class”>Description goes in here</label>`. The last issue relating to success criteria 4.2.1 is also a label class issue, about “section headingOnline”, it also seems to be linked to script functionality.

The next five issues related to a failure in WCAG called F68, “This form control has not programmatically determined name.” First, the language selection menu that has no description for its users, SortSite also lists this as a usability issue. The next issue pointed to the “Days per year” input field, this control has no programmatically determined name. The next is an input class that is hidden; the users will not need it to have a description since they are not going to interact with it. The fourth F68 issue is a duplicate, it is the same as the second one, concerning the lack of a label or name for the “Days per year” input field. The last issue was also a repeated issue, the same as number three, regarding an element that the users do not interact with in the travel deduction calculator.

The next issue is also a WCAG failure, F77, “Failure of Success Criterion 4.1.1 due to duplicate values of type ID”. SortSite has detected that the ID “homeAdressHelp” has been applied more than one time. This error was detected and counted for twice. These were all of the issues found by the evaluator that were level A. Seven level AA issues were detected. Out of these, five of issues related to success criteria 2.4.6 “Headings and Labels”. The first thing SortSite comments is the “The workplace’s address”, it has a proper label, but SortSite suggests that it also should use the fieldset and legend tags. The evaluator states, “When a form contains items with the same label, screen reader users find it difficult to tell them apart.” In this calculator only one form control contains this label, therefore fieldset and legends does not have to be added. The next issue detected was also a label that was not unique, SortSite recommends that this can be solved by changing it or enclosing it in a fieldset with the belonging legend. The label belongs to the radio button “yes”, the reason why it is found more than once is because of script; one will not have to change any labels because of this. The same goes for the No option, because of the JavaScript, it exists more

than one place but they all are the same element. The phenomenon also occurred with the next issue, the workplace input field, there are duplicates within the HTML content, but no other form control has the same properties. The last issue refers to a class and script functionality and no actual form control.

The last two issues of level AA did also relate to Success criteria 2.4.6, here it detected that the two radio buttons should be enclosed by using fieldset with legends to explain the label. The next issue regarded the same problem; these issues relates to parts of the code that is not visible for the users. Overall, this evaluation detected twenty level A issues, seven AA issues and two level AAA issues. Several of these were duplicates and false positives.

### **SortSite**

SortSite has to be downloaded, this took some time. It took some additional time to get to know the software. Some misunderstandings occurred when conducting the test, at first the software evaluated the whole website rather than only the *Travel Deduction Calculator*. Furthermore, not all issues detected by the software were visible in the presentation, but became visible when some of the presented issues were clicked. This also led to some confusion; it made the interpretation of the results slow.

### **AChecker**

When running the *Travel deduction calculator* through the engine, the page reports the errors it detected quickly. Overall AChecker presents us with 125 known problems, 10 likely problems and 237 potential problems. The following image is a picture of what AChecker presented after evaluating the *Travel Deduction Calculator*.



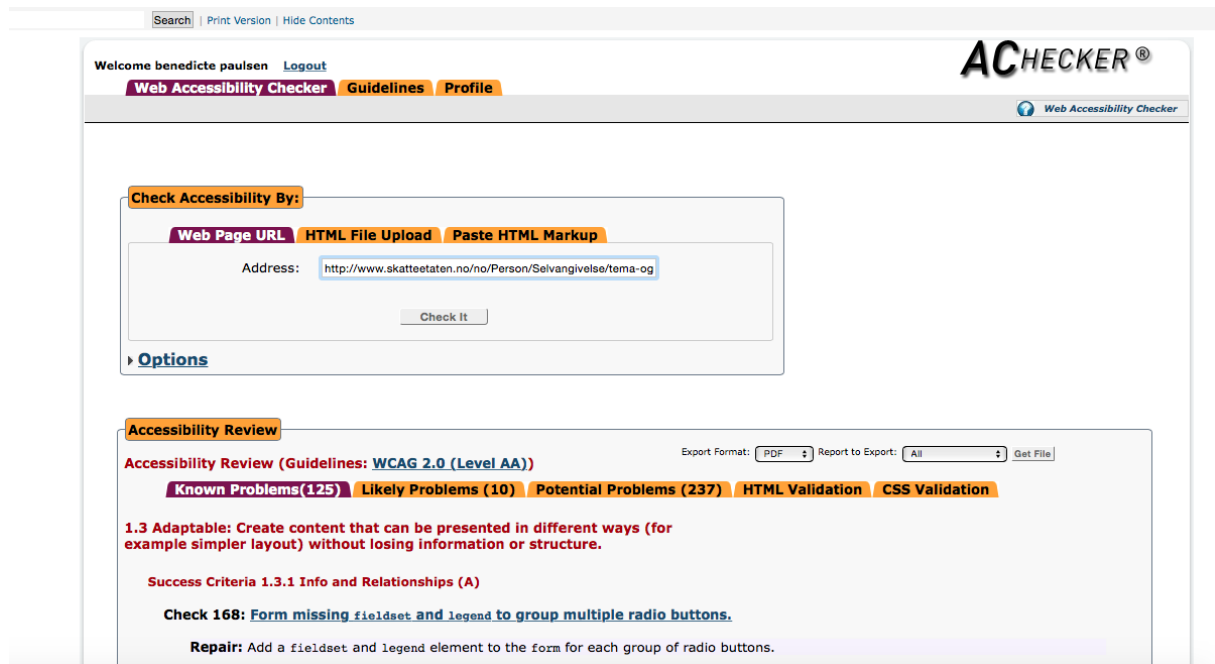


Figure 29 Validation Results presented by AChecker

AChecker found several issues, the first ones relate to guidelines *1.3 Adaptable* and Success Criteria *1.3.1 Info and Relationships*, overall 28 errors were found relating to this criterion. This criterion requires that the contents have a label element that surrounds the controls label. Many of these were duplicates; the tool does not know how to distinguish between functions that are used by users and functions that are not. It also identified errors relating to Guidelines *1.4 Distinguishable* and success criterion *1.4.4 Resize text*. Here also the error was alerted two times. The next guideline presented is *2.4 Navigable: Provide ways to help users navigate, find content, and determine where they are*, this is related to success criteria *2.4.4 Link Purpose*. Here the same line was presented 76 times. Among the links it detected were the help buttons, they need *title* attribute or *an element*, several other tools also detected this.

This screenshot shows some of the issues that were found that referred to the same line, retrieving information when it is presented like this is challenging.

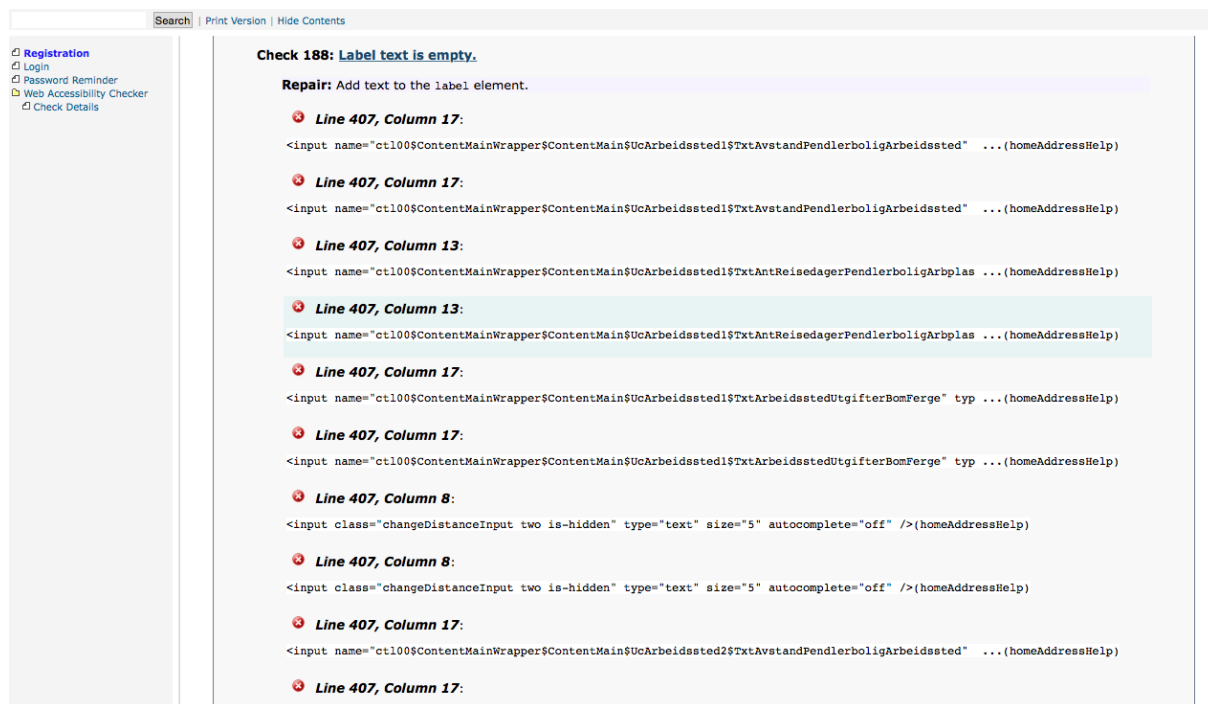


Figure 30 Accessibility issues presented by AChecker

Next the guideline *3.3 Input Assistance: Help users avoid and correct mistakes* and the success criterion *3.3.2 Labels or Instructions* was presented. It found one error where the *label* needs to be modified, further 16 issues where a *label* needs to be added were presented, all had already been detected. The last issue related to guideline *4.1 Compatible: Maximize compatibility with current and future user agents, including assistive technologies*. This issue was also already reported by the evaluation tool.

### Usability of AChecker

Overall, AChecker was easy to use, it evaluates fast, but the errors are presented close together, this makes it a bit hard to read the information. According to WCAG, text on a webpage should not exceed 80 characters; AChecker extends that length. AChecker sorts all of the issues and categorises them after the guideline and success criteria that were violated. Further, it provides the user with a link that describes the issue to the user and suggests how they should fix it. In addition to this, the lines where the issue was located is presented next to the number of the line. However, many issues are reported more than one time. The validator presents some issues that describe contents that are not in the user interface. When referring to the same line for several issues it becomes unclear, what the user actually should fix. It was difficult to know what issues were real issue.

# 5 Discussion

In this section, the analysis of the data is presented. First, the data from the user tests are presented to answer the first research question. Further, the data from the heuristic evaluation, user test and automated accessibility evaluation was compared for providing an answer to the second research question. Here the method that identified the most issues is acknowledged. By conducting tests employing some automated accessibility evaluation tools and comparing the results with the results of the other types of evaluations; a foundation for knowing if the tools, and which ones, are more suited for finding important accessibility issues was explored.

The analysis of the data is divided into two main parts. The first part answers the first research question, with the belonging data listed under it; and the second part is the second research question with the remainder of the analysis. This research focused on the topic of accessibility, therefore the researcher decided to present the data in mostly tabular format; this might help improve the accessibility for the users with assistive technologies, such as screen readers.

## 5.1 Research Question R0

***R0: What problems do the users of screen readers face when they interact with the Norwegian Tax Administrations pages and forms?***

By conducting the participant observation, possible challenges and barriers faced by users of screen readers were identified. In table 2, challenges that occurred often and appeared to be the most critical are presented.

**Table 2** Participants' challenges and barriers when interacting with the pages and forms

Number of Task	Challenges	Barrier
----------------	------------	---------

Task 1	<ul style="list-style-type: none"> <li>Context (tax return)</li> <li>Context (work and education)</li> <li>Address (No editing field)</li> <li>Days per year lacks information</li> <li>Confusing feedback</li> </ul>	<ul style="list-style-type: none"> <li>Could not complete task (two participants)</li> <li>Have to press twice to calculate travel deduction (two participants)</li> <li>Expenses to ferry (no visible fields)</li> </ul>
Task 2	<ul style="list-style-type: none"> <li>Table-based deduction for tax deduction cards button was not easy to identify</li> <li>Not easy to understand all elements</li> </ul>	
Task 3	<ul style="list-style-type: none"> <li>Context</li> <li>Identifying combination box is difficult</li> </ul>	<ul style="list-style-type: none"> <li>One participant could not complete task</li> <li>One participant had to press button twice</li> </ul>
Task 4	<ul style="list-style-type: none"> <li>No feedback when the document is downloaded</li> </ul>	<ul style="list-style-type: none"> <li>Could not edit input fields</li> <li>Could not complete task (all participants)</li> </ul>

*Task 1 = Travel Deduction Calculator, Task 2 = Table based deductions, Task 3 = Special Allowance for disability, Task 4 = application form foreign citizen.*

For this research, context was used as a keyword whenever users were confused about the context of what they were seeking and issues relating to location and meaning etc. Some level of confusion regarding the context was present during the whole process; however, the confusion was more obvious some places. In table 2, this type of confusion is presented with the word context. In addition to this, the challenges column contains other challenges faced by the users where they managed to complete the task but needed guidance or had other troubles. The barrier column is dedicated to issues that could imply a barrier for the users of screen readers. Some participants were in some cases not able to complete the tasks even after receiving guidance. One of the participants was not able to interact with the form in

task number two due to the page being under construction; because of this one participant could unfortunately not complete the second task of this participant observation.

Table 3 is a data display matrix that presents the answers provided by the participants to the questionnaire they received after the participant observation. The information provided summarises the results obtained through the participant observation where the users “thought aloud” while completing the tasks.

**Table 3** Answers to questionnaire

What was OK?	<ul style="list-style-type: none"> <li>• Generally, user-friendly</li> <li>• Works fine with link display</li> </ul>
What was not OK?	<ul style="list-style-type: none"> <li>• Gets dropped at the bottom of the page</li> <li>• Too much information</li> <li>• Entering information into forms</li> <li>• The downloaded documents</li> <li>• Much time to get finished</li> <li>• Search engine</li> </ul>
Improvements?	<ul style="list-style-type: none"> <li>• Introduce editing fields</li> <li>• Fewer links to get to the end goal</li> <li>• Many graphics in second table</li> <li>• Universal design</li> </ul>
Anything else?	<ul style="list-style-type: none"> <li>• Pages should work without JavaScript</li> </ul>

The participants were mainly focused on the features that did appear to be associated with challenges on their behalf, rather than commenting on what actually worked well. The participants all commented through the observation. There were great similarities in the response from the different participants, e.g. much information, challenging editing fields, and problems finding the way. All believed that it went ok, but that there were challenges when they interacted with the pages, and that it can become difficult to use the sites. They proposed some suggestions improvements. One user commented that the universal design could be improved. One of the expert participants commented that the page should work

without JavaScript. Next, the problems and challenges faced by the users were sorted after the screen reader that was utilized when detecting the issues.

**Problems sorted by screen reader**

Different types of screen readers might respond differently to the same elements. Because of this, the Norwegian Tax Administration had an interest in knowing more about the screen readers’ interaction with its webpage. Table 4 presents the problems that caused the participants not being able to complete some of the tasks.

**Table 4** Barriers sorted by Screen Reader

Task	JAWS	Voiceover	SuperNova
Task 1	<ul style="list-style-type: none"> <li>• Could not complete</li> </ul>	<ul style="list-style-type: none"> <li>• Must press twice to complete</li> </ul>	
Task 2			<ul style="list-style-type: none"> <li>• Page under construction</li> </ul>
Task 3	<ul style="list-style-type: none"> <li>• Could not complete task</li> </ul>		
Task 4	<ul style="list-style-type: none"> <li>• Could not complete</li> </ul>	<ul style="list-style-type: none"> <li>• Could not complete</li> </ul>	<ul style="list-style-type: none"> <li>• Could not complete</li> </ul>

It was the users of JAWS who mostly faced the problems that occurred during the participant observation. In the case of the first task, one of the JAWS users managed to complete the task by pressing the button twice, the other two did not. In the third task, one of the JAWS users did manage to complete the task while the other two did not. Deciding what screen reader is the most compatible with the Norwegian Tax Administration webpage is not possible based on this set of data. However, it illustrates that different screen readers will have different challenges and problems when interacting with the webpage, therefore as many assistive technologies as possible should be included in the accessibility testing process.

Overall, the users of screen readers have some challenges in the Norwegian Tax Administration website. The problems are in most cases problems that can be easily fixed, e.g. adding correct HTML values and labels, etc. For task 2 did it was not detected any significant problems for the users, see table 2. This online form was in HTML and was not written in JavaScript. Users did receive hints during the sessions for avoiding spending extensive amounts of times searching for the forms and pages. It was noted when several of the participants had the same navigational challenges, see challenges regarding context in table 2.

Overall all participants managed to complete the tasks, even though they had some challenges. The webpage is mostly accessible for the users of screen readers. The screen readers interacted differently with different types of forms. None of the participants were not able to complete the HTML form, using only HTML for making forms can be a way to increase accessibility, if the form fields have the proper values. More problems occurred when they tested the Word document and the JavaScript form.

## 5.2 Research Question R1

***R1: How should the Norwegian tax Administration formulate a testing protocol that combines automated testing tools, manual inspection and user testing to ensure accessible pages and forms on its sites?***

Here the results from the evaluations conducted by utilizing the automated accessibility evaluations tools are presented. The results are compared with the results from the manual evaluation and the results from the participant observation.

Table 5 displays the tools that were selected through the literature review, and the accessibility issues they detected when evaluating the *Travel Deduction Calculator*. It also presents the number of issues that was left after removing false positives and duplicates, and the percentage of relevant issues.

**Table 5** Presentation of issues found by the tools when analysing the travel deduction calculator

Tool	Issues Detected	Real issues	Percentage
WAVE	75	5	6.7 %
AccessMonitor	8	6	75 %
MAUVE	26	5	19.2 %
SortSite	29	5	17.2 %
AChecker	125	5	4 %

There were extensive amounts of information that had to be evaluated. Issues that were reported more than once were not always visible as duplicates, meaning that some duplicates may look like two (or more) different errors. The tools did not always present the issues in a very understandable way, meaning that some interpretation had to be done as to what feature it represented; due to this, there may perhaps be issues that has been overlooked or not included properly. The table does imply that there were many occurrences of false reporting; when the amount of data becomes extensive, it becomes challenging to make order out of all of the details. AccessMonitor is the tool that did include the fewest false positives. AChecker presented 96 percent false positives, which was the highest among the tools.

A total of 16 success criteria, according to WCAG 2.0, were identified as potential violations in the heuristic evaluation. Figure 31 contains all success criteria that were identified as potential problems.

Level	Success Criteria
A	1.1.1, 1.3.1, 1.4.8, 2.1.1, 2.4.3, 2.4.4, 3.3.2, 4.1.1, 4.1.2
AA	2.4.6, 2.4.7, 3.2.4
AAA	3.1.3, 3.1.4, 3.1.5, 3.1.6

Figure 31 Shows all Success Criteria identified in the heuristic evaluation

Some of the success criteria detected were level AAA. A person how has little or moderate level of training in accessibility can be able to find these issues manually when evaluating



similar pages. This method requires knowledge about HTML and CSS. When a person checks for accessibility issues using the web content accessibility guidelines as heuristics it becomes biased by the fact that the person decides if potential issues are of significance or not. In this research, three pages were evaluated manually, checking the *web content accessibility guidelines*. The researcher in this case was no expert when starting the evaluation; the results may differ with different evaluators. The process was very time-consuming; the issues that were found are suggested in the testing manual as issues evaluator can check manually.

Figure 7 presents the issues that were detected: The manual evaluation included some level AAA criteria and the tools tested for contents that were excessive to the form itself.

**Table 6** Problems detected in *Travel Deduction Calculator* webpage

<b>Problems</b>	User Test	Heuristics	WAVE	Access Monitor	MAUVE	SortSite	AChecker
<i>Address</i> input field	*						
Identifying <i>Workplace</i>	*						
Tab	*	*					
Option Scroll	*						
Much Info <i>Days per year</i>	*						
<i>Days per year</i>	*	*	*	*	*	*	*
Function of radio buttons	*		*	*			
Confusing feedback	*						
<i>Calculate travel deduction</i>	*						
<i>Calculate travel deduction</i>	*						
<i>Yearly expense of ferry</i>	*				*	*	*
Link purpose <i>Help</i> buttons		*	*	*	*	*	*
Language menu			*	*	*	*	*
search engine			*	*	*	*	
Definition list (AAA)		*					
No text summary (AAA)		*					
pronunciation (AAA)		*					

<b>W3C Validation</b>		*		*			*
<b>Total</b>	11	7	5	6	5	5	5

No testing method identified all of the issues. The users detected far more issues than the other two evaluation methods. The users were better at detecting issues about feedback and issues, which regarded the actual flow of the user experience. Even though input fields were labelled properly, users still had problems identifying them. The results indicate that users can have problems identifying fields even though they have proper labels. The users also found issues regarding the submit buttons, the evaluation tools do not check buttons and the manual inspection used the cursor rather than enter to test them. The *Days per year* input field did not have a label, all of the methods detected this. Users had problems knowing what to insert into it. They also reported excessive information, and confusing feedback, this is not something a tool will find. People with vision will be able to surpass this type of information and perhaps forget that it can be a challenge to users of screen readers.

The tasks in the user test instructed the users to complete the form, hence this was the only part of the user interface that was investigated through the participant observation. Therefore, for enabling a comparison of the selected methods, issues regarding contents that do not regard the form were eliminated. Table 8 is the same as table seven minus the problems detected outside of the form.

**Table 7** Issues detected in *Travel Deduction Calculator Form*

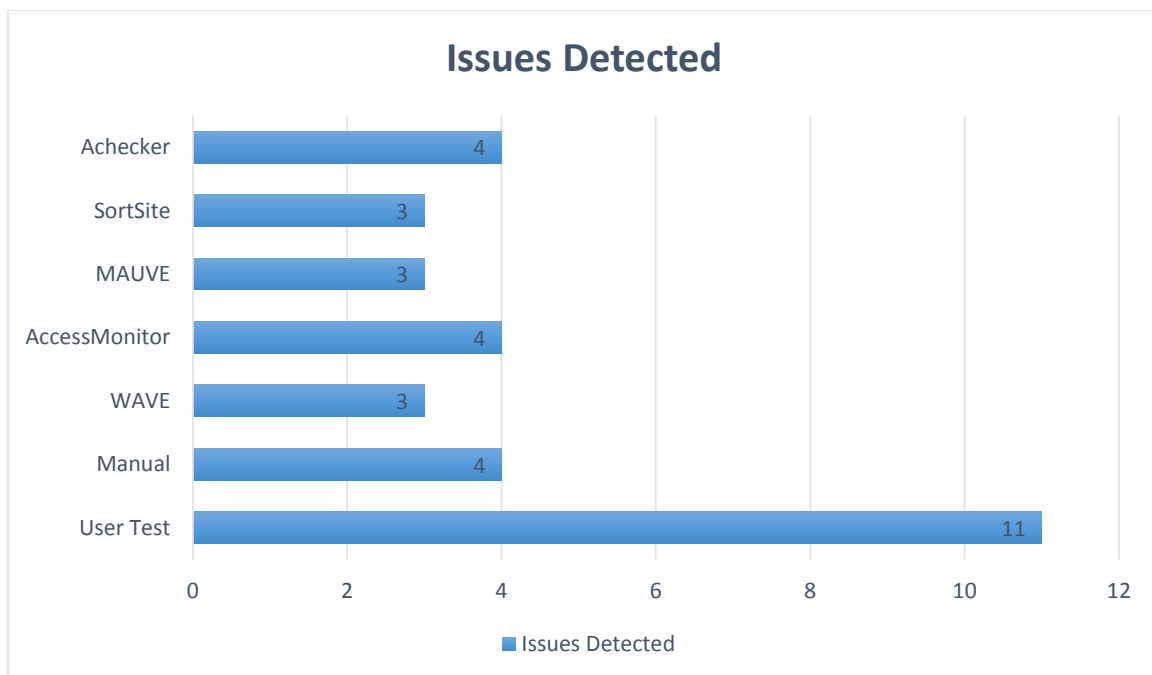
<b>Problem</b>	<b>User Test</b>	<b>Heuristics</b>	<b>WAVE</b>	<b>AccessMonitor</b>	<b>MAUVE</b>	<b>SortSite</b>	<b>AChecker</b>
<b>Identifying Address</b>	*						
<b>Identifying Workplace</b>	*						
<b>Tab</b>	*	*					
<b>Option Scroll</b>	*						
<b>Much Info <i>Days per year</i></b>	*						
<b><i>Days per year</i></b>	*	*	*	*	*	*	*
<b>Function of radio buttons</b>	*		*	*			
<b>Confusing feedback</b>	*						

<b>Calculate travel deduction</b>	*						
<b>Calculate travel deduction</b>	*						
<b>Yearly expense of ferry</b>	*				*	*	*
<b>Link purpose Help buttons</b>		*	*	*	*	*	*
<b>W3C Validation</b>		*		*			*
<b>Total</b>	<b>11</b>	<b>4</b>	<b>3</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>4</b>

The results show that the tools and the heuristic method managed to detected fewer issues in the actual form than the real users. Some of the tools found more issues than the other two methods. However, in the end they were not able to detect the issues that created confusion for the real users.

Next, the amounts of issues detected by the different methods are illustrated in a bar chart. Here only the issues that were found inside the actual form are included, this means that all issues detected by the tools in the website surrounding the form are removed.

**Table 8** Number of problems detected in *travel deduction calculator* form



When eliminating all issues that are relevant only to the webpage users detected 11 issues, while the tools and heuristic method detected four issues at most. The tools alerted several false positives and they tended to react to the same issue more than one time. It looks like it

can be a good idea to use an automated accessibility evaluation tool in addition to user testing. Initially the automated accessibility evaluation tools reported very different findings; however, after removing false positives results show that they find very similar issues.

The tools were good at finding links, legends and some form fields. These tools should be used to make sure that input fields, list boxes, buttons etc. are marked properly. The manual inspection method found many of the same issues, it is easy to check form controls, contrast and other single elements, checking the flow and user experience is more difficult. The users with disabilities are best at finding the accessibility issues, and should definitely be included when testing dynamic contents like the *Travel deduction calculator* or other form. The manual inspection can use tab and make sure that it works on the page, this is something that one can use the manual method for when conducting an accessibility test. The heuristic method is good for finding level AAA criteria, which is not required, but these will make the webpage more accessible. If testers want to test for these as well, then the manual method using level AAA success criteria as heuristics is suitable.

Overall, the results illustrate that testing with real users of assistive technologies is the best way for ensuring that the challenges they may encounter are identified. If there are problems checking form controls manually then the tools can be a good asset, they will eliminate some issues. However, these results illustrate that accessibility is not only tags and label elements, but also the flow of the user experience. In the future, the Norwegian Tax Administration may include automated accessibility evaluation tools into their accessibility testing process, however, it may be good to utilize these tools at an early stage of the process, and test some forms with people with disabilities. Based on the findings from this research, and the literature review, an accessibility-testing manual was created. It includes suggestions for automated accessibility evaluation tools, contents that can be checked manually, and planning of a user test, in addition to other elements that should be included in an accessibility testing process. Please see appendix 3 for further details about the automated accessibility-testing manual. Because of the qualitative nature of this research, the findings cannot be generalized. However, others as well as the Norwegian Tax Administration may use the accessibility-testing manual.

This research found that one should include as many assistive technologies as possible, that automated accessibility evaluation tools are good for testing static web contents and real users are better for testing dynamic content and the flow of the user experience. The accessibility-testing manual will unfortunately not ensure that a webpage becomes accessible for all people. However, it does include essential points that, as of today, are suggested by various sources. Formulating the accessibility-testing manual is presented next.

### **5.3 Formulating Accessibility Testing-Manual**

Accessibility testing is an essential part of ensuring web accessibility. Testing for accessibility is often compared to usability testing, but there are some differences. As of today, testers have no guarantee that they can find all accessibility issues on a website by using one common testing method. As previous research suggested, testing with real users with disabilities is the most effective way to find accessibility issues on a website. This research found that users of screen readers found over 50 percent more issues than automated accessibility evaluation tools, and manual inspection. Currently, some suggestions for designing an accessibility-testing plan exist, but most of them do not include systematic suggestions.

Proper labelling of forms, improvements of link labels, appropriate alternative texts for pictures, improvements of the page layout and accessible PDFs are common issues for users of screen readers and are easy to fix (Lazar et al., 2007). Currently, there are many automated accessibility evaluation tools including WAVE, SortSite, AccessMonitor, AChecker and MAUVE are free. These tools can be a good supplement for checking issues that for some reason are not found through the user test, e.g., legend tags, contrasts, alt tags and other HTML attributes. "The user needs to be aware of their limitations and will need a strong understanding of accessibility issues and the implications for people with disabilities in order to interpret the reports and the accessibility issues or potential issues flagged by the software tools" (Faulkner et al., 2000). The tools were effective in use, but did not find as many issues as they lead to believe. AccessMonitor was one of the tools that found the most issues and was easy to use, WAVE was the tool that was easiest to use. These two tools were suggested as a part of the accessibility-testing manual.

Gordón et al., (2014) Suggested the basics that should be included in an accessibility test, among these were the planning, then the testing process, these should include analysis, design, execution and evaluation. The testing manual provided through this research (please see appendix 3) also include suggestions provided by Barnum (2011) and Dick & Jewett (2009). This research also identified that testing for accessibility should be included in earlier stages of the development process, however, “Currently only a few tools allow to support accessibility inspection in earlier phases than post-implementation” (Xiong et al., 2007).

The accessibility-testing manual contains three common ways for testing for accessibility; testing with users with disability, manual walkthrough, automated accessibility evaluation tools, in addition to testing using persona. The manual also contains all resources found in this research. Usability experts and developers can use this document as a guide for ensuring accessible web contents.

## 6 Conclusion

The work achieved until now is only the beginning of creating an accessibility-testing manual that ensures accessible pages and forms. In this research, it was presented some potential improvements that could be brought to the existing manuals. By including more features in the accessibility-testing manual, it could perhaps help to solve current potential shortcomings or improve them. Current automated accessibility-testing manuals are similar to usability-testing manuals.

The findings provided insights into how screen readers work with the webpage provided by the Norwegian Tax Administration. Users of screen readers depend on accessible design to be able to fully use web pages. This research found that there were some common challenges among the users of screen readers when interacting with the webpage under investigation. Even though not all tasks were possible to complete they still felt the website was good. These results were compared to results provided from a heuristic evaluation and evaluation with automated tools. Some of the challenges that the users faced were also detected by the other two methods. These issues should be relatively easy to fix.

For future testing for web accessibility, the people at the Norwegian Tax administration can use the automated accessibility evaluation tools to find the common issues fast. Further, they may check some common issues manually. Their website is possible to use for users of screen readers. What were most problematic for them were the forms. In the future, tasks can be designed to include forms, especially those that are highly dynamic, static content can be inspected manually and with tools. Various users with different disabilities can with benefit be included in the process of testing with real users. None of the testing methods detected all issues, including several methods, and getting to know some of the most common accessibility issues, will strengthen the accessibility-testing process. Through this, signatory hopes that the conclusions of this work are relevant not just to Norwegian Tax Administration but a wider community of assistive technology users and testers.

### 6.1 Suggestions for future research

In this research, only five accessibility evaluation tools were tested. In the future, more of these can be evaluated to see if there are others who provide better results. Further, testing

for developers is important, in the future; technologies that are suitable for the developers might be compared and suggested as a part of an accessibility evaluation plan.

Several sources suggest that three users from each group of disability should be included when testing for accessibility. This is a large group of people, and it is not possible for everybody who is testing a website to include all of these users. Therefore, in the future, it should be suggested a group of participants with disabilities that can be representatives for the users with disabilities. A smaller group that is able to find most of the accessibility issues in a website.

For future research, the accessibility testing process may be improved more. There are other methods for accessibility testing, like personas and inspection methods, which can be suitable for some parts of the accessibility testing. It is acknowledged that the accessibility-testing manual provided do not guarantee that a webpage becomes fully accessible to everybody. In the future, researchers can try to identify methods that actually do detect all accessibility issues, and by this provide a tool that promotes inclusive design.



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# **8 Appendices**

## **8.1 Appendix 1**

### **Consent form**

# **Inquiry to participate in a research project**

## **User Testing of the Norwegian Tax Administration Web Pages**

### **Background and Subject**

The purpose of this study is to find investigate what problems users of the assistive technology screen reader faces when interacting with the Tax Administration webpage. The research will generate guidelines on how the Norwegian Tax Administration should proceed when testing their pages in regards of accessibility. The Disability Discrimination Act states that all Norwegian public websites have to be universally designed. Meaning that they have to comply with the web content accessibility guidelines level AA, provided by the World Wide Web Consortium. It will take some time before all web-based services are universally designed. People can still face barriers even if the page complies with WCAG, also, so far there exists no clearly defined manual on how to test pages that will definitely ensure that all users are included. This research aims at contributing with exactly this. This master project is provided through Oslo and Akershus University College of Applied Sciences in cooperation with the Norwegian Tax Administration.

The Norwegian Tax Administration want to get insight into how users of screen readers perceive their pages. Because of this, it is desirable with a study sample that uses screen readers on a regular basis.

### **What does it entail to participate in this research?**

The participant will be given four tasks within the pages of the Norwegian Tax Administration, the completion of these tasks will be documented. The whole session will be recorded using audio recorder if the participant agrees to this. The participant will be asked to “think aloud”, meaning that he/she may comment the interactions during the observation. After the user test, the user will be asked a few questions about the pages and session.

### **What happens to the information about you?**

All of the information will be treated confidentially. Personal information will not be necessary in this research, only information about the assistive technology, gender, age group and the performance of the test. All information generated from the user test will only be available to signatory. The data will be stored on an extern hard drive that required password.

The participants will not be recognised in the dissertation.

The project will be ended may 18<sup>th</sup> 2016. The recordings will be deleted when the thesis is delivered. The data will be anonymized right after the observation.

### **Participation is voluntary**

It is voluntary to participate in the research, and you can at any given time pull your consent without giving an explanation. If you decide that you do not want to participate after all, all of the data about you will be removed.

If you want to participate in the study, or have any questions, please contact:

Benedicte Paulsen Hess  
Telephone: 92887882  
E-post: benedicte.paulsen@outlook.com

Supervisor: Wondwossen Beyene  
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E-post: wondwossen.beyene@hioa.no

This research is reported to the data protection official for research, Norwegian Social scientific data service AS.

## Consent to take part in the research

I have received the information about the research and am willing to participate:

-----  
(Signed by the participant, date)

I hereby consent to the following method for data collection being utilized:  
(Mark the field for yes, if the method is ok or no, if you do not want this method being used)

Type	Yes	No
Interview		
Observation		
Audio Recording		



## 8.2 Appendix 2

### User Test Protocol

## **User Test Protocol**

### Welcome

- Welcome the participant
- Explain the project and what we're going to do

### Consent form

- Introduce the consent form (It is already e-mailed to the participant)
- Sign the consent form

### Instructions

- Explain the tasks
- Will have to open the Norwegian Tax Administration Webpage

## Task One

- **Calculate travel deduction**

Enter the Norwegian Tax Administration webpage:

1. Choose “person” and enter option:

Time:

Agility:

Challenges:

Error:

Comment:

2. Choose “Tax Return”:

Time:

Agility:

Challenges:

Error:

Comment:

3. Choose “Topic and deductions”:

Time:

Agility:

Challenges:

Error:

Comment:

4. Choose “work and education”:

Time:

Agility:

Challenges:

Error:

Comment:

5. Choose "Travel (home-work)":

Time:

Agility:

Challenges:

Error:

Comment:

6. Enter the "calculate your travel deduction here":

Time:

Agility:

Challenges:

Error:

Comment:

7. Insert an "Home Address"

Time:

Agility:

Challenges:

Error:

Comment:

8. Enter into the "Workplace 1"

Time:

Agility:

Challenges:

Error:

Comment:

9. Write into "Days per year"

Time:

Agility:

Challenges:

Error:

Comment:

10. Select either "Yes" or "No" on the "Do you save at least two hours in travel and waiting time by driving a car compared to using public transport?"

Time:

Agility:

Challenges:

Error:

Comment:

**If Yes:** Enter some text

**If No:** Proceed

11. Enter calculate travel route

Time:

Agility:

Challenges:

Error:

Comment:

12. Calculate travel deduction

Time:

Agility:

Challenges:

Error:

Comment:

## Task Two 2

We are going to test table based deduction form

1. Enter "Person":

Time:

Agility:

Challenges:

Error:

Comment:

2. Choose "Tax deduction card and advance tax":

Time:

Agility:

Challenges:

Error:

Comment:

3. Choose "Table-based deductions":

Time:

Agility:

Challenges:

Error:

Comment:

4. Enter "Table-based deductions":

Time:

Agility:

Challenges:

Error:

Comment:

5. Select "Table number 7101":

Time:

Agility:

Challenges:

Error:

Comment:

6. Select "Income type" "salary":

Time:

Agility:

Challenges:

Error:

Comment:

7. Select "Deduction period" "Month":

Time:

Agility:

Challenges:

Error:



Comment:

8. Write 1000 in “Deduction basis”

Time:

Agility:

Challenges:

Error:

Comment:

9. “Calculate withholding tax

### Task three: Finding out the special allowance for disability for 2014

1. select "Person"

Time:

Agility:

Challenges:

Error:

Comment:

2. Select "Tax Return":

Time:

Agility:

Challenges:

Error:

Comment:

3. Select "Topic and deductions":

Time:

Agility:

Challenges:

Error:

Comment:

1. Select "Pension and disability benefit":

Time:

Agility:

Challenges:

Error:

Comment:

1. Select "Special allowance for disability":

Time:

Agility:

Challenges:

Error:

Comment:

1. Select year 2014 click "show":

Time:

Agility:

Challenges:

Error:

Comment:

## Task Four

**Filling in a form called: Application for tax deduction card for foreign citizens**

Enter the front page

13. "Person"

Time:

Agility:

Challenges:

Error:

Comment:

14. Enter "Tax deduction card and advanced tax":

Time:

Agility:

Challenges:

Error:

Comment:

15. Enter "Foreign employees":

Time:

Agility:

Challenges:

Error:

Comment:

16. Choose “Apply for a tax deduction card”

Time:

Agility:

Challenges:

Error:

Comment:

17. Press “Download, complete and deliver to your tax office”:

Time:

Agility:

Challenges:

Error:

Comment:

18. Download the document

Time:

Agility:

Challenges:

Error:

Comment:

19. Fill in the document

Time:

Agility:

Challenges:

Error:

Comment:

**Questions:**

- How do you think this went?
  
- What was OK?
  
- What was not ok?
  
- What can be improved
  
- Anything more to add?

## **8.3 Appendix 3**

### **Accessibility-Testing Manual for the Norwegian Tax Administration**



# Web Accessibility-Testing Manual

»» For The Norwegian Tax Administration

## Index

- ▶ Introduction
- ▶ Define
- ▶ Plan
- ▶ Different testing methods
  - Testing during development
  - Automated Accessibility Evaluation Tools
  - Manual walkthrough
  - Users testing
    - With people with disabilities
    - With a created persona
- ▶ Documentation & Analysis
- ▶ Resources

# Introduction

- ▶ This is a manual on how to define, plan, execute and document a Web Accessibility Test. In addition to some suggestions for *testing during development*
- ▶ This manual includes three common accessibility evaluation methods:
  - ▶ *Automated Accessibility Evaluation Tools,*
  - ▶ *Manual walkthrough,*
  - ▶ *Users testing.*
- ▶ This testing manual does not guarantee that a webpage becomes accessible for everybody. It does however provide some techniques to remove common accessibility issues.



## Define

- ▶ Define the scope, what, why, who, how
- ▶ What services are to be tested?
  - The service provider needs to define what services and functions that should be tested
  - Navigation, forms, pages?
- ▶ Who should test? the developer, UX-advisor etc. and who should observe?
- ▶ How should the test be done (which testing method) and documented? (See following pages)



# Plan

- ▶ Involve the participants(s) and observer(s)
  - See page 9 for finding users with disabilities for testing
- ▶ What actions should be taken by who, which equipment is needed and what are the users needs?
  - It is recommended to let users of assistive technologies use their own equipment
- ▶ When, how long and where will the test be conducted
  - Sometimes participants prefer testing at their own house or at their workplace, let them choose.
- ▶ Align and inform all stakeholders about the scope(what, why, who, how), what equipment/resources needed, where and when, and how the test would be documented

## Testing during development

- ▶ To save time and later efforts, some measures can be done during development:
  - Use automated accessibility evaluation tools, insert code directly.
  - Developers can listen to their code using screen readers
  - See the last page



# Automated Accessibility Evaluation Tools

- ▶ To find issues regarding accessibility:
  - AccessMonitor: <http://www.acessibilidade.gov.pt/accessmonitor>
  - WAVE: <http://wave.webaim.org>
- ▶ Also consider:
  - Validate the HTML <https://validator.w3.org>
  - Validate the CCS <http://jigsaw.w3.org/css-validator/>
  - Validate the contrast <http://wave.webaim.org>
- ▶ Static and dynamic content should be ran through the automated tools
- ▶ Tools are good at checking: <label>, 'title' and <legend>

## Manual Walkthrough

- ▶ Heuristic evaluation using the predefined criteria:
  - WCAG 2.0
  - Success Criteria that can be easier to find:
    - A: 1.1.1, 1.3.1, 1.4.8, 2.1.1, 2.4.3, 2.4.4, 3.3.2, 4.1.1, 4.1.2
    - AA: 2.4.6, 2.4.7, 3.2.4
    - AAA: 3.1.3, 3.1.4, 3.1.5, 3.1.6
  - Insert alt text
  - Inspect elements, buttons, input fields, links, list box, images etc.

HTML element	Role	Name	Value	State
<a>	link	'title' attribute, text within <a> element or 'alt' attribute if image link. Concatenated if both text and image 'alt' attribute are provided	'href' attribute	
<button>	push button	text inside <button> element or 'title' attribute		
<fieldset>	grouping	text inside <legend> element within fieldset element		
<input type = "button", "submit", or "reset">	push button	'value' attribute		
<input type = "image">	push button	'alt' attribute or 'title' attribute		
<input type = "text">	editable text	<label> element associated with it or 'title' attribute	'value' attribute	
<input type = "password">	editable text	<label> element associated with it or 'title' attribute	value is purposefully hidden	
<input type="file">	editable text	<label> element associated with it or 'title' attribute	'value' attribute	
<input type="checkbox">	checkbox	<label> element associated with it or 'title' attribute		'checked' attribute
<input type="radio">	radio button	<label> element associated with it or 'title' attribute		'checked' attribute
<select>	list box	<label> element associated with it or 'title' attribute	<option> element with 'selected' attribute set to "selected"	
<textarea>	editable text	<label> element associated with it or 'title' attribute	text within <textarea> element	



## User testing with people with disabilities

- ▶ It is recommended to use at least three participants from each group of disability
- ▶ Find users, suggestions:
  - Norwegian Blind Association: <https://www.blindeforbundet.no>
  - NAV: [www.nav.no](http://www.nav.no)
  - Pensjonistforbundet: <http://www.pensjonistforbundet.no>
  - Dysleksi Norge: <https://www.dysleksinorge.no>
  - Hørselshemmedes Landsforbund: <https://www.hlf.no>
  - MediaLt: <http://medialt.no/>
  - Statped: [www.statped.no](http://www.statped.no)
- ▶ Based on the scope, create different tasks for the participants to execute
- ▶ Let the users navigate naturally without lead, while the observer notes
- ▶ Ask them to think aloud
- ▶ Ask them open questions after the user test to get insight into how they experience the pages and forms
- ▶ If there are time/resource limitations, then dynamic content should be prioritized for user testing, for example forms with JavaScript
- ▶ User testing should be compensated

## Testing with a persona

- ▶ Same procedure as with a real user, but all steps of participant must happen imaginarily
- ▶ The following criteria has to be described:
  - Name
  - Daily routines
  - Device and technologies
  - Disability?



## Documentation & Analysis

- ▶ To document the accessibility test with users, the following documentation is recommended:
  1. Voice recording
  2. Video recording of keyboard and user movements
  3. Screen recording
  4. Written notes
- ▶ Analyse the results after the test, and not during
- ▶ Categorize the issues and describe how they were triggered
- ▶ Do not wait with the analysis

## Tools & Resources

- ▶ About Universal Design and Web Accessibility:
  - Agency for Public Management and eGovernment (Difi): <https://uu.difi.no/krav-og-regelverk/kom-i-gang>
  - WCAG 2.0: <http://www.w3.org/TR/WCAG20/>
- ▶ Assistive technologies:
  - Overview of the different tool see: <http://www.disabled-world.com/assistivedevices/computer/screen-readers.php>
  - Test with different tool see: <http://iktforalle.no/virtuell-hjelpemiddellab/veileder.html#hjelpemidler>
- ▶ Guidelines for creating forms:
  - Elmer 2: <http://elmer.no>
  - WAI: <http://w3c.org/wai>
- ▶ Framework: React for JavaScript
- ▶ For support & further insights contact:
  - Claseda AS, [accessability@claseda.no](mailto:accessability@claseda.no), +47 928 87 882

