Accessibility on a Finnish city government website

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Accessibility is an important, but often overlooked topic on the web that is slowly gaining importance in societies around the world as it allows people with a wide range of disabilities to use public services, and it also makes them much more usable for all people. State governments and other international institutions have taken notice of improving accessibility on the various websites and other digital services they provide, but what does this entail for a city government website in Finland?
This thesis aims to find an answer through four research questions. First, what guidelines should be taken into account and where these requirements come from? Second, how should these guidelines be taken into consideration when designing and developing a website? The analytical part of the thesis continues by exploring how the successful implementation of the guidelines could be measured and analysed. And, finally, an accessibility evaluation is carried out on both the old and the new website of the city of Pori, a medium size city located on the west coast of Finland to evaluate how well the required guidelines are followed on its newly built website. The first three research questions are answered through available literature and legal resources, where as the last one is answered through an accessibility evaluation carried out on the website of the city of Pori.
Although the design and content on the city of Pori website is unique to it, the challenges and solutions discussed in this thesis are general enough that they could potentially support future efforts to implement accessibility on the web.

Keywords: accessibility, web, government, website

Contents

1 Introduction

Accessibility is an important, although often overlooked aspect of designing a high-quality website. It is especially important on websites for various government institutions as such sites should be accessible for every person visiting the site.

The city of Pori is a medium size city with a population of 83000 [1] located on the west coast of Finland. It has various websites that it uses to provide access to information and services. When accessibility became a requirement for Finnish government websites and services, the accessibility of the city's websites was found to be insufficient. In 2021, the city decided to change the content management system used to publish and manage the city's various websites from Drupal 7 to WordPress. Content from the old website, over 7000 web pages on the main site alone with more than 2000 pages on the Visit Pori site and 150 pages on Business Pori site, will be migrated onto the new platform. The migration also includes a few websites for various services and businesses operated by the city such as museums [2]. The websites also include various types of content, such as documents in various formats, images, and videos.

The city has three main websites aimed towards various user groups. The first, shown in Figure 1.1, is the main website for the city of Pori under the pori.fi domain. It contains various information on services and point of interests located in and provided by the city. The top of the page contains links for various demographics living, or moving into the city such as families with children, young people, or new

residents. Below that is a banner with the city's logo, a search bar, and a language selector. Below the banner are five drop down menus divided into three sections. Each drop down menu contains selected subcategories on the leftmost section that reveal further categories in the middle section when hovered over. The rightmost section contains links to external pages.

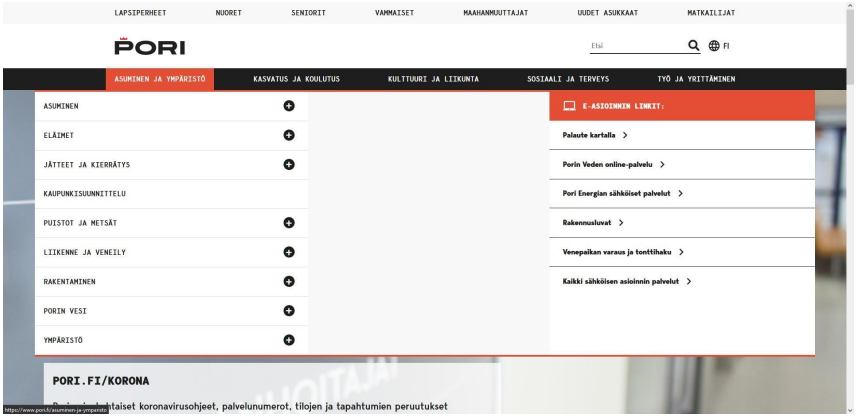


Figure 1.1: The front page of the old city of Pori website.

The second page, shown in Figure 1.2, is mainly aimed towards tourists visiting the city located under the visitpori.fi domain. It contains information on various tourist attractions in the city. Like the main site, the page contains a banner with a search bar and a language selector, and six drop down menus, which contain links to other pages. The link bar on the top of the page is also present but contains links to useful information targeted for tourists.

The third site shown, in Figure 1.3, is aimed for businesses and entrepreneurs interested in the city under the businesspori.fi domain. The site provides information on various business opportunities and successes in the city of Pori. The site also contains the banner with the search bar and language selector but, unlike the other two sites, it lacks the top link bar.

The change of platforms offers a change to evaluate and improve the accessibility of the websites and content they include. This master's thesis, written as part of

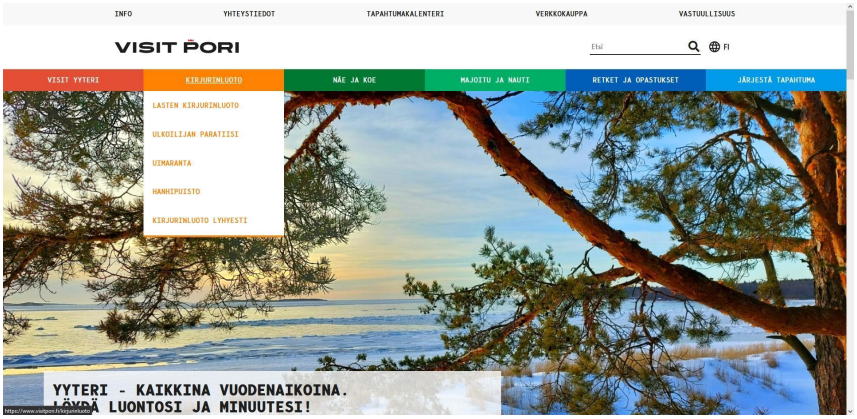


Figure 1.2: The front page of the old Visit Pori website.

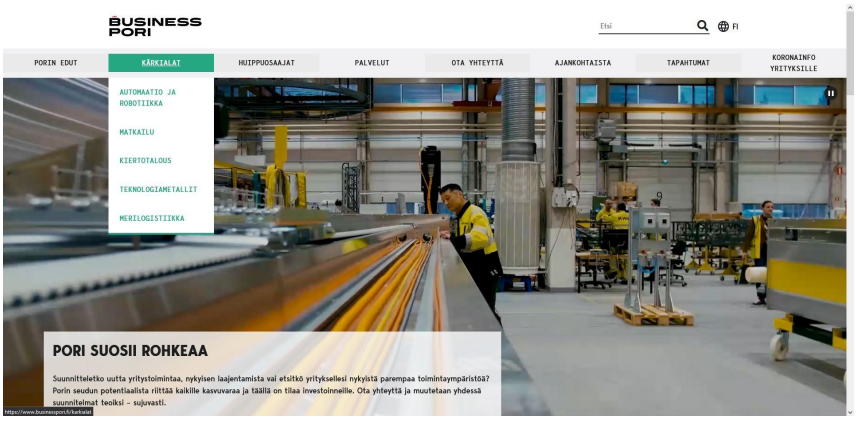


Figure 1.3: The front page of the old Business Pori website.

the migration effort, aims to improve the accessibility of the new website through the following research questions:

RQ1: What kind of accessibility guidelines should a government website in Finland follow?

RQ2: How should these guidelines be taken into consideration when designing and developing a website?

RQ3: How could the implementation of the guidelines be measured and analyzed?

RQ4: How well are the guidelines implemented on the new website of the city of Pori?

Chapter 2 introduces various background information such as existing guidelines and content management systems relevant for this thesis. It also explores what kind of requirements recent Finnish laws introduce for accessibility on government websites and other online services in Finland. Chapter 3 introduces various tools and methods to measure accessibility on a website. In Chapter 4, the current state of accessibility of the old websites for the city of Pori is explored. A more in-depth analysis is also carried out on selected pages on both the old and the new websites. The result of these analysis is then compared. Lastly, Chapter 5 concludes the thesis.

2 Accessibility on the web

This chapter aims to answer research questions RQ1 and RQ2. Section 2.1 covers accessibility as a concept. Section 2.2 examines who accessibility is for. Section 2.3 presents a set of relevant guidelines, namely, Web Content Accessibility Guidelines 2.1. Section 2.4 briefly mentions technologies meant to aid in conforming with the guidelines. Sections 2.5 and 2.6 explore accessibility features found in some highly popular content management systems, these being Drupal 7 and WordPress respectively. Section 2.7 answers research question RQ1, mainly through legal sources. Finally, Section 2.8 answers research question RQ2. The contents of this chapter will then be used as the base of the analysis in Chapter 4.

2.1 Accessibility

The United Nations Convention on the Rights of Persons with Disabilities follows decades of work by the United Nations to change attitudes and approaches to persons with disabilities. It aims to change the view of people with disabilities from "objects of charity, medical treatment, and social protection towards viewing persons with disabilities as subjects with rights, who can claim those rights and making decisions for their lives based on their free and informed consent as well as being active members of society." [3]

The Convention is intended as a human rights instrument with an explicit, social development dimension. It adopts a broad categorization of persons with disabilities

and reaffirms that all persons with all types of disabilities must enjoy all human rights and fundamental freedoms. It clarifies and qualifies how all categories of rights apply to persons with disabilities and identifies areas where adaptations must be made for persons with disabilities to effectively exercise their rights and areas where their rights have been violated, and where protection of rights must be reinforced.

Article 9 of the convention defines accessibility as various design principles that allows people with disabilities to use, for example, public services, such as public transport, access buildings with ease, and access information, communications and other services, such as emergency services with ease. The article also requires that state parties take appropriate measures to develop and ensure compliance with minimum standards and guidelines for accessibility in both public and private facilities, provide training to ensure accessibility among other things. [3]

Accessibility can and should also be incorporated into the design on the web and there are various guidelines available that try to standardize different accessibility considerations and make the web accessible for a wider range of people.

2.2 Who is accessibility for?

Papunet is an online website by Kehitysvammaliitto, or the Finnish Association on Intellectual and Developmental Disabilities that aims to provide tools and information for making websites accessible for people with disabilities. The website states that all users benefit from accessibility. Good accessibility is particularly important and even necessary for those with a disability or functional limitation. For example, a visual impairment or physical disability can have an impact on the use of digital services. Accessible online services can improve people's equality. When services are made accessible and easy enough to use, everyone can use them. [4]

Many kinds of disabilities that a truly accessible website must address exists. The Web Accessibility Initiative of the World Wide Web Consortium classifies them

in five categories:

Auditory

"Auditory disabilities range from mild or moderate hearing loss in one or both ears ("hard of hearing") to substantial and unrecoverable hearing loss in both ears ("deafness"). Some people with auditory disabilities can hear sounds but sometimes not sufficiently to understand all speech, especially when there is background noise. This can include people using hearing aids." [5]

Cognitive, learning, and neurological

"Cognitive, learning, and neurological disabilities involve neurodiversity and neurological disorders, as well as behavioral and mental health disorders that are not necessarily neurological. They may affect any part of the nervous system and impact how well people hear, move, see, speak, and understand information. Cognitive, learning, and neurological disabilities do not necessarily affect the intelligence of a person." [5]

Physical

"Physical disabilities (sometimes called "motor disabilities") include weakness and limitations of muscular control (such as involuntary movements including tremors, lack of coordination, or paralysis), limitations of sensation, joint disorders (such as arthritis), pain that impedes movement, and missing limbs." [5]

Speech

"Speech disabilities include difficulty producing speech that is recognizable by others or by voice recognition software. For example, the loudness or clarity of someone's voice might be difficult to understand." [5]

Visual

"Visual disabilities range from mild or moderate vision loss in one or both eyes ("low vision") to substantial and unrecoverable vision loss in both eyes ("blindness"). Some people have reduced or lack of sensitivity to certain colors ("color blindness"), or increased sensitivity to bright colors. These variations in perception of colors and brightness can be independent of the visual acuity." [5]

2.3 Web Content Accessibility Guidelines

Web Content Accessibility Guidelines or WCAG [6] are a set of guidelines developed by the Accessibility Guidelines Working Group, which is a part of the World Wide Web Consortium's Web Accessibility Initiative. The World Wide Web Consortium, also known as W3C is the largest international standards organization that develops different standards and guidelines for use on the web. Web Content Accessibility Guidelines were first introduced with version 1.0 of the guidelines in 1999 [7]. The next version WCAG 2.0 superseded them in 2008 [8] and it has been since revised in 2018 to WCAG 2.1 [9]. Revision 2.2 of the guidelines are set to be published in 2022 [10].

WCAG 2.1 is a wide set of recommendations meant to make web content more accessible for people with a wide range of disabilities, including partial hearing loss or deafness, learning disabilities, low vision or blindness and cognitive disabilities amongst others. It is an extension of the earlier WCAG 2.0 and wholly replaces the outdated WCAG 1.0 guidelines. WCAG is divided into four principles. Each contain multiple guidelines that are themselves divided into one or more sub-guidelines. In addition, there are multiple success criteria for each guideline. The success criteria found under the principles are also grouped into conformance levels, these being, from lowest to highest, level A, level AA, and level AAA. The grouping makes

communicating how closely the guidelines should be followed easy. For example, Finnish government websites are required to conform to at least level AA. The World Wide Web Consortium also provides a reference guide with various examples and counterexamples on how to and not to meet the various guidelines. The whole list of guidelines alongside a short explanation for them can be found in Appendix A. The four main principles of WCAG 2.1 are explained below.

Perceivable

The first principle of WCAG suggests that all information and user interface components on screen must be presented in a way that is perceivable to the user. It contains four guidelines called Text Alternatives, Time-based media, Adaptable, and Distinguishable. The Text Alternatives guideline suggests that all non-text elements on a web page have a text alternative that allows the content to be changed to other forms that people might need. Such as speech or braille. It has only a single associated success criterion. The Time-based Media guideline suggests that all time-based media are provided with alternatives. It has nine associated success criteria. The Adaptable guideline suggests that all content is created in a way that can be presented in different ways without the content losing any information or structure. It has six associated success criteria. Lastly, the Distinguishable guideline suggests that all content should be made so that they are easy to hear see for the user and has thirteen associated success criteria. [9]

Operable

The second principle of WCAG suggests that the entire user interface and components used for navigation are operable. It contains five guidelines, Keyboard Accessible, Enough Time, Seizures and Physical Reactions, Navigable, and Input Modalities. The Keyboard Accessible guideline suggests that all functionalities should

be usable with a keyboard. It contains four success criteria. The Enough Time guideline suggests that users should be provided with enough time to read and use content. It has six success criteria. The Seizures and Physical Reactions guideline suggests that all content should be designed in a way that does not cause seizures of physical reactions. It has three success criteria. The Navigable guideline suggests that users should be provided with ways to find and navigate content and to determine where they are. It has ten success criteria. And lastly, the Input Modalities guideline suggests that functionality should also be operable with methods other than keyboard and has six success criteria. [9]

Understandable

The third principle of WCAG suggests that all information and user interface operations must be understandable. It contains three guidelines, Readable, Predictable, and Input assistance. The Readable guideline suggests that all text content should be readable and understandable. It has six success criteria. The Predictable guideline suggests that web pages should behave in a predictable way. It has five success criteria. Lastly, the Input Assistance guideline suggests that the user should be helped to avoid and correct mistakes and has six success criteria. [9]

Robust

The fourth principle of WCAG suggests that all content must be robust enough that it can be interpreted by a wide variety of user agents, assistive technologies included. It contains a single guideline, Compatible, that suggests that compatibility with current and future user agents, assistive technologies included, should be maximized. The Compatible guideline has three Success criteria. [9]

2.4 Accessible Rich Internet Applications

The Accessible Rich Internet Applications is a specification created by the World Wide Web Consortium's Web Accessibility Initiative. The specification also referred as WAI-ARIA provides a framework that can be used to add accessibility features to a web page and help developers create websites that conform with recommendations found in the Web Content Accessibility Guidelines. It defines a set of properties that can be injected into standard HTML and JavaScript code to indicate various identify various user interactions, such as menus, primary and secondary content, and other types of structures on a web page. It also provides a way for indicating a state of some elements fox example, if a checkbox is selected. [11]

2.5 Drupal and its accessibility features

The Drupal content management system has various built in accessibility features and tools, although this chapter will focus on Drupal 7 as that is the version of the content management system used on the city of Pori websites. They can be roughly divided into two parts: A set of documentation that can be used to implement accessibility into the website and content stored and managed with Drupal, and various contributed modules for enhancing accessibility within Drupal. The documentation is divided into three parts: A set of tools, techniques, and resources, a list of best practices, and a list of issues concerning accessibility within the contributed modules. The documentation also contains a similar list of tips and tricks for building an accessible theme for Drupal 7. [12] Drupal 7 contributed modules can be used to extend and add features to Drupal 7. One such contributed module available for is the Accessibility module. It is a suite of modules that provide accessibility testing for content authors, theme designers, and developer and contains five sub-modules: The Content accessibility module, the Accessibility WYSIWYG module, the Ac-

cessibility Reporting module, the Theme accessibility module, and the Accessibility TestSwarm module. [13] The suite allows administrators of the site to enable various accessibility tests that can catch common accessibility issues, many of which are aligned with international guidelines such as WCAG 2.1. The Content accessibility module, once enabled and configured, can be used to check the content of the site for issues such as missing alternative text, as demonstrated in Figure 2.1 showing an example of this from Drupal 7 online documentation. [12]. The module can show a user with the "check content for accessibility" permissions all the accessibility problems on the site either automatically, or after the user switches a toggle, depending on how the module is configured. The Accessibility WYSIWYG module works with Drupal's WYSIWYG and CKEditor text editor modules. It points our typos by adding red underlining under any incorrectly spelled words. The Accessibility Reporting module allows users with correct permissions to compile accessibility reports on the website and its content. [12] Themes can be used to alter the look and feel of a website using Drupal 7, but themes can have a major impact on accessibility. The Theme accessibility module provides developers building a theme for a Drupal 7 based website feedback on potential accessibility problems while building the theme. However, it alters the way Drupal 7 renders web pages, so it is recommended to leave disabled on a production version of the website. The last module in the Accessibility suite is the Accessibility TestSwarm module. It allows developers to integrate automated accessibility tests on their website through Drupal 7 TestSwarm contributed module. It also modifies how Drupal 7 renders pages like the Theme accessibility module, and it is recommended to leave it disabled on a production site. [13]

Figure 2.1: An example of the content accessibility module pointing out an image without alternative text from Drupal 7 online documentation. [12]

2.6 WordPress and its accessibility features

WordPress also has various accessibility features but takes a slightly different approach to accessibility by requiring that all themes and plug-ins created for WordPress must follow the WordPress accessibility coding standards. It states that all themes and plug-ins should conform to WCAG 2.0 at level AA. A dedicated WordPress accessibility team also actively makes sure that WordPress core product and its code base itself and resources made available by WordPress officially are accessible. WordPress also aims to conform with Authoring Tool Accessibility Guidelines version 2.0, which is another set of guidelines created by the World Wide Web Consortium that aim to provide guidelines "for designing web content authoring tools that are both more accessible to authors with disabilities and designed to enable, support, and promote the production of more accessible web content by all authors [14]." WordPress also has various third-party plug-ins for enhancing and monitoring accessibility on a website. [15]

2.7 Accessibility requirements for a Finnish government website

In the European Union, the Directive on the accessibility of the websites and mobile applications of public sector bodies (Directive (EU) 2016/2102), was adopted by the European parliament and the European council of the European Union on October 26, 2016. It seeks to harmonize accessibility legislation between EU member states. [16] In Finland, the Directive was implemented as part of the digital services act (306/2019) [17] that was enacted to law on April 1, 2019. Amongst other things, it sets the minimum requirements for the accessibility of the websites and mobile applications of various public sector bodies in Finland, the monitoring of the implementation of accessibility and the obligations regarding the digital services provided

to the public by Finnish public authorities. [18] The digital services act is divided into five chapters that contain 17 sections combined. The first chapter provides a general overview of the law, including the purpose of the law, a few definitions, and describes where the law applies. The second chapter concerns organizing digital services for the public. It covers designing and maintaining of such services, how such services should be provided, and when the site could and should require electronic identification from the user. The third chapter concerns accessibility of the digital services. It defines accessibility requirements and their fulfillment for the digital services and when these requirements can be diverged from in case of unreasonable burden. The chapter also states that the service provider must keep an up-to-date accessibility statement and that there must be a way for users to give feedback on accessibility of the service. The fourth chapter covers the supervision and legal protections concerning accessibility requirements. It states what kind of accessibility complaint and clarification request rights the user of the digital service has, what are the tasks and jurisdiction of the supervisory authority, and what kind of rights for accessing and inspecting information the user has. The chapter also clarifies fines and appeal rights involved with the act. Finally, the fifth chapter defines when the act becomes law and from when the different chapters and sections should be followed. [17] In summary, all digital services provided by a Finnish governmental organization, websites included, have three requirements on accessibility, defined by the digital services act: The service and all its contents must comply with Web Content Accessibility Guidelines 2.1 at level A and AA. The service must provide an up-to-date accessibility statement. And the service must have an electronic feedback channel the users may use to provide feedback on the services accessibility and respond to any such feedback within 14 days. [19]

2.7.1 Conform with WCAG 2.1 at level AA

The first requirement stated by the digital services act is that the website or online service must conform with Web Content Accessibility Guidelines 2.1 at levels A and AA. The first level, A contains some basic success criteria that aim to make the web accessible for people with special needs by, for example, allowing a person with trouble hearing to follow along some type of audio content by requiring captions be provided. Level AA success criteria aim to extend accessibility beyond level A by requiring, for example, that live audio content is also provided with captions. There is also a third level AAA that extends accessibility even further by, for example, prerecorded audio content is provided with a sing language interpretation. The digital services act, however, does not require conformance with level AAA. [19]

2.7.2 Provide an accessibility statement

The second requirement stated by the digital services act is an accessibility statement. An accessibility statement is a document that describes the status of accessibility of an online service or a website and explains any existing deviations from the accessibility requirements. A detailed description for what an accessibility statement must contain is described in commission implementing decision (EU) 2018/1523. [20] The decision defines some mandatory and optional items the statement must contain. First is a written commitment that the public sector body making the statement is committed to making all its websites and other online services accessible in accordance with some national legislation transposing the Directive (EU) 2016/2102 of the European Parliament and of the Council, the digital services act in the case of Finland, and list the scope of the statement, meaning the websites and online services it covers. The statement must also contain the following five sections:

A compliance status

All websites and online services covered by the statement must be classified as either (a) fully compliant, (b) partially compliant, or (c) not compliant with some standard which, in the case of the European Union which Finland is a member of, is the Web Content Accessibility Guidelines 2.1 at levels A and AA. In case the website or online service is partially not compliant with the standard, a reason for the non-compliance, or a suitable exception found in the standard must be given.

A list of non-accessible content

The statement must also mention all non-compliant websites and online services, or sections of them that are not yet compliant with the standard being applied or are not covered by the applied legislation. [20] Some content can also be excluded from being compliant due to a disproportionate burden exemption found in article 5 of Directive (EU) 2016/2102. The exemption can be evoked if attempting to conform to the standard would cause excessive burden to the organization responsible for the website or online service. The exemption, however, can only be used on parts of the website or online service and cannot be used to exclude the entire site or service. The exemption must also be planned beforehand with, for example, and accessibility assessment that concludes attempting to conform with some accessibility requirements would be considered a disproportionate burden. The use of the exemption must also explicitly be mentioned in the accessibility statement when listing non-compliant content. Any user of the website or online service also has the right to request clarification on the use of the exemption and is in some cases eligible to receive the content in an accessible format to that user, is said content or service is essential for determining or implementing the user's interests, rights, or obligations. [21]

Date and preparation method of the accessibility statement

The accessibility statement must mention the date it was created and last modified, alongside with how it was prepared based on a self-assessment or external expert assessment. [21]

A method for giving feedback and contact information

The statement must provide a description of, and a link to, the feedback mechanism to be used to notify the organization responsible for the website or online service of any compliance failures and to request information and content excluded from the scope of the applicable legislation. [20]

An enforcement procedure

The statement must describe a way for the user to contact Aluehallintovirasto (AVI) for a request for clarification or a complaint. [21] The decision also mentions some optional items that can be included in an accessibility statement in case mentioning them is deemed appropriate. These include a commitment for a higher level of conformance than required by applicable legislation, a list of remedial measures that will be taken to address non-accessible content of websites online services with a timeline for putting those measures into effect, a formal administrative or political level endorsement of the accessibility statement, the date of the initial publication or the website or online service, the date of the last substantial revision of the content found on the website or online service, a link to an accessibility evaluation report if one exists in particular if said report concluded the site or service is fully compliant, any additional phone assistance for persons with disabilities, and assistive technology users support, and any other content deemed appropriate to include in the report. [20]

2.7.3 Provide a feedback channel

The third and final requirement of the digital services act is a feedback channel. The digital services act requires that the accessibility statement of the website or online service includes the service provider's electronic contact information, where anyone using the website or online service can send feedback about deviations from the accessibility requirements they have observed in the digital service, or to request clarifications on the reasons for the unreasonable burden that justifies some content has not been made accessible. Also, in case a user has a justified reason to access some content that does not fulfill the accessibility requirements to ascertain or fulfill the users' interests, rights, or obligations, that content must be provided to that user in a form that is accessible from the users' viewpoint. However, if the content is not provided, a written justification must be provided for the user. [17]

Any feedback received should be acknowledged with an automatically sent response message that includes the date and time that feedback was received on. All feedback must be handled and responded to as soon as possible, but within 14 days after it has been sent. The time limit can be extended with an additional 14 days in case it concerns a large amount of non-accessible content. The user who sent the feedback must be notified of the extension. [17]

2.8 Keeping accessibility in mind

The Web Content Accessibility Guidelines 2.1 covers many aspects of accessibility with different user interface components and many types of contents that may appear on a website. However, the list of requirements defined by WCAG 2.1 is quite cumbersome to peruse through. In light of this, the Web Content Accessibility Guidelines 2.1 document includes a How to Meet WCAG 2.1, Understanding WCAG 2.1 and Techniques for WCAG 2.1 documents that clarify and give various examples

on how to conform with the success criteria found in the guidelines. Compiling the success criteria found in the guidelines into a more easily readable and followable list for is useful for amswering Research Question 4 and also for employees tasked with adding more content to a website. Here, such a list is produced by first, classifying all guidelines found in WCAG 2.1 by the type of content they cover. Then, the resulting list of guidelines was grouped by content type. The guidelines marked as level AAA are not a strict requirement as was found in research question RQ1, so they were separated under an "optional" heading. Lastly, the guidelines were rewritten in a more easily understandable way.

Text Optionally:

- If your text contains any idioms, jargon, words, or phrases used in an unusual or restricted way, provide an easily understandable definition for them.
- If your text contains any abbreviations, specify their expanded forms as well.
- Refer writing text that is understandable at a lower secondary education level or provide an alternative version of your text that is.

Links:

- Provide an alternative text for any links contained in your text.
- When adding links to your text, use language that well describes your link in the context of the text it is included in.

Links Optionally:

- When adding links to your text, use language that well describes your link.

Images:

- Provide an alternative description for your image.
- Use colors with a contrast ratio of at least 4.5:1 in your images.
- Prefer using text over an image that contains text in your content.
- If your image contains animations (e.g., it is a gif), unsure it does not more than three times per second, or the flash is below the general flash and red flash thresholds.

Images Optionally:

- Use colors with a contrast ratio of at least 7:1 in your images.
- Only use text in your content with no images of text.
- If your image contains animations (e.g., it is a gif), ensure it does not more than three times per second.

Prerecorded Video:

- Provide alternative text descriptions for your video.
- Provide an alternative text version for your video.
- Provide an alternative audio version for your video.
- Ensure your video includes captions.
- Ensure your video does not flash more than three times per second, or the flash is below the general flash and red flash thresholds.

Prerecorded Video Optionally:

- Provide a sing language interpretation for your video.
- Ensure your video does not flash more than three times per second.

Prerecorded Audio:

- Provide an alternative text description for your audio.
- Provide a text-based alternative for your audio content.
- Ensure your audio content includes captions.

Prerecorded Audio Optionally:

- If your audio content primarily contains spoken content and it is not a CAPTCHA or an audio logo or a vocalization be primarily a musical expression, ensure it has no background sound, or that background sounds can be turned off or are not louder than 20 decibels.

Live Audio:

- Ensure the live audio content includes captions.

Live Audio Optionally:

- Ensure the live audio content has an equivalent text-based version available.

3 Measuring and analyzing accessibility guideline implementations

This chapter aims to answer research question RQ3 by exploring various methods of measuring accessibility on a website. These tools will then be used in Chapter 4 to analyze the accessibility of the various websites of the city of Pori.

An algorithm

Wille, et al. in their paper "Measuring the Accessibility Based on Web Content Accessibility Guidelines", propose an approach for a metric to put the results of all 61 success criteria found in WCAG 2.0 together and calculate a comparable result for the WCAG 2.0 fulfillment. [22] Although the research paper considers version 2.0 of WCAG as the 2.1 revision of the guidelines was published two years after the paper was published, the findings of the paper are still quite suitable, since the revision is purely additive. WCAG 2.1 adds 17 success criteria, bringing the total amount from 61 up to 78. The researchers established that:

"The metric requires the measurement of the fulfillment of success criteria by a test tool or, if no tool is available or possible, as an assessment by the tester. Therefore, the tester indicates for each of the criteria their evaluation as "fulfilled",

"not fulfilled" or "not applicable". The result of this evaluation depends on the large extent on the test tool or the profound experience of the tester. Nevertheless, this measurement outlines the basis for the result of a numerical value as the degree of accessibility." [22]

They note that this calculation leads to general characterization and does not talk much about how accessible a web page really is. And that, this value should only be used as an additional indicator to assess whether the efforts to implement an accessible web page are on the right track. The differentiation of the success criteria, for example, level A is more important than level AA, will not be considered in the model because of equality of their importance. Hence, the degree of accessibility is calculated with the following Equation 3.1, where DoA is the Degree of accessibility, sc are the success criteria defined by the WCAG 2.1, $f(fsc)$ is a function that returns the amount of fulfilled success criteria, and $f(nasc)$ is a function that returns the amount of those success criteria that do not apply. [22] The original algorithm has been slightly modified to generalize it for success criteria.

$$DoA = \frac{((f(sc) + f(nasc)) \times 100)}{sc} \tag{3.1}$$

The calculated values are given between 1 and 100, but the paper notes that a 100 percent accessibility cannot be achieved by a tester. The researchers note that their classification is based on the BITV-Test procedure. The researchers note that their measurement approach is a typical method of process evaluation by defining any criteria and counting their compliance. And that the results were transformed in a percentage scale with their benefits and their weaknesses. [22]

Web Accessibility Evaluation Tool

Another highly convenient method to analyze accessibility on a website are a variety of browser plug-ins and crawlers that crawl through a given website, highlighting any

lacking accessibility found. One such tool is the WAVE Web Accessibility Evaluation Tool that can be used as a browser plug-in, shownin Figure 3.1 or using the crawler on the tools homepage. The tool receives a web URL as an input and indicates its findings with symbols overlaid on top of the website as well as a navigable sidebar. [23]

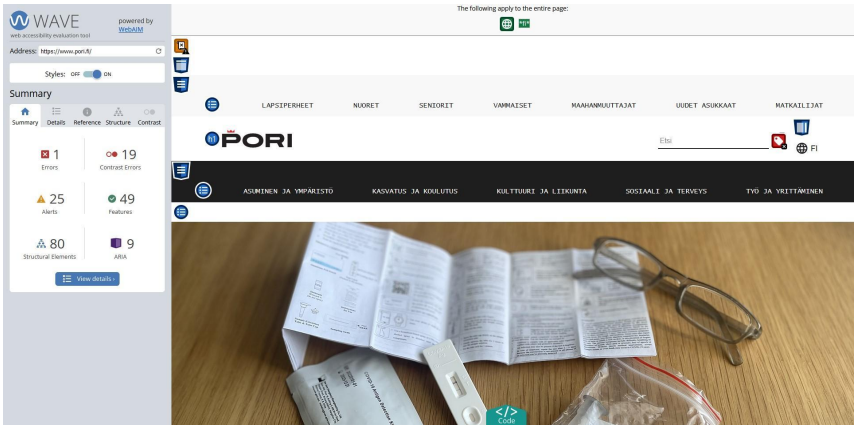


Figure 3.1: The front page of the city of Pori website evaluated with the WAVE tool.

Google Lighthouse

Lighthouse is an open-source automatic tool by Google meant to improve quality of web pages. The recommended way to use it is through development tools integrated into the Google Chrome browser, shown in Figure 3.2, but it is also available as a browser plug-in for Chrome, a node module to use it form a command line interface or integrate it to a continuous integration pipeline in a Git repository. Lighthouse is not strictly just an accessibility scanner, rather, it audits multiple aspects of a website divided into five categories and calculates them an overall score. These categories are performance for optimizing the website for users to be able to see and interact with page content, SEO or search engine optimization for optimizing the pages search engine results ranking, PWA or progressive web app for validating the

website conforms with the requirements of the PWA specification, best practices which aim to improve the overall code health of the website, and lastly, accessibility. [24]

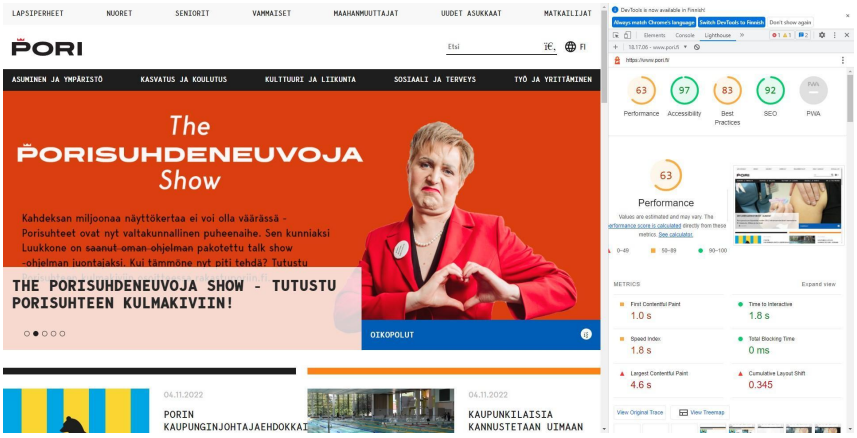


Figure 3.2: The front page of the city of Pori website evaluated with Google Lighthouse.

SiteImprove

SiteImprove is an online dashboard, as seen in Figure 3.3 and a scanner that measures quality assurance, accessibility, and search engine optimization on web pages it is configured to monitor. It assigns a score for each of the three categories and calculates what SiteImprove calls a Digital Certainty Index or DCI that SiteImprove claims represent the quality and potential impact of your site's digital presence, including its accessibility and usability, its credibility and trustworthiness, and how well-poised it is to respond to SEO challenges. [2]

WCAG-EM

WCAG-EM or Website Accessibility Conformance Evaluation Methodology is an approach created by the Web Accessibility Initiative of the World Wide Web Consortium for measuring how well a website conforms with the requirements found

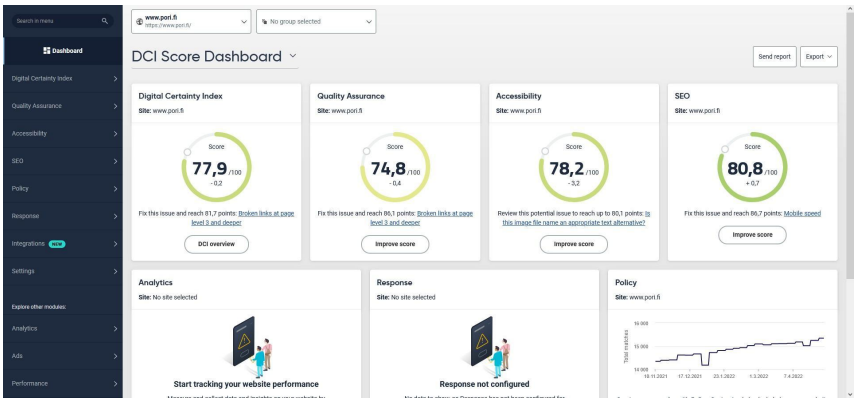


Figure 3.3: SiteImprove dashboard in use by the city of Pori.

in the Web Content Accessibility Guidelines. WCAG-EM is meant to provide a common procedure for auditing accessibility on a website which results in a easily viewable report, such as the one seen in Figure 3.4. It can be applied to measure accessibility of all websites, web applications and mobile websites and can be applied regardless of which evaluation tools, web browsers or assistive technologies were used in the assessment, though using it successfully requires knowledge of WCAG, accessible web design, assistive technologies, and how people with different disabilities use the Web. WCAG-EM has five main steps. [25]

1. Define the scope of the evaluation

   In the first step, what is included in the evaluation is defined, including the version and specific conformance level of WCAG. [25]

2. Explore the website

   In the second step, key web pages, functionality, types of web content, design functionality, and web technologies used, are identified. [25]

3. Select a representative sample

   In the third step, a structured and randomly selected samples of web

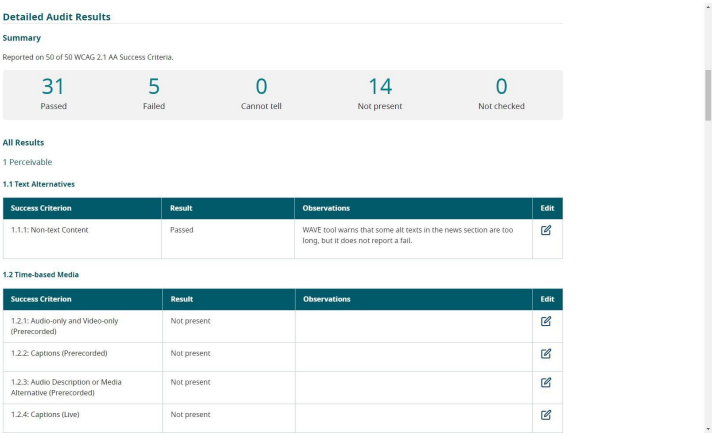
pages are selected when evaluating every be page on the site is not feasible. [25]

4. Evaluate the selected sample

   In the fourth step, successes, and failures in meeting the requirements in the WCAG and accessibility support for website features are recorded. [25]

5. Report the evaluation findings

   In the fifth step, findings of the evaluation are aggregated to calculate an overall score for accessibility. [25]



Detailed Audit Results

Summary

Reported on 50 of 50 WCAG 2.1 AA Success Criteria.

31	5	0	14	0
Passed	Failed	Cannot tell	Not present	Not checked

All Results

1 Perceivable

1.1 Text Alternatives

Success Criterion	Result	Observations	Edit
1.1.1: Non-text Content	Passed	WAVE tool warns that some alt texts in the news section are too long, but it does not report a fail.	

1.2 Time-based Media

Success Criterion	Result	Observations	Edit
1.2.1: Audio-only and Video-only (Prerecorded)	Not present		
1.2.2: Captions (Prerecorded)	Not present		
1.2.3: Audio Description or Media Alternative (Prerecorded)	Not present		
1.2.4: Captions (Live)	Not present		

Figure 3.4: Summary of the WCAG-EM report for the front page of the city of Pori website.

The World Wide Web Consortium also provides an online reporting tool to generate WCAG-EM reports, though, rather than automatically evaluating a website using the methodology, the tool allows an evaluator to input any findings made with the automated tools and manual review methods chosen to evaluate accessibility on a website from which the tool generates a report aggregating all the findings and calculating an accessibility score. [25]

4 Analysis

This chapter aims to answer research question RQ4 by utilizing the knowledge introduced in Chapter 2 tools introduced in Chapter 3 to evaluate how well the new website for the city of Pori conforms with the requirements for accessibility on a Finnish government website defined in Chapter 2. Section 4.1 will establish a baseline by exploring what kind of measures have been taken by the city to ensure the old website is accessible. Section 4.2 will analyze selected web pages found on the old and new websites of the city of Pori with tools from Chapter 3. Section 4.3 will explore the accessibility statements for the various websites of the city of Pori while Section 4.4 will do the same with the feedback channel required by the digital services act.

4.1 Current situation with accessibility on the old website

Although accessibility on websites is a relatively old concept, it became a serious concern on the websites of the city of Pori only after the digital services act [17], and with it, the accessibility Directive of the European Union, entered in the Finnish legislation. The lack of understanding regarding accessibility was almost immediately noticed, and this was remedied with internal training courses with the help of experts from SiteImprove, FAIDD, The Finnish Association on Intellectual and

Developmental Disabilities (Kehitysvammaliitto) and Corellia Helsinki Oy. In addition to this, an internal document that covers some of the most common accessibility issues, headers for example, was added to the city's employee intranet. [26]

City of Pori uses a tool called SiteImprove on its websites. The accessibility of the various sites of the city of Pori are primarily measured with an accessibility scanner built into SiteImprove. The tool periodically crawls through the websites its configured to analyze and shows all issues it found in a web dashboard. The dashboard, seen in Figure 4.1, includes an overview page of the various guidelines the automatic scan covers, these include WCAG, although the specific revision is not mentioned. The tool also scans for some quality best practices the site promises will help to improve the usability of your site, even though resolving them is not necessary for WCAG conformance. They include WAI-ARIA authoring practices, and a list of "Accessibility best practices" that are not part of any official guideline compiled by SiteImprove. In addition to content on websites, the SiteImprove accessibility scanner can also scan PDF files. Unfortunately, the tool covers a limited set of the WCAG, mostly because the guidelines in question are either completely impossible to test for in an automated fashion or have not been implemented yet.

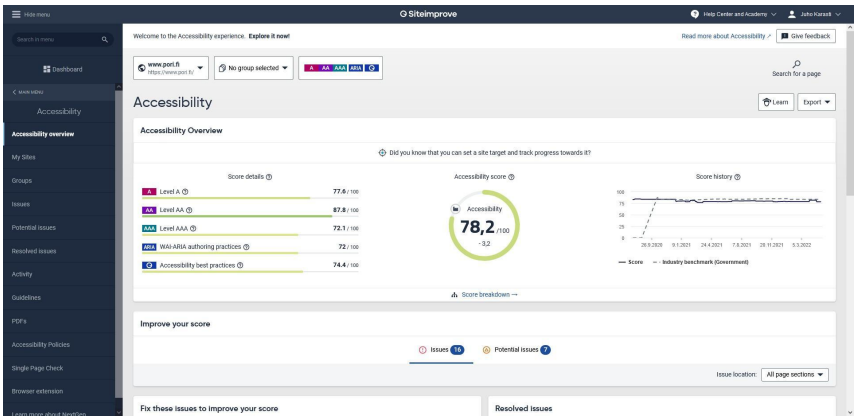


Figure 4.1: SiteImprove accessibility dashboard in use by the city of Pori.

In 2019, the city commissioned an accessibility report from Exove, a private

design and software company that pointed out numerous mistakes and areas lacking accessibility on various sites of the city. The report is limited to only cover WCAG 2.1 at conformance level AA, which is the level of conformance required by the digital services act. [17] Additionally, every single page on all the websites and their sub-pages were not evaluated, only the user interface, typography, page templates, and other repeating components were considered in the report. [27]

The evaluation for the report was conducted with three web browsers: Mozilla Firefox, Apple Safari, and Google Chrome with a browser plug-in called WAVE Web Accessibility Tool by WebAIM was installed on the Google chrome web browser. Also, the SiteImprove tool was used. The pages evaluated were walked through with the mentioned browsers using a screen reader called Apple VoiceOver and, in some cases, a keyboard. Using the sites with a screen reader without looking at the screen, and that all the components on the screen were described by the screen reader with a sufficient accuracy. The reports generated by the used browser plug-in and SiteImprove tool were used to support checking that all WCAG success criteria were complied with. [27]

4.2 Accessibility analysis

This section explores how well the old and new websites of the city of Pori conform with the first requirement mentioned in Section 2.7, conformance with the Web Content Accessibility Guidelines 2.1 at level AA. This is achieved by utilizing the World Wide Web Consortium's Website Accessibility Conformance Evaluation Methodology (WCAG-EM) [25] introduced in Chapter 3 which provides a standard template for building an accessibility report for a website. The tool, however, only provides a way to manually input findings. In addition, WCAG-EM is aimed more towards evaluating the accessibility of a website, rather than assessing page templates provided by a content management system such as WordPress. To work around this,

the normal workflow for WCAG-EM is modified by evaluating each template separately, utilizing the reporting tool more like a list of things to check with the help of the list of things to keep in mind from Section 2.8, the final report is still useful for aggregating an overall accessibility score for further comparison. Web Accessibility Evaluation Tool [23] in conjunction with manual checking will be used to evaluate a passed/failed/not present/not checked value for each requirement. In addition, the NVDA screen reader software [28] will be used to test the websites.

4.2.1 Accessibility analysis for the old website

To evaluate how much accessibility of the new website for the city of Pori has improved when compared to the old website, a baseline is established by evaluating how well a selection of pages on the old website conforms with the Web Content Accessibility Guidelines 2.1 at levels A and AA. The results are presented by a selection of pages that contain a wide variety of different kinds of accessibility issues found on the old website with a short description of what the page is and how well it conforms with the different success criteria found within WCAG 2.1. The description is then followed by a more detailed overview of what kind of faults or failed success criteria were found on the page. The overview is followed by Table 4.1 which summarizes all of the succeeded, failed and not present success criteria on all evaluated pages with their Degree of Accessibility score achieved with the Equation 3.1 from Chapter 3.

Pori.fi header

The header portion of the old website, seen in Figure 4.2, for the city of Pori is present on all pages. It contains a bar with links to pages that congregate pages and information for certain groups of users, such as families with children, or new residents. Below that, there are a city of Pori logo, a search bar, and a language

selector. The bottom of the header contains a menu bar that contains sub menus grouped around various topics, such as living and the environment, or social and health. Out of the 50 success criteria, 24 passed, 6 failed and 20 were not present.

Figure 4.2: The header on the old city of Pori website.

Failed success criteria:

1.3.5: Identify Input Purpose

- The search bar in the header does not have a label attribute.

2.1.1: Keyboard

- The language selector is not accessible through keyboard navigation.
- The sub menus on the menu bar cannot be accessed with a keyboard.

2.4.1: Bypass Blocks

- The contents of the header cannot be bypassed.

2.4.6: Headings and Labels

- The search bar does not have a label.

4.1.2: Name, Role, Value

- The search bar and the language widget are not identified with a screen reader when hovered over with a mouse.

Pori.fi front page

The front page of the website of the city of Pori, seen in Figure 4.3 is the first page the user sees. The page contains a header at the top, a footer at the bottom, and various other content, such as a carousel scrolling through featured articles, and a section with news articles. Out of the 50 success criteria, 31 passed, 4 failed and 15 were not present.

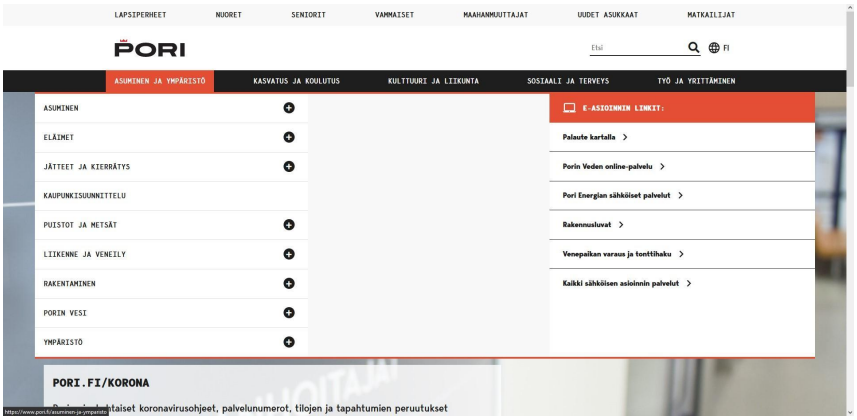


Figure 4.3: The front page on the old city of Pori website.

Failed success criteria:

1.4.3: Contrast (Minimum)

- Some text, especially in the news section of the page that show the date of the article, lack good enough contrast, though the same link is present in the following text with enough contrast.

2.1.1: Keyboard

- The links under the carousel cannot be navigated with a keyboard.

2.2.1: Timing Adjustable

- The scrolling speed of the carousel at the top of the page cannot the adjusted with in any way.

2.2.2: Pause, Stop, Hide

- The carousel at the top of the page cannot be stopped.

Visitpori.fi header

The Visit Pori website header, seen in Figure 4.4, is present on all pages on the Visit Pori website. The header contains a bar with links to a few important pages, such as contacts, and an event calendar. Below that, there are a Visit Pori logo, a seach bar, and a language selector. The bottom of the header contains a menu bar that contaisns sub menus grouped around various topics, such as visit Yyteri, and Kirjurinluoto. Out of the 50 success criteria, 23 passed, 7 failed and 20 were not present.

Figure 4.4: The header on the old Visit Pori website..

Failed success criteria:

1.3.5: Identify Input Purpose

- The search bar in the header does not have a label attribute.

1.4.3: Contrast (Minimum)

- The contrast on the menu bar is lacking.

2.1.1: Keyboard

- The language selector is not accessible through keyboard navigation.
- The sub menus on the menu bar cannot be accessed with a keyboard.

2.4.1: Bypass Blocks

- The contents of the header cannot be bypassed.

2.4.6: Headings and Labels

- The search bar does not have a label.

3.3.2: Labels or Instructions

- The search bar does not have a label.

4.1.2: Name, Role, Value

- The search bar and the language widget are not identified with a screen reader when hovered over with a mouse.

Businesspori.fi front page

The front page of the website of the Business Pori website, seen in Figure 4.5 is the first page the user sees. The page contains a header at the top, a footer at the bottom, a carousel scrolling through featured pages, and a news section. Out of the 50 success criteria, 28 passed, 6 failed and 16 were not present.

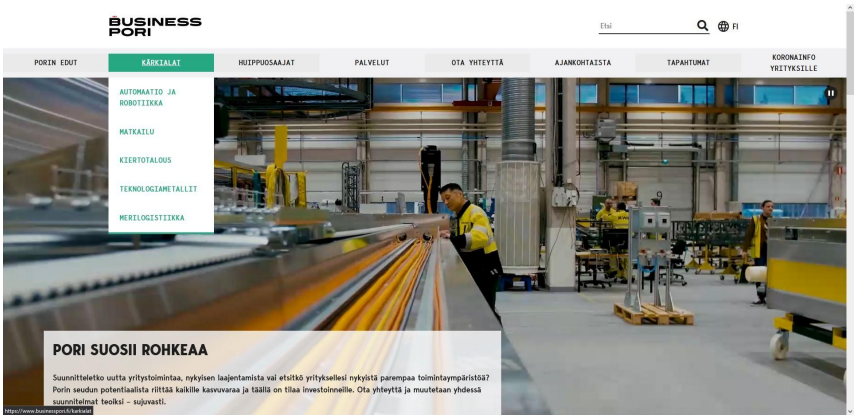


Figure 4.5: The front page on the old Business Pori website.

Failed success criteria:

1.4.3: Contrast (Minimum)

- The date text in the news section of the page lacks proper contrast.

1.4.11: Non-text Contrast

- The date text in the news section of the page lacks proper contrast.

2.1.1: Keyboard

- The "Porin edut" section on the page is not accessible with a keyboard.

2.2.1: Timing Adjustable

- The scrolling speed of the carousel at the top of the page cannot the adjusted with in any way.

2.2.2: Pause, Stop, Hide

- The carousel at the top of the page cannot be stopped.

2.4.4: Link Purpose (In Context)

- The page has a few empty buttons and links with seemingly no functionality.

News archive (uurtisarkisto)

The news archive template is used on a unique page, like the one seen in Figure 4.6, which is present on all three websites of the city of Pori to aggregate all news on the site. It contains a search bar at the top, as selection of various search criteria that can be used to scope the search, and the news articles matching the search criteria. Out of the 50 success criteria, 24 passed, 6 failed and 20 were not present.

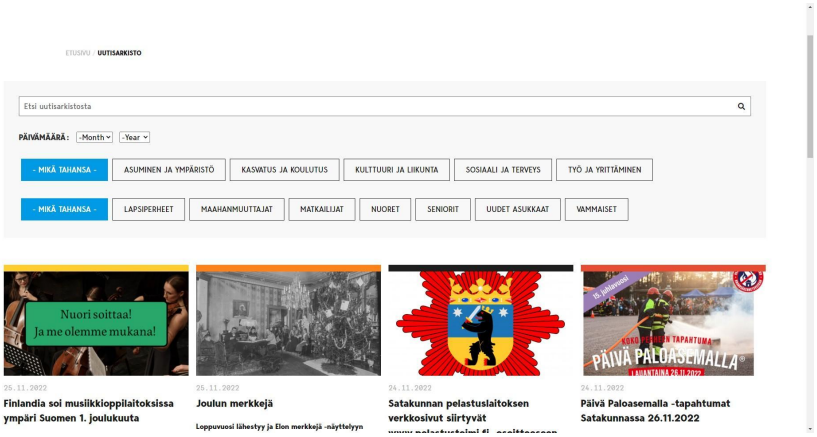


Figure 4.6: The news archive page on the old city of Pori website.

Failed success criteria:

1.3.3: Sensory Characteristics

- The month and year selection drop downs lack a proper label, so their function might be difficult to understand.

2.1.1: Keyboard

- On erroneous input, a warning box that cannot be accessed with a keyboard appears at the top of the page.

2.4.3: Focus Order

- When a search is made, the page resets, which moves focus back to the top of the page.

2.4.6: Headings and Labels

- The two visually identical category selection widgets have no labels, so distinguishing them might be difficult.
- The year and month selection drop downs are in English and might be difficult to understand.

3.2.2: On Input

- Inputting search terms or picking categories refreshes the page, which makes keyboard navigation much more tedious.

4.1.3: Status Messages

- On erroneous inputs, a warning box appears at the top of the page, but it is not described to the user, nor can it be navigated to with a keyboard.

Phone book (puhelinluettelo)

The phone book template is used on a unique page, like the one seen in Figure 4.7, which is present on all three websites of the city of Pori, contains all the contact information for the employees of the city of Pori. It contains a menu that the user can use to show the contacts of a certain category or a unit functioning under the city. On the left, there are the general operating hours of the city, a search bar, and the contact information for all the employees matching the search criteria. Out of the 50 success criteria, 23 passed, 6 failed and 21 were not present.

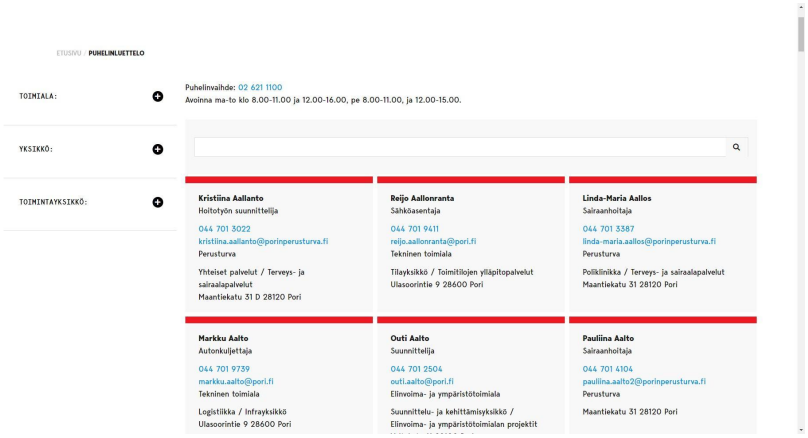


Figure 4.7: The phone book page on the old city of Pori website.

Failed success criteria:

1.3.1: Info and Relationships

- The search criteria menu lacks labels, which could make using it difficult.

1.3.5: Identify Input Purpose

- The search field has no label.

1.4.3: Contrast (Minimum)

- Link text and breadcrumbs do not have enough contrast.

2.1.1: Keyboard

- The search criteria menu is not accessible with a keyboard.

2.4.3: Focus Order

- The location of the focus resets when user searches something on a website, which leads into a lot of extra scrolling.

2.4.6: Headings and Labels

- Many of the sections on the search page have no labels or headings.

Event (Tapahtuma)

The event template is used to present information on some event, as seen in Figure 4.8. The page contains a larger image on the right, information about the event, such as the location and the price of the tickets, with a general description of the event below. Out of the 50 success criteria, 24 passed, 2 failed and 24 were not present.

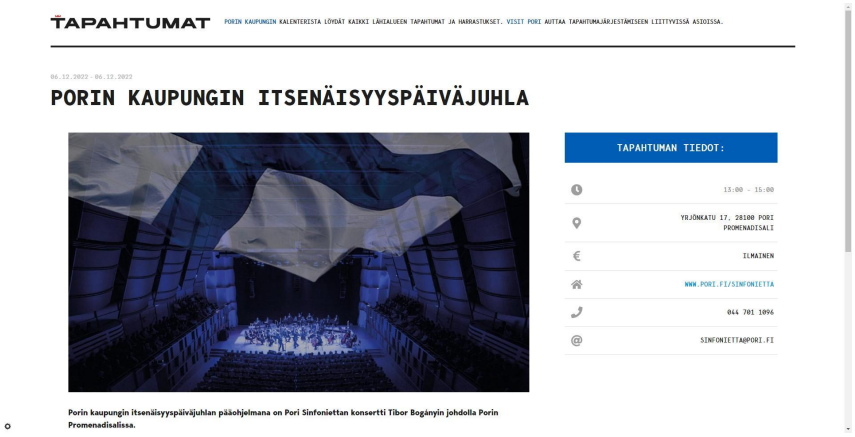


Figure 4.8: An event page on the old city of Pori website.

Failed success criteria:

1.1.1: Non-text Content

- The "tapahtuman tiedot" section relays information about, for example the location of the event, with icons that have no labels that a screen reader could read.

1.4.3: Contrast (Minimum)

- The links in text and date and time texts on the page lack enough contrast.

Visit Pori service card (palvelukortti)

The Visit Pori service card template is used to present various services, such as hotels and restaurants, found in and around the city of Pori. Each service card, as seen in Figure 4.9, contains a photo carousel at the top of the page, information about the service, a section with keywords, and the contact details for the service. Out of the 50 success criteria, 24 passed, 3 failed and 23 were not present.

Failed success criteria:

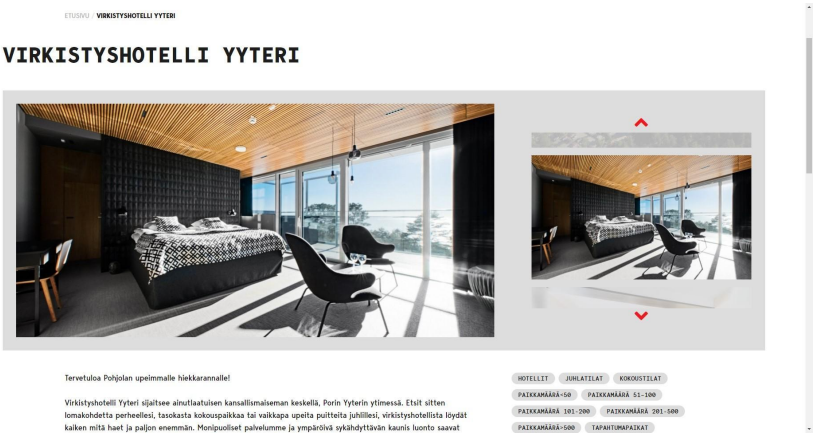


Figure 4.9: A service card page on the old Visit Pori website.

1.3.1: Info and Relationships

- The image gallery is not labeled, which leaves the purpose of the previous and next buttons unclear.
- The keywords section has no label.

1.4.3: Contrast (Minimum)

- The links in text and breadcrumbs lack enough contrast.

1.4.11: Non-text Contrast

- The title bar of the contact details section lacks enough contrast.

Results summary

Table 4.1 summarises the result of the accessibility evaluation for all of the pages selected on the old city of Pori websites and their Degree of Accessibility score calculated with the Equation 3.1 from Chapter 3.

Page	Passed	Failed	Not present	DoA
pori.fi header	24	6	20	88%
pori.fi footer	26	0	24	100%
pori.fi front page	31	4	15	92%
visitpori.fi header	23	7	20	86%
visitpori.fi footer	26	0	24	100%
visitpori.fi front page	26	5	19	90%
businesspori.fi header	23	6	21	88%
businesspori.fi footer	27	0	23	100%
businesspori.fi front page	28	6	16	88%
content page (sisältosivu)	30	2	18	96%
news (uutinen)	25	4	21	92%
news archive (uutisarkisto)	24	6	20	88%
phonebook (puhelinluettelo)	23	6	21	88%
front-page-template	22	5	23	90%
target audience page (kohderyhmäsivu)	24	2	24	96%
event (tapahtuma)	24	2	24	96%
Visit Pori service card (palvelukortti)	24	3	23	94%
office (toimipiste)	23	3	24	94%
search	27	6	17	88%

Table 4.1: Table summarising the amount of Passed, Failed, and Not present success criteria on evaluated pages of the old website of the city of Pori, alongside a Degree of Accessibility score.

4.2.2 Accessibility analysis for the new website

To evaluate how much accessibility of the new website for the city of Pori has improved when compared to the old website, a point of comparison is established by evaluating how well a selection of pages on the old website conforms with the Web Content Accessibility Guidelines 2.1 at levels A and AA. The results are presented by a selection of pages that contain a wide variety of different kinds of accessibility issues found on the old website with a short description of what the page is and how well it conforms with the different success criteria found within WCAG 2.1 The description is then followed by a more detailed overview of what kind of faults or failed success criteria were found on the page. The overview is followed by Table 4.2 which summarizes all of the succeeded, failed and not present success criteria on all evaluated pages with their Degree of Accessibility score achieved with the Equation 3.1 from Chapter 3.

Pori.fi footer

The footer, seen on Figure 4.10, present on all pages of the new website of the city of Pori. It contains generic contact details for the city of Pori, social media links, and links to a few important pages on the website. Out of the 50 success criteria, 25 passed, 1 failed and 14 were not present.

Figure 4.10: The footer on the new city of Pori website.

Failed success criteria:

2.4.4: Link Purpose (In Context)

- The alternative text on the social media links (Facebook, Twitter, etc.) on the left side of the page are not recognizable, there is no indication which social media site they lead to.

Pori.fi front page

The front page on the new website, seen in Figure 4.11, is the first page that the user sees when visiting the site. It contains a header at the top, a footer at the bottom, and various sections containing content such as featured pages or news articles. Out of the 50 success criteria, 34 passed, 2 failed and 14 were not present.

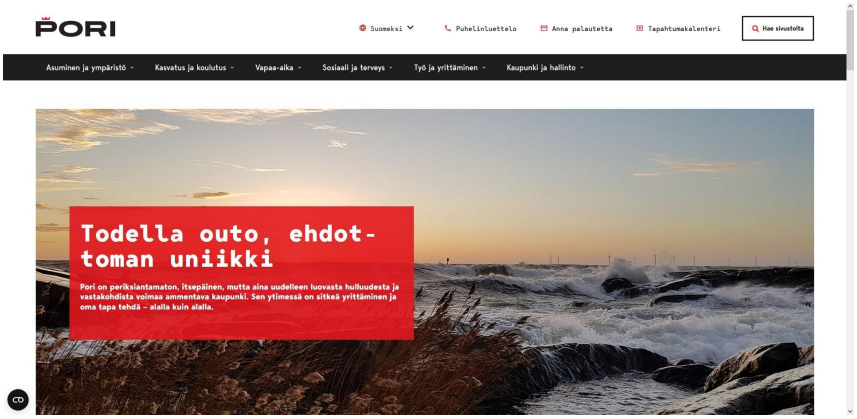


Figure 4.11: The front page on the new city of Pori website.

Failed success criteria:

2.4.4 : Link Purpose (In Context)

- The page has two featured pages on yellow background. The “Read more!” (Lue lisää!) link only prompts the user to read more, so real porpose of the link is not clear.

3.2.4: Consistent Identification

- There are multiple arrow shaped components that acts as links to other pages on the page, only some of which can be focused separately with a keyboard.

Visitpori.fi front page

The front page, seen in Figure 4.12, is the first page that a person interested in visiting the city of Pori as a tourist, or out of interested in the various attractions of the City sees. The page contains a header at the top, a footer at the bottom, and various sections containing featured articles, or social media posts. Out of the 50 success criteria, 30 passed, 1 failed and 19 were not present.

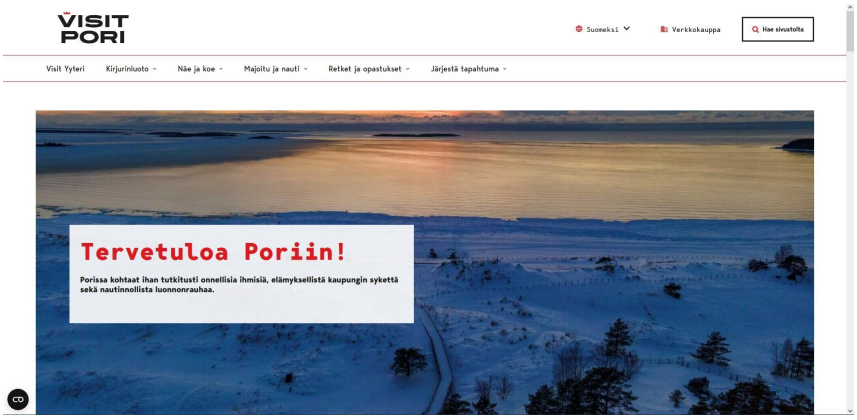


Figure 4.12: The front page on the new Visit Pori website.

Failed success criteria:

1.1.1: Non-text Content

- Multiple images on the page lack an alternative text.

News (uutinen)

This is a template for a news, like the one seen in Figure 4.13, article on the new website. The page contains a large image at the top, and the article itself below

that, followed by a few keywords. Out of the 50 success criteria, 27 passed, 2 failed and 21 were not present.

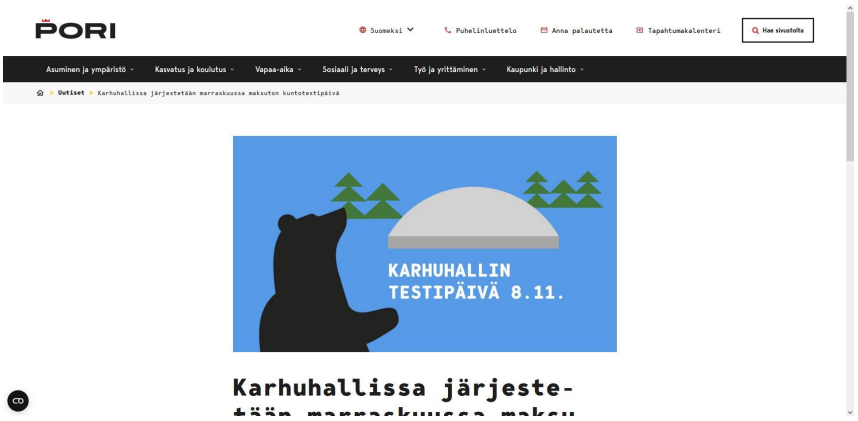


Figure 4.13: A news page on the new city of Pori website.

Failed success criteria:

1.3.1: Info and Relationships

- The keywords section is not labeled, so it cannot be identified with a screen reader.

2.4.4: Link Purpose (In Context)

- The alternative texts of the keywords in the article do not indicate that what is being currently highlighted on the page is a keyword, so they cannot be identified with a screen reader.

Front-page-template

This is a generic template for a homepage for various services and institutions, such as museums, located in the city of Pori. For example, the new homepage for Satakunnan Museo seen in Figure 4.14. The page contains the contact information and opening hours at the top, followed by links to the events happening soon,

followed by social media posts. Out of the 50 success criteria, 27 passed, 1 failed and 22 were not present.

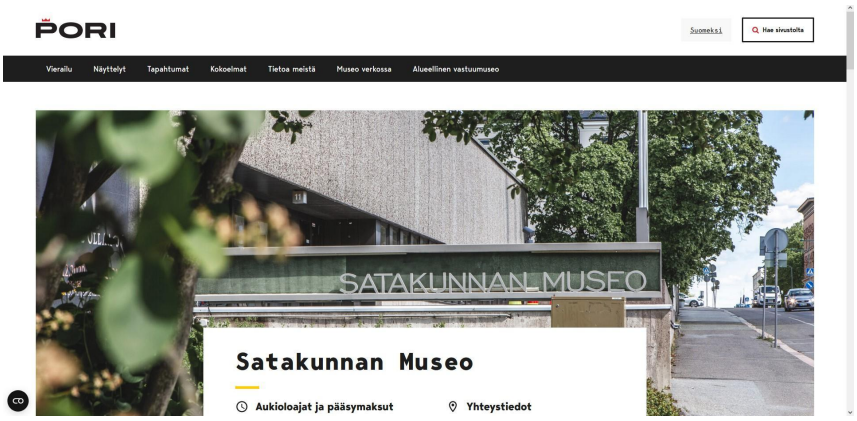


Figure 4.14: the new website for Satakunnan museo based on the generic front page template.

Failed success criteria:

2.4.3: Focus Order

- There are multiple links on the page where the next item that gains focus is an arrow component that has the exact same content.

Event (tapahtuma)

This is a new template for a dedicated page for an event happening somewhere in the city of Pori. The page, like the one seen in Figure 4.15, contains a large image at the top, the description of the event, and a box with information about the event, such as the date and time of the event. Out of the 50 success criteria, 25 passed, 1 failed and 24 were not present.

Failed success criteria:

1.1.1: Non-text Content

Figure 4.15: An event page on the new city of Pori website.

- The “tapahtuman tiedot” section that relays information about, for example, the date of the event with icons that have no labels that a screen reader could read.

Results summary

Table 4.2 summarises the result of the accessibility evaluation for all of the pages selected on the new city of Pori websites and their Degree of Accessibility score calculated with the Equation 3.1 from Chapter 3.

Page	Passed	Failed	Not present	DoA
pori.fi header	30	0	20	100%
pori.fi footer	25	1	24	98%
pori.fi front page	34	2	14	96%
visitpori.fi header	30	0	20	100%
visitpori.fi footer	25	1	24	98%
visitpori.fi front page	30	1	19	98%
businesspori.fi header	28	1	21	98%
businesspori.fi footer	27	0	23	100%
businesspori.fi front page	34	0	16	100%
content page (sisältosivu)	32	0	18	100%
news (uutinen)	27	2	21	96%
news archive (uutisarkisto)	29	1	20	98%
phonebook (puhelinluettelo)	28	1	21	98%
front-page-template	27	1	22	98%
summary page (koontisivu)	26	0	24	100%
event (tapahtuma)	25	1	24	98%
Visit Pori service card (palvelukortti)	27	0	23	100%
office (toimipiste)	26	0	24	100%
search	32	1	17	98%

Table 4.2: Table summarising the amount of Passed, Failed, and Not present success criteria on evaluated pages of the new website of the city of Pori, alongside a Degree of Accessibility score.

As can be seen from Table 4.2, the new website, while doing having considerably better performance on accessibility, still can be improved. In Table 4.3, all accessibility issues found on the new website are presented and supplied with a suggestion on how to fix it.

Failed criteria	Location	Description	Suggested fix
1.1.1: Non-text Content	Event pages under promenadisali.pori.fi and possibly others	The "Tapahtuman tiedot" section that relays information about, for example, the date of the event with icons that have no labels that a screen reader could read	Give the icons alternative text that indicate what information they contain.
1.3.1: Info and Relationships	All news located under pori.fi, visitpori.fi, businesspori.fi and possibly others	The keywords section is not labeled, so it cannot be identified with a screen reader.	Add a heading for the section to identify it.
2.4.4: Link Purpose (In Context)	Every page at businesspori.fi.	The "Business Pori" link in the header of the Business Pori website is labeled "torstai".	Give the link a sensible alternative text.

1.1.1: Non-text Content	Visitpori.fi and possibly others.	Multiple images on the page lack an alternative text.	Ensure that all images have an alternative text affiliated with them.
2.4.4: Link Purpose (In Context)	All news located under pori.fi, visitpori.fi, businesspori.fi and possibly others.	The alternative texts of the keywords in the article do not indicate that what is being currently highlighted on the page is a keyword, so they cannot be identified with a screen reader.	Modify the alternative text of the keywords to identify them as keywords.
2.4.4: Link Purpose (In Context)	pori.fi front page	The page has two featured pages on yellow background. The "Read more!" (Lue lisää!) link only prompts the user to read more, so real porpose of the link is not clear.	Include information about the featured page the link leads to into the alternative text in the link.
2.4.3: Focus Order	All news archives, all phone books and all search pages	The entire page is refreshed when a search is made, which leads into additional scrolling.	Redesign the page in a way that refreshes only the search results when a search is made.

2.4.4: Link Purpose (In Context)	All footers.	The alternative text on the social media links (Facebook, Twitter, etc.) on the left side of the page are not recognizable, there is no indication which social media site they lead to.	Add information about which social media site or account the link leads to in the alternative text for the links.
2.4.3: Focus Order	All news archives and all search pages	The search button gains focus before the additional search criteria.	Redesign the page so that the additional search criteria gain focus before the search button.
2.4.3: Focus Order	Pori.fi front page, Satakunnanmuseo.pori.fi front page and possibly others.	There are multiple links on the page where the next item that gains focus is an arrow component that has the exact same content.	Ensure all of the arrow components either can gain focus on a keyboard or make all of them purely decorative.

Table 4.3: Table with a summary of which success criteria were found to be unfulfilled on the new website, together with the location of the failure, its description, and a suggestion of how to fix it.

4.2.3 Results of the accessibility analysis

The old website for the city of Pori built on top of the Drupal 7 content management system had multiple different accessibility issues. These issues mostly contain things such as lacking contrast between color of fonts or various user interface components and background color and lack of support for keyboard only navigation on the pages. These have mostly been fixed on the new WordPress based site thanks to a new theming with a fresh look and feel across most of the websites operated by the city of Pori. Contrast errors have especially been mostly fixed, with most errors appearing to be false positives inside the menu bar at the bottom of the header on each site. Keyboard navigation is also much easier. For example, the afore mentioned menu bar was previously completely unusable on a keyboard on the old site, where as the menu bar found on the new site is fully keyboard accessible. Unfortunately, most evaluated pages on the new site still contain some accessibility issues. Some should be rather trivial to fix. Fox example, the links for various social media accounts for the city of Pori located in the footers on various sites are difficult to identify with a screen reader alone as the alternative text for those links has no mention which social media site they lead to. The YouTube links are especially bad in this regard as a screen reader tries to read the YouTube URL out loud for the user. There are also a few less trivial accessibility issues. For example, the new event page found on some sites still contain information such as date and time of the event that are indicated with icons that are unusable with both a keyboard and a screen reader. Table 4.4 is a summary of the Tables 4.1 and 4.2 which presents all the findings for a comparison at a single glance.

Page	Passed success criteria	Failed success criteria	DoA
pori.fi header	+6	−6	+12%
pori.fi footer	−1	+1	−2%
pori.fi front page	+3	−2	+6%
visitpori.fi header	+7	−7	+14%
visitpori.fi footer	−1	+1	−2%
visitpori.fi front page	+4	−4	+8%
businesspori.fi header	+5	−5	+10%
businesspori.fi footer	±0	±0	±0%
businesspori.fi front page	+6	−6	+12%
content page (sisältosivu)	+2	−2	+4%
news (uutinen)	+2	−2	+4%
news archive (uutisarkisto)	+5	−5	+10%
phone book (puhelinluettelo)	+5	−5	+10%
front-page-template	+5	−4	+8%
summary page (koontisivu)	+2	−2	+4%
event (tapahtuma)	+1	−1	+2%
Visit Pori service card (palvelukortti)	+3	−3	+6%
office (toimipiste)	+3	−3	+6%
search	+5	−5	+10%

Table 4.4: Table showing the change in accessibility between the new and the old sites. The first column shows the change in the amount of passed success criteria, the second shows the amount of failed success criteria, and the third shows the change in the Degree of Accessibility value.

4.3 Analysis of the accessibility statement

This section explores how well the old and new websites of the city of Pori conform with the second requirement mentioned in Section 2.7, the accessibility stament.

4.3.1 Accessibility statement on the old website

All three sites pori.fi, visitpori.fi and businesspori.fi have a near identical accessibility statement. The statements begin with the required commitment from the city of Pori that the site the accessibility statement covers will be accessible followed by a mention of the digital services act and the Directive (EU) 2016/2102 the act implements. They also contain a compliance status which states that the site is partially compliant with the Web Content Accessibility Guidelines 2.1 at level AA. The statements have a list of non-accessible content and evokes the exemption found in article 5 of the Directive (EU) 2016/2102 while noting that the underlying platform of the site will be changed in 2022. The statements do not contain a date they were created or last modified and only mention that they are based on an accessibility report made by Exove Oy in 2019 with no further clarification. The required feedback channel and information about how to contact Aluehallintovirasto in case the user wishes to request a clarification of file a complaint is present. The statements also contain a few optional components mentioned in the committee implementing decision (EU) 2018/1523.

The accessibility statements for the main website of the city of Pori, the Visit Pori website and the Business Pori website mostly contain all the required components. The only one missing is the date the statements were created and last modified on. These should be added when the statements for the new sites are created and modified appropriately when changes to the statements are made.

The other potential issue for the accessibility statements is the lack of discoverability. None of the three websites of the city of Pori seem to have a link to their

accessibility statement anywhere on the site, so the only way to find them is to use the search with an online search engine, such as Google, or using the city of Pori websites own search function. This means that a user visiting either the Visit Pori or the Business Pori website has no clear way of finding the accessibility statements for those sites. In addition, they are all located under the pori.fi domain, alongside the accessibility statements for a few other services and websites of the city of Pori that this thesis does not cover.

4.3.2 Accessibility statement on the new website

The accessibility statement on the new website seems to be the same as the old site copied over as is. As on the old site, the only missing part is the date the statement was created and last midified. The location issue is also present, as all of the accessibility statements are located under the pori.fi domain. The new website does have a link to the accessibility at the very bottom of the footer, however, this is only the case on the main website and does not exist on the Visit Pori or the Business Pori websites.

4.3.3 Summary of the results

The accessibility statement on the new website should be updated by at least removing the mention of the accessibility evaluation made by Exove as the evaluation was made against the old website so it no longer applies. The non-accessible section of the statement should also be updated to reflect the state of the new website. It would also be recommended to move the accessibility statements under the domain of that site, for example, the accessibility statement for the Visit Pori website should be moved somewhere under visitpori.fi. Also the accessibility statements should be linked to the bottom of the footer on both the Visit Pori website and the Business Pori website in the same way as on the main city of Pori website.

4.4 Analysis of the feedback channel

This Section explores how well the old and new websites of the city of Pori conform with the third requirement mentioned in Section 2.7, the feedback channel.

4.4.1 Feedback channel on the old website

A feedback channel where the user can send feedback about any deficiencies about accessibility they have encountered on the site or request a clarification for a reason for any such occurrences exists and is clearly mentioned in all three accessibility statements for the main website of the city of Pori, the Visit Pori website and the Business Pori website.

4.4.2 Feedback channel on the new website

As the accessibility statements are the exact same ones on the old and the new websites, the feedback channel exists and is mentioned in the same way as well, making them identical between the old and the new websites of the city of Pori.

4.4.3 Summary of the results

Finding the channel is somewhat difficult, especially on the Visit Pori and Business Pori websites, for the same reasons as finding the accessibility statements themselves, but this can be fixed by making the changes to the location of the accessibility statements mentioned above.

5 Conclusions

This thesis answered the research questions by exploring what accessibility is, how it relates to the websites on the internet and by conducting accessibility evaluation on a selection of pages found across websites operated by the city of Pori.

A Finnish law implementing an EU Directive gives research question RQ1 a clear answer by requiring all government owned and operated websites and online services to conform with the Web Content Accessibility Guidelines 2.1 at levels A and AA. The guidelines also contain a higher level AAA, but conforming at that level is not required even if doing so is desirable. In addition to this, the law requires that an accessibility statement is made available on the website and that the website has a feedback channel listed in the accessibility statement, where a user of the website may request clarification about why some part of the website is not fully accessibly, or request an accessible version of some resource on the website.

The guidelines found within WCAG 2.1 are often somewhat difficult to understand immediately, hence the Web Content Accessibility Guidelines are accompanied by a How to Meet WCAG 2.1, Understanding WCAG 2.1 and Techniques for WCAG 2.1 documents that clarify and give various examples on how to conform with the success criteria found in the guidelines. Research question RQ2 was given an answer based on the success criteria found within WCAG 2.1 and the accompanying documentation by compiling a set of concrete requirements for different kinds of content that could appear on a website.

Research question RQ3 was given an answer by studying a few approaches proposed in scientific papers and evaluating various tools means for measuring and analyzing that requirements from the answer to research question RQ1 are fulfilled. No proper "one size fits all" approach properly exists. So a combination of a methodology from the Web Accessibility Initiative of the World Wide Web Consortium, the creator of WCAG and all its revisions, though slightly modified to better present the findings on each individual page evaluated, and a simple Equation 3.1 proposed in one paper to form a percentage of successfully fulfilled criteria was picked with some modifications to carry out the analysis for the answer to research question RQ4.

The practical part of this thesis answered research question RQ4 with an evaluation of a selected sample of pages found on the old websites of the city of Pori and their counterparts on the new website using the chosen methodology and equation identified in the answer to research question RQ3. The presence and contents of the accessibility statements, and the feedback channel were also evaluated. The old website was found to have a wide range of different issues for its accessibility mostly concerning contrast between color of fonts and some user interface components and their background alongside some issues with operating the sites with a keyboard. The issues were found to be mostly fixed on the new website, though a few were still identified and provided with a suggestion on how to fix them. The evaluation should have caught most of the issues on both the old and the new websites but is not without limitations. All the success criteria for the guidelines were evaluated individually on each page, but they are not quite fit to be individual requirements and have some overlap between them. Another approach could be to simply use the website as is and make observations concerning lack of accessibility and then classify and label them with all the fitting success criteria. While this approach would have included a method of browsing the site like an average user, it risks missing some success criteria the reviewer is not quite familiar with, so the approach where the

success criteria were evaluated individually was chosen. The approach chosen might itself not be the best one in the first place. Some other proposed method could have been chosen, or an entirely new one could have been formed, but the chosen method originates from the creator of the Web Content Accessibility Guidelines, so it was deemed good enough.

There is surprisingly little research on the topic of this thesis, given the importance of accessibility, so further research is certainly possible.

References

[1] Tilastokeskus, *Kuntien avainluvut*, accessed Mar-2-2023, 2021. [Online]. Available: https://www.stat.fi/.

[2] *City of Pori SiteImprove dashboard.*

[3] *United Nations, Convention on the Rights of Persons with Disabilities (CRPD)*, accessed Feb-12-2023, 2007. [Online]. Available: https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html).

[4] *Acessibility resources at papunetti*, accessed Feb-12-2023. [Online]. Available: https://papunet.net/saavutettavuus.

[5] Shadi Abou-Zahra and Judy Brewer, *Diverse Abilities and Barriers*, accessed Feb-12-2023, 2017. [Online]. Available: https://www.w3.org/WAI/people-use-web/abilities-barriers/.

[6] Shawn Lawton Henry, *WCAG 2 overview*, accessed Feb-12-2023, 2005. [Online]. Available: https://www.w3.org/WAI/standards-guidelines/wcag/.

[7] Wendy Chisholm and Madison Gregg and Ian Jacobs, *Web Content Accessibility Guidelines (WCAG) 1.0*, accessed Feb-12-2023, 1999. [Online]. Available: https://www.w3.org/TR/WCAG10/.

[8] Ben Caldwell and Michael Cooper and Loretta Guarino Reid and Gregg Vanderheiden and Wendy Chisholm and John Slatin and Jason White, *Web Con-*

tent Accessibility Guidelines (WCAG) 2.0, accessed Feb-12-2023, 2008. [Online]. Available: https://www.w3.org/TR/WCAG20/.

[9] Ben Caldwell and Loretta Guarino Reid and Gregg Vanderheiden and Wendy Chisholm and John Slatin and Jason White and Andrew Kirkpatrick and Joshue O Connor and Alastair Campbell and Michael Cooper. "Web Content Accessibility Guidelines (WCAG) 2.1". accessed Feb-12-2023. (2018), [Online]. Available: https://www.w3.org/TR/WCAG21/.

[10] Chuck Adams and Alastair Campbell and Rachael Montgomery and Michael Cooperand and Andrew Kirkpatrick, *Web Content Accessibility Guidelines (WCAG) 2.2*, accessed Feb-12-2023, 2023. [Online]. Available: https://www.w3.org/TR/WCAG22/.

[11] Joanmarie Diggs and Shane McCarron and Michael Cooper and Richard Schwerdtfeger and James Craig, *WAI-ARIA*, accessed Feb-12-2023, 2017. [Online]. Available: https://www.w3.org/TR/wai-aria/.

[12] *Documentation for Drupal 7*, accessed Feb-12-2023. [Online]. Available: https://www.drupal.org/docs/7.

[13] *Drupal 7 accessibility project*, accessed Feb-12-2023. [Online]. Available: https://www.drupal.org/project/accessibility.

[14] Jan Richards and Jeanne Spellman and Jutta Treviranus, *Authoring Tool Accessibility Guidelines (ATAG) 2.0*, 2015. [Online]. Available: https://www.w3.org/TR/ATAG20/.

[15] "WorPress acessibility guidelines". accessed Feb-12-2023. (), [Online]. Available: https://wordpress.org/about/accessibility/.

[16] *Directive (EU) 2016/2102 on the accessibility of the websites and mobile applications of public sector bodies*, accessed Feb-12-2023, 2016. [Online]. Available:

https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016L2102&from=EN.

[17] *Act on the Provision of Digital Services (306/2019)*, accessed Feb-12-2023, 2019. [Online]. Available: https://www.finlex.fi/fi/laki/alkup/2019/20190306#Pidm45237816268352.

[18] *Act on the Provision of Digital Services on the Ministry of Finance website*, accessed Feb-12-2023. [Online]. Available: https://vm.fi/digipalvelulaki.

[19] *Requirements of the Act on the Provision of Digital Services*, accessed Feb-12-2023. [Online]. Available: https://www.saavutettavuusvaatimukset.fi/digipalvelulain-vaatimukset/.

[20] The European Comission, *Commission Implementing Decision (EU) 2018/1523*, accessed Feb-12-2023, 2018. [Online]. Available: https://eur-lex.europa.eu/eli/dec_impl/2018/1523/oj.

[21] *Acessibility statement requirements*, accessed Feb-12-2023. [Online]. Available: https://www.saavutettavuusvaatimukset.fi/digipalvelulain-vaatimukset/tietoa-saavutettavuusselosteesta/.

[22] Wille, Kathrin and Dumke, Reiner R. and Wille, Cornelius, *Measuring the Accessability Based on Web Content Accessibility Guidelines*, 2016. DOI: 10.1109/IWSM-Mensura.2016.032.

[23] WebAIM (Web Accessibility In Mind), *WAVE Web Accessibility Evaluation Tool*, accessed Feb-12-2023, 2001. [Online]. Available: https://wave.webaim.org/.

[24] Google LLC, *Google Lighthouse*, accessed Feb-12-2023, 2016. [Online]. Available: https://developers.google.com/web/tools/lighthouse/.

[25] Shawn Lawton Henry and Shadi Abou-Zahra, *WCAG-EM Overview*, accessed Feb-12-2023, 2005. [Online]. Available: `https://www.w3.org/WAI/test-evaluate/conformance/wcag-em/`.

[26] Sebastian Hidvégi, *Personal communication*, 2022.

[27] Exove, *Accessibility report*, 2019.

[28] Michael Curran and NV Access and contributors, *NVDA screen reader*, accessed Feb-12-2023, 2006. [Online]. Available: `http://www.saavutettavuus.fi/nvda.php`.

Appendix A Full description of success criteria found in Web Content Accessibility Guidelines 2.1

This appendix contains the the contents of the Web Content Accessibility Guidelines 2.1 in full from the official document. [9]

Success Criteria	Level of Conformance	Name	Description
SC 1.1.1	A	Non-text Content	This success criterion is met when all non-text content has some form of equivalent text alternative. Though there are a few exceptions. For example, if the content is purely decorative.
SC 1.2.1	A	Audio-only and Video-only (Prerecorded)	This success criterion is met when all prerecorded audio and video content are provided with an equivalent alternative.
SC 1.2.2	A	Captions (Prerecorded)	This success criterion is met when all prerecorded audio content is provided with captions, except in cases where the content is an alternative for some text content.
SC 1.2.3	A	Audio Description or Media Alternative (Prerecorded)	This success criterion is met when all descriptions for prerecorded audio or video content are provided with an alternative, except in cases where the content is an alternative for some text content.
SC 1.2.4	AA	Captions (Live)	This success criterion is met when all live audio content is provided with captions.
SC 1.2.5	AA	Audio Description (Prerecorded)	This success criterion is met when an audio description is provided for all prerecorded video content.
SC 1.2.6	AAA	Sign Language (Prerecorded)	This success criterion is met when all prerecorded audio content is provided with a sing language interpretation.
SC 1.2.7	AAA	Extended Audio Description (Prerecorded)	This success criterion is met when an extended audio description is provided for all video content where pauses in foreground audio are insufficient to allow audio descriptions to convey the contents of the video.
SC 1.2.8	AAA	Media Alternative (Prerecorded)	This success criterion is met when an alternative for time-based content is provided for all prerecorded audio and video content.
SC 1.2.9	AAA	Audio-only (Live)	This success criterion is met when an alternative for time-based content that presents equivalent information for live audio-only content is provided.
SC 1.3.1	A	Info and Relationships	This success criterion is met when all information, relationships, and structure conveyed in the content can be determined programmatically or are available in text form.
SC 1.3.2	A	Meaningful Sequence	This success criterion is met when the sequence in which the content is meant to be consumed can be determined programmatically.

SC 1.3.3	A	Sensory Characteristics	This success criterion is met when instructions for understanding or operating all content is not based on sensory content. For example, shape, size, color, or sound.
SC 1.3.4	AA	Orientation	This success criterion is met when all content on a screen is not restricted into one orientation for it to be consumed correctly.
SC 1.3.5	AA	Identify Input Purpose	This success criterion is met when the purpose of all input fields can be determined programmatically.
SC 1.3.6	AAA	Identify Purpose	This success criterion is met when the purpose of all parts of a user interface can be determined programmatically.
SC 1.4.1	A	Use of Color	This success criterion is met when color is not the only visual mean of conveying information, relaying an action, distinguishing some visual element, or prompting a response from the user.
SC 1.4.2	A	Audio Control	This success criterion is met when all audio that plays for more the three seconds have an easy to use to mechanism to pause or stop the audio.
SC 1.4.3	AA	Contrast (Minimum)	This success criterion is met when all text and images of text has a contrast ratio of at least 4.5:1. Except in cases of large text, decorative content, or if the content is a logo of some kind.
SC 1.4.4	AA	Resize text	This success criterion is met when all text can be resized up to 200 percent without losing any functionality, except in case the content is a caption or an image of some text.
SC 1.4.5	AA	Images of Text	This success criterion is met when text is used to convey information instead of images of text.
SC 1.4.6	AAA	Contrast (Enhanced)	This success criterion is met when all text and images of text has a contrast ratio of at least 7:1. Except in cases of large text, decorative content, or if the content is a logo of some kind.
SC 1.4.7	AAA	Low or No Background Audio	This success criterion is met when all audio content that are not a CAPTCHA, a logo in audio form, or is not primarily some musical content either have no background noise, or the noise can be turned off, or the background noise is at least 20 decibels lower than the primary audio content.

SC 1.4.8	AAA	Visual Presentation	This success criterion is met when all text content has modifiable background and foreground colors, can be restricted to a width of 80 characters, can be given a line spacing at least a space and a half within a paragraph and paragraph spacing of at least 1.5 times larger than the line spacing.
SC 1.4.9	AAA	Images of Text (No Exception)	This success criterion is met when all images of text are purely decorative and have no essential content.
SC 1.4.10	AA	Reflow	This success criterion is met when Content can be presented without loss of information or functionality, and without requiring scrolling in two dimensions at a width equivalent to 320 CSS pixels and at a height equivalent to 256 CSS pixels.
SC 1.4.11	AA	Non-text Contrast	This success criterion is met when all user interface components and graphical objects have a contrast ratio of at least 3:1 against any adjacent colors.
SC 1.4.12	AA	Text Spacing	This success criterion is met when all text content can be given a line height of at least 1.5 times the font size, spacing following paragraphs of at least 2 times the font size, letter spacing of at least 0.12 times the font size, and word spacing of at least 0.16 times the font size. Except in cases of human languages and scripts that do not use these properties.
SC 1.4.13	AA	Content on Hover or Focus	This success criterion is met when all content that can be revealed and hidden by hovering over some other content with a mouse can be dismissed without moving the pointer or loosing focus from the previous content, can be hovered over with a pointer without it disappearing when the pointer moves, and remains visible after the pointer is moved away until the user dismisses it, or the content is no longer valid.

Table A.1: Success criteria of the Perceivable principle of WCAG 2.1

Success Criteria	Level of Conformance	Name	Description
SC 2.1.1	A	Keyboard	This success criterion is met when all functionality is usable through a keyboard. Except in cases where the required input depends on specific paths of movement.
SC 2.1.2	A	No Keyboard Trap	This success criterion is met when all components that can be reached with a keyboard can be exited with a keyboard as well.
SC 2.1.3	AAA	Keyboard (No Exception)	This success criterion is met when all functionality is usable trough a keyboard without exceptions.
SC 2.1.4	A	Character Key Shortcuts	This success criterion is met when keyboard shortcuts that are implemented using letters, punctuation's, numbers of symbol characters can be either turned off, remapped to different keys, or activate only when the component they are used in has focus.
SC 2.2.1	A	Timing Adjustable	This success criterion is met is met when each time limit for content can either be turned off, adjusted to at least ten times the default limits, extended before the time runs out with a 20 second windows. These are not required if the timing is part of a real-time event and has no alternative, or if it essential for the current activity, or if the time limit is longer than 20 hours.
SC 2.2.2	A	Pause, Stop,	This success criterion is met is met when al moving, blinking, scrolling, or auto-updating content that either starts automatically, lasts more than five seconds, or is presented at the same time with other content, have a mechanism for pausing, stopping, or hiding the content. Except in cases where moving, blinking, scrolling, or auto updating the content is essential.
SC 2.2.3	AAA	No Timing	This success criterion is met is met when timing is not essential part of the content. Except for real-time events.
SC 2.2.4	AAA	Interruptions	This success criterion is met is met when interruptions can be postponed by the user. Except in cases of an emergency.

SC 2.2.5	AAA	Re-authenticating	This success criterion is met is met when user can re-authenticate to renew an expired session without any loss of data.
SC 2.2.6	AAA	Timeouts	This success criterion is met is met when the user is warned in case inactivity will result in data loss. Except in cases where data is retained for more than 20 hours before data loss.
SC 2.3.1	A	Three Flashes or Below Threshold	This success criterion is met when no content that flashes more than three times in a second, or the flash is below the general flash and red flash thresholds, exists.
SC 2.3.2	AAA	Three Flashes	This success criterion is met when no content that flashes more than three times in a second exists.
SC 2.3.3	AAA	Animation from Interactions	This success criterion is met when all non-essential animations triggered by user interactions can be disabled.
SC 2.4.1	A	Bypass Blocks	This success criterion is met when blocks of content present on multiple pages can by bypassed.
SC 2.4.2	A	Page Titled	This success criterion is met when all web pages have descriptive titles.
SC 2.4.3	A	Focus Order	This success criterion is met when an entire web page can be traversed in a meaningful order.
SC 2.4.4	A	Link Purpose (In Context)	This success criterion is met when the purpose of all links can be determined from the text associated with the link alone, or when combined with the links programmatically determined context. Except when the link is meant to be ambiguous.
SC 2.4.5	AA	Multiple Ways	This success criterion is met when all web pages have multiple routes to reach them. Except when the page is a step in or a result of a process.
SC 2.4.6	AA	Headings and Labels	This success criterion is met when all labels and headings describe a topic or a purpose.
SC 2.4.7	AA	Focus Visible	This success criterion is met when any user interface has a possibility of showing a visible keyboard focus indicator.

SC 2.4.8	AAA	Location	This success criterion is met when the user's location within a group of web pages is available.
SC 2.4.9	AAA	Link Purpose (Link Only)	This success criterion is met when the purpose of all links can be determined from the text associated with the link alone. Except when the link is meant to be ambiguous.
SC 2.4.10	AAA	Section Headings	This success criterion is met when section headings are used to organize the content.
SC 2.5.1	A	Pointer Gestures	This success criterion is met when all content can be operated with just a single pointer. Except in cases where use of more than one pointer is essential.
SC 2.5.2	A	Pointer Cancellation	This success criterion is met when all content that can be operated with a single pointer either has no down-event or has an up-event that cancels the previous down-event, can be aborted or undone. Except in cases where the down-event is essential.
SC 2.5.3	A	Label in Name	This success criterion is met when all content that contains visible text of some kind have a label that contains the visible text.
SC 2.5.4	A	Motion Actuation	This success criterion is met when all functionality activated by motion of the user, or the device can be disabled. Except in cases where the motion essential or used as an accessibility technology.
SC 2.5.5	AAA	Target Size	This success criterion is met when the size of the target for pointer inputs is at least 44 x 44 CSS pixels. Except in cases where the size of the input is essential, is a part of a sentences or a block of text, is determined by the user agent and cannot be modified or has an equivalent alternative in large enough size.
SC 2.5.6	AAA	Concurrent Input Mechanisms	This success criterion is met when web content does not restrict use of input modalities available on a platform except where the restriction is essential, required to ensure the security of the content, or required to respect user settings.

Table A.2: Success criteria of the Operable principle of WCAG 2.1

Success Criteria	Level of Conformance	Name	Description
SC 3.1.1	A	Language of Page	This success criterion is met when the language of the web page can be determined programmatically.
SC 3.1.2	AA	Language of Parts	This success criterion is met when the language of all passages and phrases can be determined programmatically. Except in cases of words of indeterminate language, technical terms, proper names, and words or phrases that have become part of the vernacular of the immediately surrounding text.
SC 3.1.3	AAA	Unusual Words	This success criterion is met when definitions of words and phrases used in an unusual way can be determined in some way.
SC 3.1.4	AAA	Abbreviations	This success criterion is met when the meaning of abbreviations or their expanded forms can be determined in some way.
SC 3.1.5	AAA	Reading Level	This success criterion is met when text that requires reading ability more advanced than the lower secondary education level after removal of proper names and titles has a simpler alternative available.
SC 3.1.6	AAA	Pronunciation	This success criterion is met when words with ambiguous meaning without knowing the pronunciation are provided with the correct pronunciation.
SC 3.2.1	A	On Focus	This success criterion is met when focusing on a user interface component does not initiate a change of context.
SC 3.2.2	A	On Input	This success criterion is met when changing a setting of a user interface component does not initiate a change of context. Except in cases where the user is explicitly warned about such behavior.
SC 3.2.3	AA	Consistent Navigation	This success criterion is met when navigation elements present on multiple pages are presented in the same relative order. Except in cases where the user changes this.
SC 3.2.4	AA	Consistent Identification	This success criterion is met when components with the same functionality can be consistently identified.
SC 3.2.5	AAA	Change on Request	This success criterion is met when all changes of context can only be initiated by the user, or they can be reversed.

SC 3.3.1	A	Error Identification	This success criterion is met when all input errors that are automatically identified are described to the user.
SC 3.3.2	A	Labels or Instructions	This success criterion is met when all content that requires user input are provided with labels ore instructions.
SC 3.3.3	AA	Error Suggestion	This success criterion is met when all automatically determined suggestions for correcting an error are provided to the user. Except in case doing so would jeopardize the security or purpose of the content.
SC 3.3.4	AA	Error Prevention (Legal, Financial, Data)	This success criterion is met when all actions committed on web pages that cause legal commitments or financial transactions for the user to occur, that modify or delete user-controllable data in data storage systems, or that submit user test responses, can be either reversed, checked for correctness before committing, or confirmed before committing.
SC 3.3.5	AAA	Help	This success criterion is met when context-sensitive help is provided for the user.
SC 3.3.6	AAA	Error Prevention (All)	This success criterion is met when all actions committed on web pages can be either reversed, checked for correctness before committing, or confirmed before committing.

Table A.3: Success criteria of the Understandable principle of WCAG 2.1

Success Criteria	Level of Conformance	Name	Description
SC 4.1.1	A	Parsing	This success criterion is met when all content created using markup languages contain only elements with complete start and end tags, that are nested according to their specification, that do not contain duplicate attributes, and only contain unique IDs. Except in cases where the specification permits otherwise.
SC 4.1.2	A	Name, Role, Value	This success criterion is met when the name and role of all user interface components can be determined programmatically, states, properties, and values that can be set by the user can be programmatically set, and notification of changes to these items are provided to the user agents, assistive technologies included.
SC 4.1.3	AA	Status Messages	This success criterion is met when all status messages can be provided to the user through status messages without them receiving focus.

Table A.4: Success criteria of the Robust principle of WCAG 2.1