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Web Accessibility in Finland

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Tiivistelmä — Referat — Abstract

The European Accessibility Act's 2025 enforcement mandates WCAG 2.2 AA compliance for digital services, affecting approximately 101 million EU citizens with disabilities. This thesis investigates web accessibility in Finland and examines how legislation affects accessibility outcomes.

This study analyzes Finnish websites from its top 100 most visited sites using automated accessibility testing. It compares these results with WebAIM's 1 million home pages project and of the same results from Sweden, Denmark, Norway and France. Testing was done across 496 websites.

Results reveal 96% of Finnish websites fail contrast requirements, exceeding the global average by 17 percentage points, while 74.7% fail to properly contain content within landmark regions. Paradoxically, Finland outperforms international benchmarks in form labeling (13% versus 48% globally) and providing alternative text (24% versus 55%). Government websites averaged 32 accessibility issues compared to 99 for commercial sites, a 67-point gap attributable, at least partly, to legislative requirements.

The findings indicate that legislation creates measurable public sector improvements to accessibility. The actual impact of legislation remains unclear due to limitations of automated testing, which capture only 44% of WCAG criteria. Successful accessibility adoption requires comprehensive support infrastructure beyond legislative mandates.

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Contents

1 Introduction **1**

2 Background **3**

2.1 What is Web Accessibility 3

2.2 Importance of Web Accessibility 4

2.2.1 Digital Inclusion and Social Justice 4

2.2.2 Economic and Business Considerations 5

2.2.3 Technical Benefits 5

2.3 History of Web Accessibility 5

2.3.1 WCAG Evolution 5

2.3.2 Finnish Perspective on Accessibility Development 6

2.4 Legislative Framework 7

2.4.1 Finnish Legislation 7

2.4.2 EU Legislation 8

2.5 Key Terminology and Concepts 8

2.5.1 WCAG Conformance Levels 8

2.5.2 Assistive Technologies 8

2.5.3 Technical Implementation Concepts 9

3 Methods **10**

3.1 Research Questions 10

3.2 Research Approach and Comparative Framework 11

3.2.1 Methodology Overview 11

3.2.2 Comparative Analysis Design 11

3.3 Research Methods 11

3.3.1 Automated Web Accessibility Evaluation Tools: Capabilities and Limitations 11

3.3.2 WCAG Principle Assessment Capabilities 12

3.3.3 Technical Implementation and Content Validation 12
3.3.4 Study Scope and Exclusions 14
3.4 Data Collection Tools and Procedures 14
3.4.1 Testing Tools and Website Selection 14
3.4.2 Data Processing and Analysis 15

4 Results **16**
4.1 State of web accessibility in Finland 16
4.1.1 Most common accessibility errors 16
4.2 Finland in comparison 18
4.3 Legislation's effect on web accessibility 21
4.3.1 Public vs. private 21

5 Discussion **23**
5.1 State of Web Accessibility in Finland (RQ1) 23
5.1.1 Visual Accessibility Issues in Finnish Websites 23
5.1.2 Structural Web Accessibility Challenges 24
5.1.3 Successes in web accessibility 24
5.1.4 Sector-Specific Patterns 25
5.1.5 Regional Patterns and International Comparison 25
5.2 Legislative Impact on Web Accessibility (RQ2) 26
5.2.1 Finland's Public-Private Accessibility Gap 26
5.2.2 Enforcement Mechanisms and Legislative Design 26
5.2.3 Legislative Ambiguity and Implementation Challenges 27
5.2.4 Possibility of the Brussels Effect In Web Accessibility 28
5.3 Limitations of the study 28
5.3.1 Limitations of Automated Testing 28
5.3.2 Limitations of the Datasets 29
5.3.3 Recommendations for Practitioners 29
5.3.4 Policy Considerations 30
5.4 Future Research Directions 30

6 Conclusions **32**

Bibliography **34**

1 Introduction

The European Accessibility Act (EAA) became legally enforceable across EU member states on June 28, 2025 requiring WCAG 2.2 AA compliance for websites, mobile applications, e-commerce platforms and digital services [13, 44]. This legislation touches the lives of up to 101 million EU citizens with disabilities, which accounts to about one in four adults according to 2024 Eurostat data [14].

For these citizens inaccessible websites are not just an inconvenience. They can mean an inability to access government services, manage healthcare appointments or participate in modern life [6]. Inaccessible websites create barriers to all online activities e.g. shopping, social connections, news and even banking [6, 38]. Everyday tasks like booking a hotel can become significant challenges when websites fail to meet basic accessibility standards [38].

Against this backdrop of legal mandates and real-world consequences, this thesis provides an analysis of the web accessibility landscape in Finland. It uses automated accessibility testing and cross-national comparison to establish a baseline for accessibility violation patterns across different sectors. The study contextualizes Finland's performance by comparing its results against WebAIM's Million Website Study [41] and data from Sweden, Denmark, Norway and France. The study also examines the relationship between legislative frameworks and accessibility outcomes.

This thesis is organized into five chapters that study web accessibility in Finland through the lens of automated accessibility tests. Chapter 2 provides the background by defining what is web accessibility, introduces the WCAG standards and explains why digital inclusion matters. It also describes how accessibility standards have developed from WCAG 1.0 through WCAG 2.2 and mentions the relevant legislature. The chapter ends with key terms and technical concepts needed to understand accessibility testing.

Chapter 3 describes the research methods, explaining the automated web accessibility testing approach using Pa11y CLI and the axe-core testing engine. It tells how the study compares Finnish websites to WebAIM's Million Website Study and with other Nordic countries and France. The chapter also describes what automated testing can and cannot measure, noting that a large portion of accessibility issues can only be revealed through manual work.

Chapter 4 presents the results from performing accessibility analysis on websites with automated tools and compares them to WebAIM's global data. The chapter includes cross-national comparisons with Sweden, Denmark, Norway and France using the same testing methods. It also compares accessibility performance between public sector and private sector websites across all five countries.

Chapter 5 brings together the findings to answer both research questions about Finland's accessibility status and legislative effectiveness. It provides practical recommendations for developers and policymakers while acknowledging the limitations of automated testing.

2 Background

This chapter establishes the theoretical framework for examining web accessibility in Finland. Section 2.1 defines web accessibility and introduces the Web Content Accessibility Guidelines (WCAG). Section 2.2 examines the importance of web accessibility. Section 2.3 traces the history of web accessibility. Section 2.4 analyzes the legislative framework, detailing Finnish national laws and EU directives. Section 2.5 defines key terminology and concepts and technical implementation concepts as well as limitations.

2.1 What is Web Accessibility

Web accessibility refers to the practice of making digital content and technologies usable by people with disabilities, including those with visual, auditory, physical, speech, cognitive, language, learning and neurological disabilities [43]. The internationally recognized Web Content Accessibility Guidelines (WCAG), developed by the W3C, provide a shared standard for web content accessibility [21] based on four principles that ensure content is accessible to all users:

- **Perceivable**: Information and user interface components must be presentable to users in ways they can perceive. It means providing text alternatives for images, captions for videos and sufficient color contrast for users with low vision.
- **Operable**: User interface components and navigation must be operable regardless of input method. All functionality must be available via keyboard, users must have sufficient time to read content and interfaces must not cause seizures.
- **Understandable**: Information and the operation of user interface must be understandable. This includes readable text, predictable functionality and input assistance that helps users avoid and correct mistakes.
- **Robust**: Content must be robust enough to work reliably with a wide variety of user agents, including assistive technologies like screen readers and voice recognition software.

These principles, known collectively as POUR, form the foundation of WCAG standards [45].

2.2 Importance of Web Accessibility

According to the World Health Organization, over 1.3 billion individuals worldwide live with disabilities [33]. For these individuals, web accessibility enables equal participation in digital society. As essential services migrate online — from government services to banking to job applications — website accessibility becomes comparable to physical accessibility requirements. This consideration is particularly relevant in Finland, where many social services are primarily available through digital channels [7, 8].

The European Accessibility Act (EAA), which became legally applicable in EU member states on 28 June 2025, recognizes this reality by requiring websites, apps, e-books and e-commerce platforms to conform to WCAG 2.1 AA criteria [13]. These developments put web accessibility into position as both a legal requirement and a mechanism for promoting digital equity. Web accessibility extends beyond legal compliance to encompass equal opportunities for civic participation, economic activity and information access [36].

2.2.1 Digital Inclusion and Social Justice

Research indicates that approximately 15–20% of the Finnish population experiences some form of disability affecting their digital interaction capacity [25]. Without proper accessibility implementation, different user groups encounter specific barriers:

- **Visual impairments** (blindness, low vision, color blindness): may experience difficulties when navigating certain interface designs [9].
- **Hearing impairments**: may be unable to access audio content and video presentations without captions [6].
- **Motor disabilities**: may find some websites difficult to use when they require precise mouse movements or time-sensitive interactions [9, 10].
- **Cognitive and neurological disabilities**: may encounter challenges with complex navigation systems and content structures [6].
- **Age-related changes**: affect an increasing portion of Finland's population [2].

2.2.2 Economic and Business Considerations

Research by Kärpänen demonstrates that implementing accessibility standards in digital services leads to competitive advantages including cost efficiency, improved user experience and market differentiation [23]. Organizations with accessible websites may experience higher customer satisfaction and loyalty, expanded market reach to previously excluded demographics and enhanced search engine optimization (SEO) performance [29, 31].

The Finnish market context presents specific economic considerations for web accessibility implementation. As Finland continues its digitalization process, organizations that do not implement accessibility features may limit their user base reach. Leitner's research indicates that accessibility implementation can provide competitive advantage when competitors lack accessible services [29]. Accessible websites may demonstrate cost efficiencies through reduced support requirements, as users encounter fewer barriers requiring assistance [23].

2.2.3 Technical Benefits

Integrating automated accessibility testing into CI/CD pipelines enables teams to detect 57.38% of accessibility issues before production deployment, with specific issue types like color contrast problems and HTML parsing errors detectable at 83% and 90% rates respectively [11]. This approach reduces costs by identifying violations during development when remediation is least expensive, preventing accessibility debt accumulation in the codebase [11]. Automated validation of semantic structure, keyboard navigation and ARIA attributes during the build process ensures consistent accessibility compliance while providing developers with immediate feedback and specific remediation guidance [11].

2.3 History of Web Accessibility

2.3.1 WCAG Evolution

The Web Content Accessibility Guidelines have undergone several iterations since their initial release. WCAG 1.0, released in 1999, introduced 14 guidelines with multiple checkpoints at priority levels 1-3, establishing the first structured approach to accessibility evaluation [45].

WCAG 2.0, released in 2008, restructured guidelines around four core principles (Perceivable, Operable, Understandable, Robust) with testable success criteria at levels A, AA and AAA. This framework emphasized technological neutrality and empirical testability [43].

WCAG 2.1, published in 2018, expanded the guidelines with 17 new success criteria addressing mobile accessibility, low vision and cognitive disabilities, reflecting evolving technological landscapes and understanding of diverse user needs [43]. WCAG 2.2, released in 2023, further expanded criteria with additional focus on cognitive accessibility, maintaining backward compatibility while addressing emerging needs [44].

2.3.2 Finnish Perspective on Accessibility Development

Finland's early adoption of digital government services in the late 1990s necessitated parallel consideration of accessibility concerns [32]. By 2003, Finland had incorporated web accessibility considerations into its national information society strategy, signaling institutional recognition of accessibility's importance in digital development [32]. This early commitment to accessibility reflected a broader understanding that robust digitalization requires accessibility, as the primary goal of digitalization is to automate and reduce the administrative burden of public services delivery, which must be accessible to all citizens [37].

The 2000s marked a significant expansion of critical digital services in Finland, with the introduction of digital tax services and social insurance (Kela) platforms, alongside the widespread adoption of online banking [24, 39]. These services represented essential functions that all citizens needed to be able to access and use effectively, further emphasizing the importance of digital accessibility in Finnish society.

The COVID-19 pandemic accelerated digital transformation globally, including in Finland, as services rapidly shifted online out of necessity. This sudden transition intensified the need for accessibility measures to keep pace with increasingly complex tasks being performed remotely [5]. The pandemic thus served as a catalyst for both digital adoption and the corresponding evolution of accessibility standards and practices in Finnish digital services.

2.4 Legislative Framework

Regulatory frameworks establish minimum standards and compliance mechanisms for web accessibility implementation.

2.4.1 Finnish Legislation

Act on Electronic Service Provision (2003/13)

Finland's initial legislative action on accessibility began with the Act on Electronic Service Provision in the Public Sector, establishing preliminary expectations for public sector websites [17]. This early legislation lacked specific technical requirements and enforcement mechanisms [17]. The law established general principles for accessible service provision without detailed implementation guidance [17]. Despite these limitations, this legislation signaled Finland's recognition of accessibility as a component of public service provision.

Act on the Provision of Digital Services (306/2019)

The Act on the Provision of Digital Services (306/2019) transposed the EU Web Accessibility Directive into Finnish law [18]. This legislation established mandatory WCAG 2.1 AA compliance for public sector websites, requirements for accessibility statements from covered organizations, feedback mechanisms for reporting non-compliance and oversight by the Regional State Administrative Agency for Southern Finland [18]. The legislation included a staged implementation timeline based on website age and complexity, recognizing the technical challenges of retrofitting existing systems while maintaining standards for new development [18].

Public Procurement Accessibility Requirements

Finnish procurement law (1397/2016) incorporates accessibility requirements for public sector technology acquisitions, requiring WCAG 2.1 AA compliance for digital solutions [16].

2.4.2 EU Legislation

Web Accessibility Directive (2016/2102)

The Web Accessibility Directive (WAD) mandates WCAG 2.1 AA compliance for all public sector websites and applications [12]. The directive establishes uniform accessibility requirements across member states, requiring standardized accessibility statements and enforcement mechanisms.

European Accessibility Act (2019/882)

The European Accessibility Act (EAA) expands accessibility requirements beyond the public sector to commercial digital services [13]. With full application by 2025, the EAA requires accessibility compliance from e-commerce platforms, banking services, e-books and operating systems. This legislation affects private sector websites examined in this research, creating compliance obligations requiring technical and organizational adaptations.

2.5 Key Terminology and Concepts

2.5.1 WCAG Conformance Levels

WCAG defines three levels of conformance, each building upon the previous:

- **Level A**: The minimum accessibility compliance, addressing barriers that would prevent access for certain user groups.
- **Level AA**: Addresses barriers that impair access; this level is required by Finnish and EU accessibility laws.
- **Level AAA**: The highest level of accessibility, addressing subtle barriers affecting limited user populations.

2.5.2 Assistive Technologies

Accessible websites accommodate various assistive technologies employed by users with disabilities. Screen readers convert text to speech or braille output, enabling access for

blind users and those with severe visual impairments [20]. These systems interpret visible text, structural elements, alternative text descriptions and semantic markup. Screen magnifiers enlarge screen content for low-vision users, often including contrast enhancement, color inversion and focus highlighting. Alternative input devices, including specialized keyboards, switches and eye-tracking systems, provide access for users with motor disabilities who cannot use conventional keyboards and pointing devices [20].

Voice recognition systems enable computer control via spoken commands, benefiting users with motor disabilities as well as those experiencing situational limitations. Caption and transcription tools provide text alternatives for audio content, addressing the needs of deaf and hard-of-hearing users [20]. These technologies constitute the assistive technology ecosystem that interacts with web content, requiring specific design approaches to ensure compatibility [20].

2.5.3 Technical Implementation Concepts

Key technical concepts in accessibility implementation include semantic HTML, which provides markup conveying meaning about content structure beyond visual formatting [19, 44]. This approach enables assistive technologies to interpret document organization and purpose. ARIA (Accessible Rich Internet Applications) specifications enhance accessibility of dynamic web content, providing additional attributes that communicate state, role and property information to assistive technologies [40, 44].

Keyboard accessibility ensures all functionality is available without requiring mouse input, supporting users with motor disabilities and those using screen readers [44]. This includes implementing logical focus order, visible focus indicators and appropriate keyboard shortcuts. Focus management involves controlling keyboard focus movement through interactive elements, particularly in dynamic interfaces where content changes conditionally [44].

Alternative text provides textual descriptions of non-text content, ensuring users who cannot perceive visual content can access equivalent information [44]. Color contrast ratios represent mathematical relationships between text and background colors, ensuring sufficient differentiation for users with low vision or color perception limitations [44]. These technical concepts relate directly to the automated testing methodologies employed in this research.

3 Methods

This chapter details the research methodology employed to investigate web accessibility in Finland. Section 3.1 presents the research questions guiding this study. Section 3.2 provides an overview of the research approach and comparative framework. Section 3.3 describes the specific research methods, including automated testing capabilities and limitations. Section 3.4 outlines the data collection tools and procedures.

3.1 Research Questions

This thesis investigates two research questions about web accessibility in Finland and its relationship to international standards and legislative frameworks:

- **RQ1:** What is the state of web accessibility in Finland?
- **RQ2:** How does legislation affect web accessibility?

The first research question (RQ1) examines the current state of web accessibility in Finland by analyzing the frequency and distribution of accessibility errors across different website categories. This analysis establishes a baseline understanding of Finland's accessibility landscape through comparison with WebAIM's Million Website Study data and cross-national comparison with other Nordic countries and France.

The second research question (RQ2) looks into the relationship between legislative requirements and web accessibility outcomes. This analysis focuses on a smaller subset of public sector websites that are subject to accessibility requirements adopted from the 2016 EU Web Accessibility Directive into each country's national legislation. It compares their performance against private sector websites to identify some measurable impacts of regulatory compliance.

3.2 Research Approach and Comparative Framework

3.2.1 Methodology Overview

This study uses automated web accessibility evaluation combined with cross-national comparative analysis. As there is no clear and established benchmarking standards for Finnish or European web accessibility, this research utilizes WebAIM's Million Website Study as the primary comparative framework due to its similar automated testing methodology and comprehensive scope.

3.2.2 Comparative Analysis Design

The comparative analysis encompasses two dimensions. First, a cross-national comparison examines Finland's accessibility performance alongside other Nordic countries (Sweden, Denmark, Norway) and France. France was picked due to providing a useful comparison point, having transitioned from cluster 1 to cluster 2 in digitalization rankings while Nordic countries have maintained their cluster 1 position [4, 7]. Second, a sectoral comparison analyzes differences between public and private sector websites.

3.3 Research Methods

3.3.1 Automated Web Accessibility Evaluation Tools: Capabilities and Limitations

Automated web accessibility evaluation tools (WAET) can assess certain WCAG 2.1 success criteria, particularly those that rely on the presence and structure of HTML elements, CSS properties and JavaScript implementations [1]. Research indicates that approximately 44% of all WCAG 2.1 success criteria across all conformance levels can be automatically evaluated using current technologies, while conversely 56% cannot be evaluated through automation alone and require human judgment and expertise for assessment [1].

These tools systematically evaluate websites against WCAG standards, identifying HTML structural issues, missing attributes, color contrast problems, keyboard navigation flaws and absent accessibility features [26]. Their capacity to process multiple pages and detect compliance patterns makes them suitable for large-scale studies, enabling quantitative

analysis of accessibility compliance across different sectors and countries.

3.3.2 WCAG Principle Assessment Capabilities

Automated tools demonstrate varying assessment capabilities across the four WCAG principles. They perform well in evaluating the "Robust" principle by checking code validity, proper markup and compatibility with assistive technologies. Many "Perceivable" criteria like text alternatives, color contrast and resizable text can be assessed, along with certain "Operable" elements such as keyboard accessibility and timing adjustments. Technical aspects of the "Understandable" principle, such as language identification and consistent navigation, can also be tested through automation [44].

However, automated testing has significant limitations in evaluating subjective aspects of these principles. The "Understandable" principle presents challenges when assessing whether content is actually readable and comprehensible to users with different cognitive abilities. Nuanced "Perceivable" requirements, like meaningful sequence and sensory characteristics, require human judgment. Similarly, certain "Operable" criteria such as the purpose of links in context and the effectiveness of navigation mechanisms need human evaluation. Even within the "Robust" principle, automated tools cannot fully determine if content remains accessible when technologies evolve, as this requires contextual understanding of how assistive technologies interpret the content [1, 22].

3.3.3 Technical Implementation and Content Validation

Table 3.1 presents a comprehensive overview of accessibility features categorized by assessment method.

Table 3.1: Accessibility Features by Assessment Method

Category	**Automatically Assessable**	**Requiring Human Evaluation**
HTML Structure and Content	Alternative text presence (alt attributes); Form labels and associations; Heading hierarchy (H1-H6 tags); Page titles; Language declarations; ARIA landmarks and roles	Alternative text accuracy and adequacy; Meaningful sequence; Context-dependent link purposes; Heading organization logic; Sensory characteristic dependencies
Visual Presentation	Color contrast ratios; Text resizing capabilities up to 200%; Focus indicators visibility; Content reflow; Text spacing measurements	Image content relevance; Decorative versus informative classification; Layout impact; Color usage appropriateness
Keyboard and Navigation	Keyboard event handlers; Tab order sequence; Skip link implementations; Keyboard trap detection	Consistent navigation patterns; Information architecture; Multiple pathways effectiveness; Breadcrumb accuracy
Multimedia Content	Video caption presence (track elements/SMIL); Audio description file links; Transcript availability; Auto-play controls	Caption accuracy and synchronization; Audio description completeness; Sign language quality; Background audio levels
Forms and Interaction	Required field indicators; Error message associations; Input format instructions; Validation feedback presence	Context change appropriateness; Error prevention effectiveness; Help system adequacy; Timeout warnings
Language and Cognition	Language identification tags; Consistent element placement	Reading level appropriateness; Clear language usage; Content complexity; Memory requirements; Processing time adequacy
Assistive Technology	Code validity; Proper markup structure; ARIA implementation	Screen reader experience quality; Voice control compatibility; Custom technology adaptations

While automated tools can detect the presence of accessibility features, validating their semantic correctness presents challenges. Research shows that even when accessibility elements are detected, 49% require additional validation to ensure content quality and 12% depend on advanced classifier accuracy for proper assessment [1].

Current WAET capabilities cannot evaluate contextual accessibility aspects. They fail to assess content flow logic, interface cognitive load or the actual user experience for people with disabilities. Automated tests cannot interpret cultural considerations, evaluate language appropriateness for different ability levels or determine if technically compliant solutions actually fulfill their accessibility purpose. This limitation means automated findings represent only programmatically detectable aspects of web accessibility rather than a comprehensive evaluation of the actual user experience [22]. These limitations indicate the need for evaluation methodologies that combine automated screening with human assessment and user testing with people with disabilities [1].

3.3.4 Study Scope and Exclusions

Due to the absence of established accessibility benchmarks suitable for this research, WebAIM's Million Website Study was selected as the primary comparative framework given its similar automated testing methodology and comprehensive scope. This established dataset provides a baseline for evaluating accessibility compliance across large-scale web properties.

Several standards and testing approaches were excluded from this study. WCAG 2.2 guidelines were not evaluated due to the lack of suitable open-source command-line interface implementations available for automated testing at the time of writing. Additionally, WCAG Level AAA compliance was not assessed, as this standard is not legally required by either the EU or Finland.

3.4 Data Collection Tools and Procedures

3.4.1 Testing Tools and Website Selection

The data collection methodology employed a combination of automated accessibility testing tools and data analysis scripts. Pa11y CLI [34] (Command Line Interface) was selected as the primary accessibility testing tool due to its straightforward scriptability and struc-

tured output format, which facilitated programmatic analysis of results. Pa11y utilizes the axe-core accessibility testing engine, a widely adopted open-source library developed by Deque Systems that provides comprehensive WCAG compliance testing.

The selection of websites for analysis was based on the Ahrefs ranking of top 100 websites, which provided a sufficiently large sample of high-traffic websites along with categorical classifications that enabled sector-specific analysis.

3.4.2 Data Processing and Analysis

For data processing and analysis, custom Python scripts were developed to handle two analytical approaches: single-country analysis for examining Finnish websites in detail and cross-country comparison for contextualizing Finland's web accessibility performance against other Nordic countries and France. Python was chosen as the programming language due to its robust data analysis libraries, including pandas for data manipulation, NumPy for numerical computations and matplotlib for visualization, which collectively provided an efficient development environment for implementing the required analytical procedures.

The data for this thesis was collected on February 28, 2025.

4 Results

This chapter presents the results. Sections 4.1 and 4.2 answer the first research question about the state of web accessibility in Finland first by comparing to global accessibility results from WebAIM and then comparing Finland's results to the other Nordic countries and France. Section 4.3 addresses the second research question regarding legislation's effect on web accessibility.

4.1 State of web accessibility in Finland

4.1.1 Most common accessibility errors

The analysis encompassed 99 Finnish websites from the top 100 most visited sites, with one website excluded due to technical constraints. Table 4.1 presents a comparison of WCAG 2.1 failure types between Finnish websites and the WebAIM Million study, which represents global accessibility patterns.

Table 4.1: WCAG 2.1 Failure Types - Comparison of Website Studies

WCAG Failure Type	**Finnish Websites Affected**	**Finnish Top 100 (%)**	**WebAIM Study (%)**	**Difference (%)**
Low contrast text	95	96.0	79.1	+16.9
Missing alt text for images	24	24.2	55.5	-31.3
Missing form input labels	13	13.1	48.2	-35.1
Empty links	41	41.4	45.4	-4.0
Empty buttons	14	14.1	29.6	-15.5
Missing document language	3	3.0	15.8	-12.8

The most widespread issue across Finnish websites was low contrast text, affecting 96% of homepages, which exceeded the WebAIM global average by 16.9 percentage points. Notable divergences from global patterns emerged in form-related failures, where Finnish websites performed substantially better, with only 13.1% lacking form input labels compared to 48.2% globally. Similarly, missing alternative text for images affected only 24.2%

of Finnish sites versus 55.5% worldwide, representing a 31.3 percentage point improvement.

Table 4.2 provides a comprehensive overview of the ten most common WCAG 2.1 failures identified on Finnish homepages through automated testing.

Table 4.2: Most common WCAG 2.1 failures from Finnish websites

WCAG Failure Type	% of home pages
Low contrast text	96.0%
Content not contained in landmark regions	74.7%
Links without accessible names	41.4%
Incorrect ARIA attributes	30.3%
Non-unique landmark regions	30.3%
Illogical heading order	29.3%
Untested frame elements	24.2%
Images without alternative text	24.2%
Hidden elements that can receive focus	14.1%
Improper HTML list structure	14.1%

Beyond contrast issues, structural accessibility problems were common, with 74.7% of websites affected. Navigation-related failures appeared frequently, including 41.4% of sites containing links without accessible names. ARIA implementation issues affected approximately 30% of websites, with both incorrect ARIA attributes and non-unique landmark regions occurring at nearly identical rates (30.3%). These findings indicate systematic issues with semantic HTML structure and ARIA implementation across Finnish web properties.

Accessibility per category of website

Table 4.3 presents the distribution of accessibility issues across different website categories, comparing Finnish results with the WebAIM Million study averages.

Government and Law websites averaged 14.5 accessibility issues, representing the lowest error rate among all categories examined. Financial sector websites demonstrated similarly strong performance with an average of 61.7 issues. In contrast, e-commerce and consumer-focused sectors showed considerably higher error rates. The automotive sector exhibited the highest error density at 212.7 issues per site, while food and drink websites averaged

Table 4.3: Accessibility Issues by Category: WebAIM Million vs Top Finnish Websites

Category	WebAIM Million		Finnish Top 100	
	Avg Errors	% Diff	Avg Issues	Sites
Government/Law & Government	37.2	-27.0%	14.5	2
Personal Finance	37.7	-26.0%	61.7	7
Technology & Computing	41.8	-18.0%	54.7	3
Science	44.0	-13.6%	26.2	4
Business	44.8	-12.1%	37.0	3
Education/Jobs	47.0	-7.8%	61.0	3
Health and Fitness	47.7	-6.4%	34.7	7
Food and Drink	50.4	-1.1%	206.0	5
Gaming	52.8	+3.6%	30.0	1
Real Estate	53.7	+5.4%	78.3	3
Arts & Entertainment	54.1	+6.1%	169.3	9
Automotive	57.8	+13.5%	212.7	3
Travel	59.7	+17.2%	2.0	1
News/Information	59.8	+17.4%	78.0	6
Home and Garden	61.9	+21.5%	77.6	5
Sports	66.3	+30.1%	175.5	4
Shopping	71.2	+39.8%	137.2	17
Social Media	41.7	-18.1%	83.7	7

206.0 issues. Shopping websites, representing the largest category with 17 sites analyzed, averaged 137.2 issues.

The travel category, consisting of only the state-owned railway company VR, showed markedly low issue counts at 2.0, diverging significantly from the WebAIM average of 59.7 errors. This performance could reflect the influence of public sector accessibility requirements on state-owned enterprises. Sports and arts/entertainment websites also showed elevated error rates at 175.5 and 169.3 issues respectively, substantially exceeding their global counterparts.

4.2 Finland in comparison

Cross-national comparison included five countries with the following sample sizes:

- Finland: 99 websites analyzed
- Denmark: 100 websites analyzed
- France: 97 websites analyzed

- Norway: 100 websites analyzed
- Sweden: 100 websites analyzed

Table 4.4 presents the percentage of websites exhibiting specific WCAG failures across all five countries.

Table 4.4: Percentage of Webpages with WCAG Failures by Country

Failure Type	Finland (%)	Denmark (%)	France (%)	Norway (%)	Sweden (%)
Low contrast text	96.0	95.0	82.5	90.0	92.0
Content not contained in landmark regions	74.7	61.0	58.8	64.0	69.0
Links without accessible names	41.4	39.0	27.8	31.0	29.0
Incorrect ARIA attributes	30.3	28.0	29.9	26.0	25.0
Non-unique landmark regions	30.3	40.0	24.7	28.0	30.0
Illogical heading order	29.3	37.0	16.5	35.0	22.0
Untested frame elements	24.2	19.0	20.6	21.0	19.0
Images without alternative text	24.2	28.0	20.6	19.0	14.0
Hidden elements that can receive focus	14.1	18.0	13.4	13.0	11.0
Improper HTML list structure	14.1	11.0	7.2	12.0	10.0

Finland demonstrated the highest prevalence of failures in several key categories. Low contrast text affected 96.0% of Finnish websites, marginally exceeding Denmark (95.0%) and substantially surpassing France (82.5%). Content organization issues were most pronounced in Finland, with 74.7% of sites failing to properly contain content within landmark regions, compared to 58.8% in France and 61.0% in Denmark.

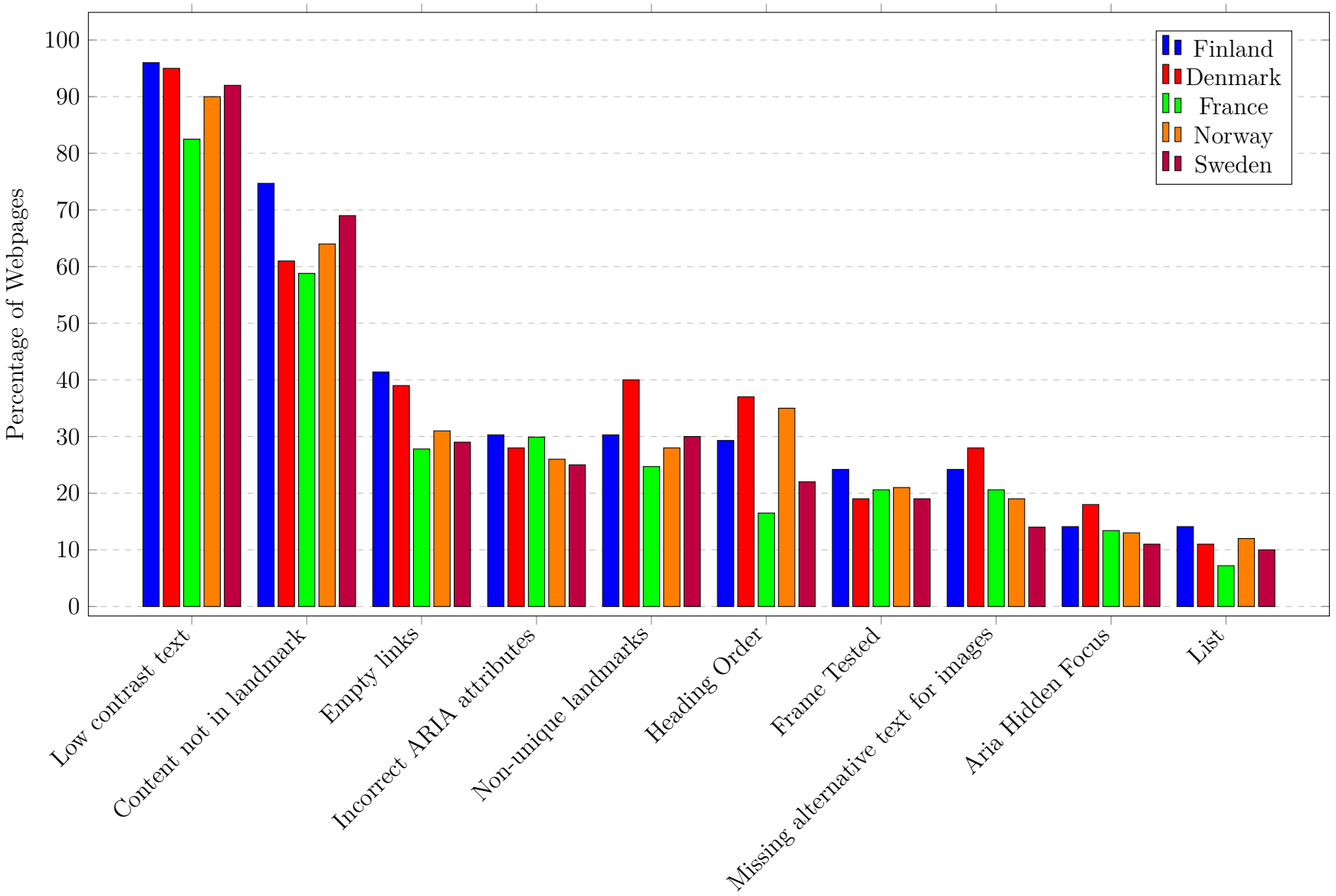

Figure 4.1: Comparison of WCAG 2.1 Failure Types: Countries vs Finland

Figure 4.1 shows the distribution of WCAG failure types across Nordic countries and France. The visualization reveals consistent patterns across Nordic countries, with Finland generally exhibiting the highest failure rates. France demonstrated lower failure rates in most categories, particularly in heading structure violations (16.5%) and improper list structures (7.2%). The similarities among Nordic countries suggest regional patterns in web development practices, while France's distinct profile indicates different implementation approaches or potentially different levels of enforcement focus.

Notable cross-national patterns emerged in ARIA implementation, where failure rates remained relatively consistent across all countries (25%-30%), suggesting universal challenges in proper ARIA deployment. Sweden showed the best performance in image alternative text provision, with only 14% of sites lacking proper descriptions, while Denmark showed the highest rate at 28%.

The Nordic countries had strong digital maturity across their web properties, consistent with their classification as first-cluster digital leaders in European digitalization studies. France's position in the second digitalization cluster aligns with the observed accessibility patterns, showing measurably different implementation characteristics from the Nordic region.

4.3 Legislation's effect on web accessibility

Accessibility legislation compliance patterns emerged from the data when comparing public and private sector websites.

4.3.1 Public vs. private

Figure 4.2 shows the average accessibility issues for government websites compared to top 100 commercial websites across all five countries studied.

Government websites had a consistently better accessibility performance compared to commercial websites across the countries studied.

Finnish government websites averaged 32.0 accessibility issues compared to 99.3 for top commercial websites, representing a 67.3-point difference. This gap could be an indication of the effectiveness of public sector accessibility requirements. Sweden exhibited the largest differential at 76.4 points, with government sites averaging only 20.4 issues versus 96.8 for

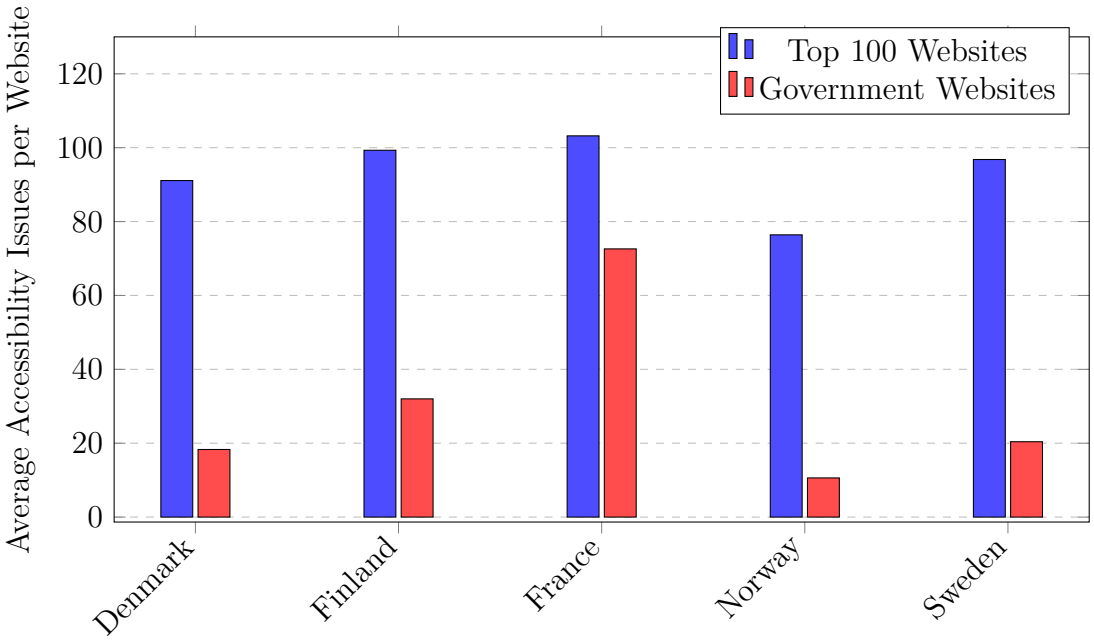

Figure 4.2: Average Accessibility Issues: Government vs Top 100 Websites by Country

Table 4.5: Average Accessibility Issues Detailed Comparison: Government vs Top 100 Websites Accessibility

Country	Top 100 Avg	Gov Avg	Difference
Denmark	91.1	18.3	-72.8
Finland	99.3	32.0	-67.3
France	103.2	72.6	-30.7
Norway	76.4	10.6	-65.8
Sweden	96.8	20.4	-76.4

commercial sites. Norway's government websites achieved the best absolute performance with an average of 10.6 issues.

France presented a distinct pattern with a smaller gap of 30.7 points between sectors. French government websites averaged 72.6 issues, substantially higher than Nordic government sites, while French commercial sites averaged 103.2 issues. This suggests different implementation or enforcement approaches between France and the Nordic region.

5 Discussion

This chapter examines the implications of the research findings regarding web accessibility in Finland. Section 5.1 addresses the first research question concerning the current state of web accessibility in Finland. Section 5.2 explores the second research question about legislative impact on accessibility outcomes. Section 5.3 discusses the limitations of the automated testing methodology. Section 5.4 presents practical implications and Section 5.5 identifies directions for future research.

5.1 State of Web Accessibility in Finland (RQ1)

This section addresses the first research question: *What is the state of web accessibility in Finland?* The analysis examines current web accessibility patterns across Finnish websites and compares them with international and cross-national data.

5.1.1 Visual Accessibility Issues in Finnish Websites

The analysis reveals that 96% of Finnish websites fail low contrast text requirements, exceeding the global average by roughly 17%. This systematic issue in Finnish web design practices warrants further examination, as the failure rate represents the most significant accessibility issue identified in Finnish websites, affecting nearly all sites examined. This finding is particularly concerning given that contrast issues are among the more straightforward accessibility problems to identify and resolve during development.

Contrast issues are straightforward as they can be identified and resolved through design tools like Figma. These tools provide contrast checking capabilities during the design process, while browser developer tools offer contrast ratio calculations for text elements with CSS selectors and color recommendations. The implementation of contrast fixes typically requires CSS color property adjustments, making contrast compliance a preventable accessibility issue in web development.

5.1.2 Structural Web Accessibility Challenges

74% of Finnish websites fail to properly contain content within landmark regions can be interpreted as a sign of a structural accessibility issue at the foundational level of web development. Landmark regions like `<main>`, `<nav>`, `<header>`, `<footer>`, `<section>` and `<aside>` represent basic HTML semantic elements that should be integral to initial site architecture. When three-quarters of websites fail at this fundamental level, it suggests that developers and/or their front-end frameworks are not incorporating accessibility considerations into their basic development processes.

While Finland's failure rate exceeds those of other Nordic countries (Denmark (61%), Norway (64%) and Sweden (69%)) these differences remain relatively modest, spanning only 5 to 13 percentage points. This pattern suggests a shared regional challenge rather than a uniquely Finnish problem, as neighboring countries appear to face similar structural accessibility barriers.

The prevalence of these structural issues, coupled with incorrect ARIA implementation (30%) and illogical heading order (29%), points to a notable absence of automated accessibility testing in development workflows. Unlike context-dependent accessibility issues that require human evaluation, structural violations such as improperly contained content represent problems that automated tools can reliably detect through DOM analysis [1]. Wiklund [42] notes, that a non-trivial portion of companies and organizations view automated tests as resource-intensive and this could extend to accessibility testing practices as well.

5.1.3 Successes in web accessibility

Finnish websites also had success in some accessibility areas compared to global benchmarks. Form accessibility showed particularly strong performance, with only 13% of Finnish sites lacking proper form input labels compared to 48% globally, representing a substantial 35 percentage point improvement over the WebAIM Million average. Image accessibility also exceeded international standards, with 24% of Finnish sites missing alternative text versus 55% worldwide.

Paradoxically this implies the opposite of what was stated in the previous chapter. The presence of better-than-average performance in form labeling and alternative text implementation demonstrates that Finnish developers can successfully implement specific

accessibility features. This localized success then contrasts with the widespread failures in fundamental areas like color contrast and landmark regions, revealing an inconsistent application of accessibility practices across different technical domains rather than a uniform approach to web accessibility.

5.1.4 Sector-Specific Patterns

The analysis reveals variation in accessibility performance across sectors. Government and law websites averaged 14 accessibility issues, while automotive (212 issues) and food and drink (206 issues) sectors showed higher error rates. The financial sector's performance (61 issues) aligns with the regulated nature of financial services. The shopping category, representing the largest sample with 17 sites, averaged around 137 issues. This performance in e-commerce is concerning given the sector's importance for digital inclusion and upcoming EAA requirements. The variation across sectors likely stems from differences in resource allocation, regulatory pressure and design priorities, though the diversity of results across multiple categories makes it challenging to identify the primary drivers of these differences.

5.1.5 Regional Patterns and International Comparison

The similarities among Nordic countries in accessibility failure patterns suggest shared regional approaches to web development. Finland's position within this regional cluster, while showing the highest failure rates in several categories, reveals a consistent performance across the Nordic region. Norway did have marginally better outcomes in several categories, slightly edging ahead of its Nordic neighbors, but the overall pattern suggests shared challenges and similar implementation maturity levels across the region.

This clustering effect is a little more notable when compared to France's distinct profile, hinting at regional cohesion in Nordic web development practices. France's distinct profile, with lower failure rates in most categories, particularly in heading structure violations (17%) and improper list structures (7%), indicates different implementation approaches or enforcement focus.

The connection between Finland's position in the number one cluster of digitalization and its accessibility outcomes indicates that high digital maturity does not automatically translate to more accessibility. This disconnect between Finland's strong digitalization

efforts and actual accessibility outcomes challenges assumptions about the relationship between digital advancement and inclusive design.

5.2 Legislative Impact on Web Accessibility (RQ2)

This section explores the second research question: *How does legislation affect web accessibility?* The analysis examines the relationship between legislative requirements and accessibility outcomes by comparing public sector websites, which are already subject to legal requirements, with private sector websites.

5.2.1 Finland's Public-Private Accessibility Gap

Finnish government websites demonstrate a clear 67-point difference in average errors compared to commercial websites (32 vs 99), providing evidence of legislative effectiveness in the Finnish context. This gap, most likely resulting from compliance with the Act on the Provision of Digital Services [18] and WAD [12], positions Finland in the middle range among studied countries. This is more effective than France's 30-point gap but slightly below the Nordic average of 70 points. The Finnish results align with observations by Michtner [30] that legislation has created a two-tier system where public sector websites receive more scrutiny and improvement efforts due to legal requirements, while private sector websites lag behind.

5.2.2 Enforcement Mechanisms and Legislative Design

The public-private gaps across countries suggests that legislative design and enforcement mechanisms influence outcomes. Even back in 2006, Paris [35] identified that while legislation to mandate web accessibility exists, the lack of enforcement mechanisms and political will has resulted in widespread non-compliance. Although this observation predates current EU directives by a decade, the pattern appears to persist in varying degrees across the studied countries.

Recent empirical evidence from Finnish higher education institutions confirms the limitations of legislation without comprehensive implementation support. Laamanen et al. [27] found that despite the Act on the Provision of Digital Services becoming legally binding in September 2020, accessibility errors in higher education institutions (HEI) landing

pages decreased by only 20% (from 5,506 to 4,504), a change that was not statistically significant (p=0.050). Institutional responses also varied: while 20 HEIs improved their accessibility, 14 actually became less accessible and 4 showed no change. This mixed response pattern suggests that legislation alone provides insufficient guidance for consistent implementation.

In comparison to Finland, France's smaller gap of 30 points between sectors and higher absolute error rates in government sites (72 issues) may reflect the evolution described by Ferri [15], where EU web accessibility legislation progressed from voluntary guidelines and fragmented national policies to binding directives. Despite gradual process toward mandatory compliance, enforcement can still remain weak, as public websites still fail to pass even automated accessibility tests.

5.2.3 Legislative Ambiguity and Implementation Challenges

The selective compliance patterns where certain accessibility aspects like form labeling show better compliance while contrast issues persist may reflect the impact of legislative ambiguity. Laufer and Nir [28] note that approaches to web accessibility legislation vary significantly, from anti-discrimination laws to guidelines and recommendations. They argue that legislative ambiguity can be counterproductive, creating situations where institutions delay necessary improvements rather than proactively ensuring accessibility.

The Finnish higher education experience provides concrete evidence of these implementation challenges. Laamanen et al. [27] identified several factors explaining the limited legislative impact: lack of implementation support despite a 1.5-year transition period, missing national infrastructure for guidance and supervision, significant knowledge gaps among content providers evidenced by basic errors like missing alternative text and resource disparities where smaller institutions showed poorer accessibility performance than larger universities. These findings suggest that the Act's framework, while legally binding, lacked the supporting mechanisms necessary for a more effective implementation. The results of Laamanen et al. and this study do, however, point to success when it comes to the legislation's effect on web accessibility in Finland.

5.2.4 Possibility of the Brussels Effect In Web Accessibility

The European Accessibility Act (EAA) could have implications beyond the EU, as it applies to all operators in the internal market and could incentivize accessibility improvements globally through processes of regulatory globalization. This potential influence echoes the *Brussels Effect*, described as a form of unilateral regulatory globalization in which a jurisdiction's standards become global norms, often because compliance is economically or technically indivisible [3]. In accessibility terms, if companies and organizations find it impractical to maintain separate EU and non-EU versions of products or services, they may adopt EAA requirements worldwide, creating a *de facto Brussels Effect*. This however, as discussed in 5.2.3 is highly dependent on the legislation and its capacity for either sanctions when enacted (as per GDPR) or support for implementation.

5.3 Limitations of the study

5.3.1 Limitations of Automated Testing

The automated testing methodology captures approximately 44% of WCAG 2.1 success criteria, significantly limiting the interpretation of results as many accessibility barriers remain undetected. Issues requiring human judgment (see table 3.1) cannot be assessed through automated means. This limitation particularly affects the detection of barriers impacting users with cognitive disabilities, as automated tools cannot evaluate content understandability or navigation intuitiveness.

While these limitations apply equally across all countries, maintaining the validity of relative comparisons, they limit conclusions about absolute accessibility levels. Cross-country comparisons remain valid for automatically detectable issues, but overall accessibility assessments must acknowledge that the majority of potential barriers remain unmeasured. The consistent testing methodology across all samples ensures that comparative analyses reflect genuine implementation differences rather than measurement artifacts.

5.3.2 Limitations of the Datasets

Ahrefs

The reliance on Ahrefs' top 100 website rankings introduces constraints that may limit generalizability. These traffic-based rankings favor large commercial websites with large SEO investments, potentially underrepresenting smaller businesses, non-profit organizations and niche sectors with different accessibility implementation patterns. Additionally, Ahrefs' categorical classifications are designed for marketing purposes rather than accessibility research and the dominance of commercial websites may skew assessments toward sectors facing fewer regulatory accessibility requirements.

Public sector website list

The analysis of public sector accessibility compliance was constrained by the limited sample size of only 10 government websites selected per country for comparison. This small sample restricts statistical power for drawing conclusions about accessibility legislation effectiveness and may not well represent the diversity of public sector web properties across different governmental departments and agencies. With only 10 data points per country, the analysis can become sensitive to outliers and may not capture the full spectrum of public sector accessibility performance, potentially affecting the validity of conclusions about legislation's impact.

5.3.3 Recommendations for Practitioners

Finnish web developers should prioritize addressing the widespread contrast issues identified in this research. Implementing systematic contrast checking during the design phase and integrating automated contrast validation into development workflows could substantially reduce the 96% failure rate. Developers should also focus on improving semantic HTML implementation, particularly proper use of landmark regions and heading hierarchies. The relatively strong performance in providing form labels and alternative text demonstrates existing capability that could be extended to other accessibility areas.

5.3.4 Policy Considerations

The higher education study by Laamanen et al. shows that legislation requires comprehensive supporting infrastructure to achieve meaningful impact[27]. Laamanen et al. conclude that while legislation provides an essential foundation, it is "not enough on its own" and requires clear institutional guidelines, staff training programs, adequate resource allocation, ongoing monitoring and organizational commitment at all levels [27]. The finding that "the direction is right, but the speed is too slow" suggests that legislative frameworks must be accompanied by implementation support systems to accelerate accessibility adoption.

The upcoming full implementation of the European Accessibility Act presents both challenges and opportunities. Michtner [30] suggests that the EAA will likely force more work to be done towards web accessibility across all sectors, similar to how GDPR affected data protection practices. The parallel with GDPR implementation provides a useful model for understanding potential compliance trajectories and organizational responses. However, without stronger enforcement mechanisms and independent monitoring, the EAA risks becoming symbolic rather than achieving genuine digital inclusion [15]. The Netflix ADA lawsuit in the United States, which led to increased accessibility efforts following legal action [30], shows how enforcement actions can drive compliance. Finnish and EU authorities might consider similar enforcement strategies to motivate proactive accessibility implementation rather than reactive remediation.

5.4 Future Research Directions

This research identifies some areas requiring further investigation to advance understanding of web accessibility implementation and regulatory effectiveness.

Longitudinal studies tracking accessibility changes following European Accessibility Act implementation would provide valuable data on regulatory effectiveness. The Finnish higher education experience [27] provides a baseline for understanding institutional responses to legislative requirements, suggesting that future research should examine which enforcement mechanisms and support structures most effectively drive improvements.

The effectiveness of different enforcement mechanisms across jurisdictions requires comparative analysis. The persistence of non-compliance despite legal requirements [15, 35] indicates systemic challenges in accessibility governance. Research should examine whether in-

dependent monitoring systems produce better outcomes than self-assessment approaches, particularly given concerns about legislative ambiguity [28].

6 Conclusions

This thesis investigated the state of web accessibility in Finland and examined how legislation influences accessibility outcomes across public and private sectors. The research reveals that Finnish websites has a paradoxical accessibility profile: while low contrast requirements exceed the global average they simultaneously outperform international benchmarks in form labeling and alternative text provision. The gap between public sector websites and commercial sites provides some quantifiable evidence of legislative effectiveness, although this legitimacy of this impact remains constrained by the limitations of automated testing.

These findings demonstrate that specific accessibility features can be implemented successfully when required, as evidenced by the superior performance in form accessibility, yet they consistently overlook basic requirements like color contrast. The research indicates that current legislative frameworks create measurable improvements in the public sector but according to other research require more comprehensive implementation support. For practitioners, this means that integrating automated accessibility testing into CI/CD pipelines could prevent the majority of detected issues before production deployment, while policymakers should recognize that legislation without robust supporting infrastructure produces limited and uneven compliance patterns across sectors.

The European Accessibility Act's full implementation presents an opportunity to establish accessibility as a standard development practice rather than a compliance checkbox, particularly if enforcement mechanisms follow the GDPR model of meaningful penalties combined with clear implementation guidance. At best, this could develop partial compliance toward genuine digital inclusion, ultimately transforming web accessibility from a regulatory requirement into an integral component of Finland's digital infrastructure that reflects the nation's commitment to equal participation in digital society.

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