

MONITORING WEBSITE ACCESSIBILITY: EVALUATING CURRENT APPROACHES AND A PROPOSAL FOR IMPROVEMENTS

Matjaž Debevc¹, Tilen Škraba², Bogdan Cerovac³,
Ines Kožuh⁴, and Nataša Rajh⁵

^{1,4}Institute of Media Communications, Faculty of Electrical Engineering and Computer
Science, University of Maribor (Maribor), Slovenia.

^{2,3}Institute for Digital Accessibility A11Y.si (Izola), Slovenia.

⁴Institute Integriert Studieren, Johannes Kepler University Linz (Linz), Austria.

¹ORCID: [0000-0003-4638-7864](https://orcid.org/0000-0003-4638-7864), ²ORCID: [0009-0002-9576-577X](https://orcid.org/0009-0002-9576-577X),

³ORCID: [0009-0007-2254-2459](https://orcid.org/0009-0007-2254-2459), ⁴ORCID: [0000-0001-7875-5583](https://orcid.org/0000-0001-7875-5583),

⁵ORCID: [0000-0003-2430-7114](https://orcid.org/0000-0003-2430-7114)

¹ matjaz.debevc@guest.um.si, ² tilen@a11y.si,

³ bogdan.cerovac@gmail.com, ⁴ ines.kozuh@um.si,

⁵ natasa.rajh@partner.jku.at

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Abstract: The introduction of WCAG 2.0 and the European Web Accessibility Directive marked significant milestones in the realm of web accessibility evaluation. However, even with the passage of considerable time, persistent challenges continue to impact the assessment of web accessibility. In this article, we aim to address these ongoing hurdles and provide comprehensive suggestions for accessibility assurance to achieve efficiency, consistency, and transparency in the processes of preparing accessibility statements, monitoring, and self-assessment. The proposed solutions include a centralised system for preparing accessibility statements, a centralised government template for feedback mechanisms, simplified self-assessment based on nine general criteria, and in-depth monitoring by experts and individuals with disabilities. Centralising all accessibility statements would facilitate monitoring updates and accessibility achievements, enabling mass verification by the bodies in charge of monitoring the Web Accessibility Directive and the public. The centralised government template for feedback mechanisms

provides benefits such as automatic form completion and shared responsibility for addressing reported inaccessible content. Simplified, centralised, and automated monitoring allows for efficient tracking of accessibility status and verification of updates using an automated software environment. Links to results can be shared with public sector bodies and inspectors, enhancing transparency and comparison. In-depth monitoring requires complete analysis and recommendations for improvements, in which experts and individuals with disabilities are involved. Proper education and training of website administrators are crucial for ensuring quality and meeting accessibility criteria. By implementing these proposals, the goal of inclusive access to information and services can be achieved for all users.

Keywords: Accessibility, World Wide Web, Web Content Accessibility Guidelines, Web Accessibility Directive, Accessibility monitoring, Accessibility statement, Feedback mechanism.

Introduction

Increased involvement of people with various forms of disabilities has, in recent years, become an important factor in the analysis, development, and evaluation of websites, mobile applications, digital products, and various services (Campoverde-Molina et al., 2023). According to the official statistical data, about a quarter of the EU population experienced long-standing activity limitations due to health problems in 2021, which can be interpreted as those people having some sort of long-lasting impairments. 6,6% of Slovenes aged 15 years or over reported severe long-term limitations and 14,8% some long-term limitations, together coming to around 21%. Numbers were the highest in Latvia, where around 37% reported some sort of long-term limitations, and the lowest in Malta, with 17% (Eurostat, 2023). The number is set to increase, due to EU population ageing, and therefore being at increased risk of developing chronic conditions (Council of the European Union, 2022).

Therefore, digital inclusion or accessibility of Information and Communication Technologies has become crucial. Digital accessibility not only being desired, but also being a right (European Commission, 2023b), was legislated with the

introduction of Directive (EU) 2016/2102, also called The Web Accessibility Directive (European Commission, 2016). The Directive obliges public sector bodies' websites and apps to be accessible, however, there are still difficulties in evaluating accessibility.

Evaluation can be performed by automated or manual evaluation tools, which cannot identify all accessibility problems (Kollotzek et al., 2021; Rajh & Debevc, 2022). In-depth monitoring as a precise manual method, however, requires a significant amount of time and expertise from the evaluator. Moreover, there is also a lack of evidence on appropriate methodologies that would allow sufficient development and evaluation of websites, mobile applications, products, and services. The Web Accessibility Directive allows a lot of freedom in terms of monitoring and reporting, lacking a unified monitoring and reporting. However, it is important to point out that many EU Member States expressed their wish for a unified approach (Rajh & Debevc, 2022).

According to the Web Accessibility Directive (European Commission, 2016), the preparation of the accessibility statement and the implementation of the feedback mechanism must be carried out by public sector bodies, while simplified and in-depth monitoring should be conducted by the assigned bodies in charge of monitoring the Web Accessibility Directive, potentially in collaboration with public sector bodies.

In this article, we highlight the current state of evaluation approaches in accordance with the given European and national accessibility laws, and provide suggestions for an appropriate methodology:

- for the preparation and presentation of an accessibility statement,
- for the implementation of a feedback mechanism,
- for evaluation and reporting for simplified and in-depth monitoring.

Existing research on website accessibility monitoring has focused mostly on comparisons or usage of automated tools only, leaving a noticeable gap in understanding of the requirements of the Directive (EU) 2016/2102, where even the bodies in charge of monitoring the compliance with the Web

Accessibility Directive strive for clear and comprehensive methodology approaches.

The first monitoring period finished in December 2021, when the Member States published their reports, providing insights into their processes and potential uncertainties. The current ongoing monitoring period will finish in December 2024. In addition to viewing the reports and other web contents where the Member States describe their processes, we had multiple talks with the Slovenian monitoring body, to get first-hand insights into their work.

Based on the current good practices of Member States, an assessment of the challenges they encounter, and an overview of the existing evaluation tools, we have formulated comprehensive recommendations. These recommendations aim to guide various stakeholders in achieving compliance with the Web Accessibility Directive effectively while facilitating enhanced accessibility for all users.

Background

Legislations and guidelines

[Directive \(EU\) 2016/2102](#)

The European Parliament and the Council of the European Union have adopted Directive (EU) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of websites and mobile applications of public sector bodies (also called the Web Accessibility Directive). In addition to technical requirements, the Directive also stipulates that public sector bodies have to provide an "accessibility statement" for their websites, which has to include information on accessibility, as well as information on submitting requests and complaints. The Directive obliges all Member States to transpose it into their national laws. In the case of Slovenia, this was accomplished through the Slovenian Act on the accessibility of websites and mobile applications (ZDSMA) (Republika Slovenija, 2021).

Fundamentally, the Directive requires that each website and mobile application has to include an **accessibility statement** and **feedback mechanism**, while also the accessibility of websites and mobile applications of public sector bodies has to be monitored and reported regularly.

Due to these requirements, simplified and in-depth monitoring (to a lesser extent) must be carried out at the national level of each European country and reported to the European Commission. Under Directive (EU) 2016/2102, there are also some exceptions, such as websites of non-governmental organisations that are not essential for the public and others.

Monitoring methodology

The European Commission has determined, in an Implementing Decision, the monitoring methodology for the Directive on Web Accessibility (European Commission, 2018a). According to this Implementing Decision, conformance of websites and mobile applications with the accessibility requirements of the Directive is monitored using the following two methodologies (European Commission, 2018a; Kollotzek, 2021, Republika Slovenija, 2021):

- **Simplified monitoring method:** Basic vulnerabilities and their severity are recorded, and a protocol is created, with descriptions of issues and heuristic solutions based on standard specifications.
- **In-depth monitoring method:** In addition to basic monitoring, a detailed analysis of the root cause for each issue, a description of its impact on user groups, and specific proposals are provided for issue resolution.

The monitoring methodology also describes the sampling approach for websites and mobile applications, and what Member States should include in their monitoring reports. These requirements are as follows:

- A detailed description of the monitoring process.
- Mapping in the form of a Correlation Table, demonstrating how the monitoring methods used relate to the requirements in the Standards and Technical Specifications of the Directive, including any significant method changes.

- Monitoring results for each monitoring period, including measurement data.
- Description of the mechanisms established by Member States for consulting relevant stakeholders on website and mobile application accessibility.
- Procedures for publishing any accessibility policy developments related to websites and mobile applications.
- Information on training and awareness-raising activities.

A feedback mechanism for reporting content accessibility needs

Directive (EU) 2016/2102 requires that public sector bodies include a feedback mechanism for sending feedback in the form of electronic messages, or by entering data into a specially prepared web or application form. The feedback mechanism is included within the accessibility statement on their website or application.

The feedback mechanism should enable users to contact the public sector body directly to report accessibility issues and request alternative formats for inaccessible content. The feedback mechanism is beneficial for users as well as public sector bodies, as it allows them to obtain valuable information to address issues on their website or application.

Directive (EU) 2016/2102 stipulates that, in response to a "legitimate and reasonable" request, a public sector body has to provide a response "in an appropriate and accessible manner within a reasonable time frame." However, if an accessibility statement is not available, the user has to establish contact with the website owner through other means, which the public sector body has to provide specifically.

The World Wide Web Consortium (W3C) provided a document to help users report website accessibility problems (W3C, 2017), in which it is stated that users should send the following information to the public sector body:

- The URL where the problem occurred.
- A description of the problem.
- The device being used.

- The operating system being used (e.g., Windows, MacOS, Linux...).
- The missing settings (e.g., font size).
- The assistive technologies being used (e.g., screen reader, magnifier, FM system...).
- If possible, a screenshot of the problem.

While the above list is a recommendation, it may be demanding for many users, and, thus, it calls for simplified and automated methods for submitting complaints or requests.

[Web Content Accessibility Guidelines](#)

The Web Content Accessibility Guidelines (WCAG) are globally recognised recommendations for enabling the accessibility of web content, published by the World Wide Web Consortium (W3C). The previous version, 2.1, which is referenced by the European Standard EN 301 549 that supports the European Directive 2016/2102, was published on 5 June 2018. As the latest EN 301 549 (version 3.2.1) references WCAG 2.1, the newest WCAG version, 2.2, published on 5 October 2023 (W3C, 2023), will become relevant when ETSI prepares standard updates and when the European Commission adopts the new version of the standard.

WCAG has a hierarchical structure, starting with principles, followed by guidelines, and then success criteria (W3C, 2018). Each success criterion belongs to one of three levels of conformance: A (the lowest level) with 30 success criteria, AA (the middle level) with 20 success criteria, and AAA (the highest level) with the remaining 28 success criteria. It is important to note that conformance on Level AA includes both Level A and Level AA success criteria.

[EN 301 549](#)

European Standard EN 301 549 (ETSI, 2021; European Commission, 2021), establishes requirements for the accessibility of Information and Communication Technologies (ICT). It has been "harmonised" with Directive (EU) 2016/2102. In practice, this means that, if the EN 301 549 is considered and applied appropriately, it is deemed to fulfil the technical requirements of Directive (EU) 2016/2102 sufficiently.

The EN 301 549 covers all areas of ICT, and the ninth chapter of the EN 301 549 (version 3.2.1) focuses on requirements for websites. In this part, the EN 301 549 relies heavily on WCAG 2.1 Level AA guidelines for web content. Annex A to the EN 301 549 provides a detailed description of the relationships between the Standard and the requirements of Directive (EU) 2016/2102. Specifically, Table A.1 provides a list of all requirements for web content from all chapters of the EN 301 549, including the Level AA WCAG 2.1 requirements from the ninth chapter.

The EN 301 549 requirements are divided into four basic principles: Perceivable, Operable, Understandable, and Robust (POUR), stemming from WCAG (Altinier et al., 2022). The Standard includes a total of **137 requirements** specifically for web pages (ETSI, 2020; European Commission, 2023; European Commission, 2023a), which encompass 50 Level AA WCAG 2.1 criteria.

Slovenian Act on the accessibility of websites and mobile applications

To claim that a Slovene public sector body' website is fully accessible, we have to demonstrate conformance with all the requirements stated in the Slovenian Act on the accessibility of websites and mobile applications (ZDSMA) (Republika Slovenija, 2021), which include the requirements of the EN 301 549.

The process of evaluating websites, mobile applications, products, and services

Examples of European good practices in monitoring

The accessibility statement provides information about accessibility and measures to improve accessibility. These statements have to be monitored by bodies in charge of monitoring the Web Accessibility Directive. Countries have taken different approaches to meet these requirements.

Examples that could be highlighted include the Norwegian, Dutch, Danish and Irish models, which represent good practices for meeting these requirements:

- **The Norwegian model** requires centralised submission of accessibility statements and relevant accessibility assessments. The statements are linked from the public sector body websites (UUtlysinet, 2023). Public access to the centralised register is not available. With this centralization, the inspection has a complete overview without manual verification, making it possible to identify which public sector bodies still need to submit statements, which ones need to update them, which ones have unresolved issues and what WCAG issues are reported. The inspection also maintains a list of all public sector bodies, including the websites and mobile applications they own. Furthermore, accessibility statements for third-party products, which are sometimes part of public sector websites or mobile applications and where the public sector bodies are only subscribers are also required (e.g., chat services and similar tools). Centralising and standardizing the accessibility statements facilitates full oversight by the inspection authorities significantly and increases transparency for the interested public. Accessibility statements are still self-assessments which could be biased.
- **The Dutch model** focuses on publicly disclosing the accessibility status of websites and mobile applications through an interactive web portal called the Digital Accessibility Dashboard (DigiToegankelijk, 2023). This portal provides information about the accessibility of websites and mobile applications of public sector bodies. The Digital Accessibility Dashboard, developed in collaboration between the Dutch government and the accessibility sector, contains information on over 4,000 websites and mobile applications. The websites and applications are assessed based on various accessibility aspects, such as usability for individuals with different types of disabilities, visual presentation, and accessibility across different devices. The assessment results are disclosed publicly and presented in the form of graphs and Tables, allowing users to assess the accessibility status of a website or application quickly. Additionally, the Digital Accessibility Dashboard provides tools and resources for improving the accessibility of websites and applications, along with instructions on how to use these tools. The Dutch model has been successful in promoting the improvement of

website and application accessibility by facilitating easier access to accessibility information. Furthermore, the Digital Accessibility Dashboard has streamlined the work of the inspection authorities, enabling them to monitor and track the accessibility status of websites and applications better.

- **In Denmark**, for simplified monitoring of website accessibility, they use an open-source automated tool, "QualWeb" (Danish Agency for Digital Government, 2023). Additionally, all simple verifications of public sector bodies are published on a shared platform, accessible to the general public. Similar to Norway, Denmark has developed a centralised system for accessibility statements.
- **In Ireland**, within the framework of the NDA organisation, they use a fully automated open-source tool called "Axe Core" for automatic checking of all specified public sector bodies' websites. The automated tool is run on a weekly basis. Each public sector body has its own link, where they can view the results. From this perspective, Ireland implements a similarly simplified monitoring approach as Denmark.

Implementation of monitoring in Slovenia

In compliance with the sampling size methodology by the European Commission (European Commission, 2018a), Slovenia has to conduct 117 inspections for simplified website monitoring and 16 inspections for in-depth monitoring (calculation based on population size on 17th July 2023) from approximately 3,000 public sector bodies (European Commission, 2022; Republika Slovenija, 2021). Regarding mobile applications, 8 inspections are required, with a smaller sample size in the early monitoring years. Each Member State also has to consult with organisations representing persons with disabilities when selecting the sample.

The first monitoring period in Slovenia

In the first inspection of the year 2021, the Slovenian inspection authority conducted 116 inspections. For simplified monitoring, they used three tools: **Wave**, **Axe DevTools**, and **Accessibility Insight for Web**, which were used frequently in other monitoring processes (Bhagat & Joshi, 2019). Due to

various limitations, they focused on identifying violations of a maximum of three WCAG success criteria, no matter which ones, in the initial inspection.

During the first monitoring period, using the simplified method, out of the 116 public sector bodies' websites inspected, errors were not found in only 5 of them. In 8 websites only one error was found, in 9 websites two errors were found, and in 94 websites three errors were found. Thus, the inspection identified a total of 308 irregularities in the 116 inspections conducted. By December 1, 2021, 47 bodies had resolved all the errors, 44 bodies had resolved only some of the errors, and 17 bodies had not resolved any errors. Based on the received inspection reports and identified irregularities, the public sector bodies resolved 194 errors. In three bodies with nine errors, their websites were taken down. To address the remaining 105 identified errors, the inspection authority had to continue with the inspection procedures and issue 61 orders to rectify the identified irregularities and deficiencies.

The second monitoring period in Slovenia

In the second monitoring period (2022-2024), the Slovenian Inspectorate for Information Society conducted inspections using both the simplified and in-depth methods. With the simplified method, they examined 118 public sector bodies' websites in 2022, while, with the in-depth method, the required 16 public sector bodies were inspected for each reporting period, totalling 32 sector bodies, to compensate for the absence of in-depth monitoring during the first monitoring period.

In the same year on the same sample, no errors on the websites or in the accessibility statement were found in 6 bodies. Similarly, 18 bodies did not have any website errors, but they neither had a correct accessibility statement nor had one at all. In the inspection process it was determined that 3 bodies were not subject to the Electronic Communications Act, so their missing accessibility statements were not included in the statistical overview. Errors were identified in 109 bodies, with 11 bodies having only one error, 9 bodies having two errors, and 68 bodies having three errors. Thus, the Inspectorate identified a total of 233 irregularities in the 115 inspections conducted. In 2021, during 116 simplified website inspections, 304 errors were identified,

indicating an improvement in website accessibility (European Commission, 2022; Republika Slovenija, 2021).

In 2023, the Inspectorate also began conducting in-depth inspections of mobile applications and issued a call for conformance with the law to all public sector bodies (the call was sent to nearly 3,000 bodies).

What are the difficulties in monitoring and reporting?

Regarding **accessibility statements**, significant difficulties were encountered in verifying who has such a statement on their website or mobile application and in checking the content of the statements. Some statements were merely copied from other public sector bodies and lacked the necessary provisions. While many public sector bodies already fulfil the statements independently, most of them indicate that the Statement is based on self-assessment. However, problems arise, as most organisations lack the necessary expertise to conduct self-assessments. This raises concerns about the effectiveness of support and independent fulfilment of the statements.

Regarding the use of **automated tools**, the Slovenian Inspectorate expected the European Commission to establish appropriate reference tools for simplified and in-depth website monitoring, ensuring comparable final results. Each tool detects different errors and varying numbers of errors, yielding varying error counts. Consequently, it is imperative to **validate all obtained results meticulously and independently**. Moreover, exercising caution is essential when categorising and defining the identified errors.

The **number of criteria** specified in the Standard also poses a significant challenge. The EN 301 549 includes 137 accessibility requirements for websites and 162 for mobile applications, encompassing 50 WCAG criteria. However, automated tools can only find issues in code, which covers practically around 30% of the WCAG criteria (Figure 1). It is also crucial to understand that automated tools only find obvious errors but cannot approve conformance. Other success criteria need to be verified purely manually. As a result, all stakeholders report that significant time and trained personnel are needed to comply with all the requirements. Currently, the Slovenian Inspectorate uses

its own list of identified errors to test the performance criteria for websites and mobile application inspections, expanding the list of errors continuously.

Figure 1. Criterion coverage using automated tests according to the European Standard EN 301 549. Source: Bogdan Cerovac.



The next issue concerns the preparation of **adequate accessibility reports**. In reports from the first reporting period, it became evident that practically every country had chosen its own concept of monitoring and reporting. Due to the diversity of results and the varied use of indicators, it is impossible to compare the results among European Union countries.

During its inspections, the Slovenian Inspectorate also observed that, due to the scope of provisions used to determine conformance to the Slovenian Disability and Accessibility Act, there has been a noticeable **reduction in web content** and a **lack of readiness** to plan and develop mobile applications in Slovenia.

Suggestions for improving the assessment methodology

Given the challenges and lack of adequately trained professionals, the following measures need to be addressed:

- **Centralized preparation of accessibility statements:** A systematised template, powered by a centralised database, should be established to ensure consistency of the statements, enhance transparency, and facilitate more effective reporting to the European Commission.

- **Centralized national template for feedback mechanism:** A recognisable, unified, and efficient contact point should be provided for end users, along with automated mechanisms to verify response deadlines and improve monitoring and reporting to the European Commission.
- **Self-assessment and reporting based on simplified monitoring:** This approach would assist public sector bodies in being more effective, while ensuring data quality for supervisory authorities.
- **In-depth monitoring and reporting by experts:** Experts should be involved in monitoring to alleviate the burden on Member States' bodies in charge of monitoring the Web Accessibility Directive. This approach should also include individuals with disabilities, to contribute to high-quality results and provide specific and professional recommendations for improvements to the public sector bodies.

Centralised preparation of accessibility statements

The Directive (EU) 2016/2102 established requirements for the accessibility of websites and mobile applications in the public sector, with the most important requirement being the accessibility statement. To ensure consistency, transparency, and more effective reporting by public sector bodies, the European Commission developed a systematised template for accessibility statements (European Commission, 2018).

However, since public sector bodies face difficulties in preparing accessibility statements, the following possible scenarios should be considered for a well-prepared statement:

- Accessibility statements with self-assessment should require evidence that the person who conducted the self-assessment possesses the necessary professional knowledge.
- Accessibility statements should include evidence that they were prepared by external experts, thereby transferring the responsibility for statement accuracy to these external experts.

Due to the lack of professionals, it is advised for public sector bodies to seek external opinions on accessibility to obtain reliable and detailed statements.

This does not necessarily require an immediate comprehensive assessment of the website. External assessors can determine relatively quickly whether the website is at least approximately accessible or not. Expert external opinions would contribute significantly to more detailed and realistic statements.

All statements should be entered into a centralised system for the preparation and creation of accessibility statements. This means that public sector bodies would complete their statements on a central website and obtain a properly prepared accessibility statement and a URL link to be placed on their main web page. With a centralised solution, bodies in charge of monitoring could easily verify the updates to statements and monitor the accessibility status of each public sector body according to the criteria. This solution would enable better tracking and control of accessibility statements. The centralised platform would also facilitate quick verification of statements against the Web Accessibility Directive requirements.

Although the centralisation of statements does not guarantee an improvement in quality, it is important that all public sector bodies have regular opportunities for structured and mandatory education, as required by Directive (EU) 2016/2102.

Until centralised solutions for accessibility statements are developed and incorporated into legislation, we recommend promoting (or even requiring) the use of existing tools to generate accessibility statements consistently. One example is the W3C WAI Accessibility Statement Generator (W3C, 2021).

Centralised national template for feedback mechanism

The implementation of a centralised national template for a feedback mechanism, as required by Directive (EU) 2016/2102, would necessitate coordinated actions at the State level. To achieve this goal, it would be necessary to establish the appropriate infrastructure and organisational framework.

The centralised template for the feedback mechanism would provide the option for automatic completion of certain required fields, such as the institution's name and address, URL, operating system, and browser type. It

would then include the necessary software solutions to fulfil the other aspects of the feedback mechanism. An example of such a feedback system was also proposed in the European project UPowerWAD (UPowerWAD, 2021).

A unified feedback form would serve to report inaccessible content. The responsibility for processing information from the feedback mechanism would be transferred to the website administrator or another independent organisation responsible for the website. In this case, the administrator would need to possess a high level of expertise in identifying errors and a profound knowledge of accessibility.

Bodies in charge of monitoring could also use the feedback mechanism to monitor common issues and enhance their knowledge and assessment skills further regarding appropriately fulfilled criteria. An increase in received reports for a particular public sector body may signal the need for additional oversight.

Self-assessment and reporting based on simplified monitoring

Directive (EU) 2016/2102 requires the implementation of simplified monitoring, providing the option for a public sector body to conduct self-assessments and submit reports upon request by the body in charge of monitoring. In this regard, a centralised self-assessment template can be helpful, allowing an overview of the status and changes according to the criteria of the Accessibility Standard for each public sector body. This would enable inspectors to review individual criteria and track changes more easily, contributing to improved transparency, not only for the body in charge of monitoring, but also for the general public as well.

In the simplified monitoring process, public sector bodies can complete the centralised self-assessment template themselves if they possess internal knowledge or with the assistance of external experts. Such a template also contributes to consistency in the evaluation process among different public sector bodies and facilitates more effective reporting to the European Commission.

The Report should include information about identified barriers, actions taken to address them, and any plans for future improvements. The Report should be detailed, comprehensive, and communicate the public sector body commitment to web accessibility clearly.

Furthermore, the Accessibility Report should be publicly accessible, ensuring transparency, and providing users with information about the accessibility of their digital services. This allows not only the body in charge of monitoring, but also individuals, including those with special needs, to understand the level of accessibility provided and to make informed decisions about service usage.

In the case of simplified monitoring, which relies primarily on testing with automated tools and, to a lesser extent on manual testing, it is not necessary to follow the WCAG guidelines directly. Instead, the focus is on the following **nine user accessibility needs**, which are then mapped to success criteria within WCAG (Fischer, 2019; European Commission, 2018b):

- Use without vision.
- Use with limited vision.
- Use without color perception.
- Use without hearing.
- Use with limited hearing.
- Use without vocal ability.
- Use with limited manipulation or strength.
- Need to reduce the risk of seizures caused by flashing content.
- Use with limited cognition.

For simplified monitoring, not all WCAG success criteria are required. Instead, a limited and narrow set of success criteria is determined that can be identified by automated tools. These success criteria are then mapped to the nine users' accessibility needs. Part of these success criteria can be identified through programmatically automated systems that include automatic tests for website verification. A public sector body could verify the results produced by these programmatically automated systems independently using the assigned URL links. Additionally, at least once or twice a year, a manual evaluation

template would be provided as part of the centralised template. This template would also cover the assessment of mobile applications.

In the centralised self-assessment template, reliance can also be placed on the rules of Accessibility Conformance Testing (ACT) (Abou-Zahra, 2018; W3C, 2020a; W3C, 2020b), developed by companies and organisations under the W3C consortium. Although officially published by the W3C, the ACT rules ensure credible verification of the WCAG 2.1 success criteria. The goals of participating communities include reducing diverse interpretations of WCAG, making test procedures comparable, and developing a library of widely accepted rules. ACT rules also guide the development of automated and semi-automated testing tools that public sector bodies and regulatory bodies can use for more efficient and successful monitoring.

Moreover, the centralised template could facilitate the maintenance of a unified record and statistics based on key indicators, enabling easier comparisons among public sector bodies and countries within the EU.

A good practice example of simplified monitoring was conducted by the Norwegian body in charge of the monitoring as a pilot project within the European project WAI-Tools (Uutylsinet, 2020; W3C, 2020c). The simplified monitoring methodology within the WAI-Tools project provides organisations with a structured and practical approach to evaluating the accessibility of their websites.

In simplified monitoring it is also important to consider the significance of a website and ensure an appropriate level of reviews accordingly. Setting excessively high requirements for a local community that publishes one post per year would be impractical, while higher requirements should be established for social welfare centres, healthcare facilities, or elderly care homes. For the former, high-quality self-assessments made with the help of the centralised template would be sufficient, but, for the latter, strict reliance on self-assessments should be avoided, especially if they cannot demonstrate the necessary expertise.

In-depth monitoring

The method of in-depth monitoring, as required by Directive (EU) 2016/2102 (European Commission, 2018), involves a detailed examination of **all the requirements and criteria** described in the Standards and Technical Specifications in the Directive.

In most European countries, in-depth monitoring is typically carried out by external experts who are engaged for this purpose. These experts can also utilise templates such as WCAG-EM (Acosta-Vargas et al., 2016). The WCAG-EM template provides guidance on using evaluation methodologies and solutions for specific situations related to WCAG 2.1 (50 success criteria). With the help of the WCAG-EM template, a summary report for management is prepared, where individual areas are described in a clear and accessible manner, highlighting any issues. This summary is then supplemented with a technical report that describes the results based on the individual success criteria listed in the EN 301 549 (137 success criteria). Each result has to include a heading or location where a non-conformance was found. If the non-conformance is recurring, it is noted as a global non-conformance that needs to be addressed. Each individual success criterion is assessed using the following five options:

- Passed.
- Failed.
- Cannot tell.
- Not present.
- Not checked.

During the evaluation process, the authors of the article found it appropriate to introduce an additional assessment category for "**passed, but with possible improvements**". This category is already being used for monitoring in Norway and Sweden and is reserved for proposing enhancements to otherwise relatively good solutions.

Automated tools and their effectiveness

Conformance in in-depth monitoring cannot be determined solely using automated evaluation tools; a significant degree of human manual analysis is required. Furthermore, current automated evaluation tools only enable checking for obvious errors evident in the code and cannot assess overall conformance.

There are also tools available on the market known as Intelligent Guided Tests that assist users in conducting manual tests, even for inexperienced evaluators. Examples of these tools are **AXE devTools**, **Accessibility Insights for Web**, **Siteimprove**, and **TPGi ARC** (Manca et al., 2023).

Another type of tools utilises machine learning and combines computer vision and supervised machine learning techniques (Evinced, 2023; axe DevTools pro, 2023). Tools of this generation are becoming increasingly advanced in detecting elements of user interfaces, their possible states, and assessing accessibility simultaneously.

Intelligent guided tests and machine learning-based approaches offer improvements by providing guided assessments and utilising advanced techniques. The development of the ACT rules (ACT-Tools) by the W3C consortium has the potential to automate certain evaluations and monitor accessibility trends (Abou-Zahra, 2018; W3C, 2020a; W3C, 2020b).

Conclusion

We have presented comprehensive proposals for improving accessibility assurance according to the requirements of the Web Accessibility Directive. Considering a general lack of appropriately skilled personnel, we emphasised the importance of centralised solutions to enhance efficiency, consistency, and transparency in the processes of preparing accessibility statements, monitoring, providing, and receiving feedback, and self-assessment. The proposed solutions are as follows:

- A centralised solution for preparing accessibility statements.
- A centralised government template for a feedback mechanism.

- Simplified monitoring and reporting in the form of self-assessment using nine general criteria.
- In-depth monitoring and reporting by experts and individuals with disabilities.

The incorporation of all accessibility statements into a centralised system would facilitate the monitoring of statement updates and accessibility achievements. Bodies in charge of monitoring and the wider public would be able to conduct mass verification of statement updates and monitor the state of accessibility achievements according to the criteria set for each public sector body.

The centralised government template for the feedback mechanism would bring additional benefits, such as automatic form completion, making it easier to report inaccessible content. Website administrators would be responsible for addressing information received through the feedback mechanism. Additionally, a higher number of reports from a particular public sector body would assist in additional verification.

The Directive (EU) 2016/2102' requirements also include simplified and in-depth monitoring for ensuring website accessibility. The proposed simplified, centralised, and automated monitoring allows for efficient tracking of accessibility status, verification of statement updates, and fulfilment of success criteria by utilising an automated software environment that checks the basic success criteria related to all nine user points of concern periodically. Links to the results, which could be made available to the public, would be sent to public sector bodies and bodies in charge of monitoring, enabling them to conduct reviews based on individual criteria and track changes, thereby enhancing transparency and accountability. As an additional measure, the A3 metric could be introduced for easier and faster comparison of reports.

In-depth monitoring, involving experts with specialised knowledge and experience, as well as individuals with disabilities, would enable a thorough analysis of website accessibility. These experts would relieve supervisory bodies, provide quality results, and offer specific and professional recommendations for improvement to the public sector bodies. The

integration of both simplified and in-depth monitoring would contribute to raising the quality of website accessibility and understanding the needs of users with disabilities better.

Properly trained website administrators are crucial for ensuring quality and conducting assessments in accordance with the accessibility success criteria. Training should also include ongoing education, to enable them to successfully meet most accessibility criteria while recognising that they may not be able to fulfil all of them.

Implementing the proposed solutions and ensuring the availability of appropriately skilled professionals would lead to significant progress in the field of Accessibility, benefiting all website users. This contributes to greater inclusivity and enables equitable access to information and services for all users.

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Conflict of Interest

The authors have no conflicts of interest in connection with this study.

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