Using Self-Assessment for Improving Maturity on Accessibility Requirements in Software Practice at Visma: A Case Study

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Abstract. Technology has become ubiquitous, providing us with easy access to information, enhanced social connectivity, and expanded employment opportunities. However, nearly one billion people face significant challenges when using common software applications due to their disabilities. Consequently, it is crucial to prioritize accessibility requirements when developing inclusive software. Adhering to accessibility standards not only fulfills legal obligations but also enables software teams to identify the essential accessibility aspects that should be incorporated into software requirements. Agile teams have implemented various strategies, including self-assessment, to meet accessibility requirements. Nevertheless, there is a limited understanding of how agile software development teams effectively implement accessibility standards and strive to enhance accessibility requirements. This study presents a case study of how Visma software teams use self-assessments to facilitate the implementation of accessibility requirements. We evaluated 23 product self-assessments and it was revealed that some teams demonstrated significant progress in meeting the criteria, while others encountered challenges along the way. Multiple factors contribute to the non-compliance to accessibility standards such as insufficient time, knowledge, guidance, understanding, and resources. To overcome these challenges, planning carefully and considering all aspects is essential. By addressing these critical aspects, software teams can enhance their understanding, skills, and resources, ultimately improving the accessibility of their products and ensuring equal opportunities for all individuals.

Keywords: Agile Software Development · Accessibility Requirements · WCAG Guidelines · Self-Assessment · Case Study

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1 Introduction

Technology has become an integral part of daily life, providing numerous benefits such as information access, social interaction, and employment opportunities. However, approximately one billion individuals [18] around the globe face difficulties when using popular software applications due to their disabilities. This emphasizes the importance of designing software systems with accessibility to ensure everyone can benefit from technological advancements [15]. Accessibility in software development has become a civil rights issue, aiming to eliminate discrimination against individuals with disabilities, promote equal treatment and opportunities, and foster social justice and equity [12].

Complying with accessibility criteria can be a legal requirement and crucial for creating an inclusive user experience for individuals with disabilities [10]. Developers who prioritize accessibility can expand their user base and provide equal opportunities for all. However, compliance with laws can be challenging, particularly in industries like finance and healthcare, which have complex and ever-changing regulations. Accessibility requirements are often associated with user experience, considering how users interact with the software interface [14]. There are two types of accessibility that should be considered: technical accessibility and usable accessibility. Technical accessibility involves implementing proper software engineering practices, such as labeling ALT (alternative) tags and providing keyboard-only access to the interface. This ensures that assistive technologies used by individuals with disabilities can effectively understand and interact with the design elements. Usable accessibility, on the other hand, ensures that the broadest range of users can use the solution effectively [16].

To address accessibility challenges, various initiatives have established guidelines, such as the W3C Web Content Accessibility Guidelines (WCAG) [9] and Section 508 (29 U.S. Code §794d) [6]. Those guidelines aid organizations in identifying the accessibility aspects that need to be considered in the software products. WCAG latest version (version 2.1) includes 78 testable success criteria organized in 3 levels, namely: level A (lowest), AA (mid-range), and AAA (highest). Conformance to these success criteria determines the extent that a certain software content meets accessibility requirements. It is important to note that fulfilling the highest conformance level does not necessarily guarantee complete accessibility for individuals with specific disabilities. Nonetheless, it sets a benchmark for accessibility and demonstrates a commitment to inclusion [9].

Some countries have laws and policies requiring accessibility in software products [5], and new models have been developed to integrate accessibility activities into the software development process [17], including evaluating and verifying implementing accessibility.

Software requirements can be functional or non-functional. Functional requirements define what a system should do, while non-functional requirements (NFR) define how it should do it [2]. NFR, including accessibility, are essential for the success of software systems [3]. However, defining and prioritizing these requirements can be challenging, especially in agile software development. This

highlights the need for better documentation, explicit prioritization, testing, and self-evaluations within teams through self-assessments [1].

Self-assessment is a practice that allows a team or organization to identify strengths, areas for improvement, develop improvement plans, and track progress. It motivates team members to take ownership of their working practices and prioritize improvements. Self-assessments are common in agile development teams, with tools like the Spotify Health Check [11] being widely used [13]. The self-assessments can also be used to evaluate accessibility standards and can help agile teams to identify improvement opportunities. However, there is limited knowledge about how self-assessments are employed to implement accessibility requirements.

This paper reports on a case study that aimed to characterize the adoption of self-assessments in addressing accessibility requirements within a large IT company called Visma. The study analyzed the self-assessment documentation of 23 teams to identify the extent of their compliance with WCAG AA criteria, interviewed the head of the accessibility team, and surveyed team members about the benefits and challenges of using self-assessments to promote the adoption of accessibility criteria and improve the quality of their ICT products.

After evaluating 23 product self-assessments, we found that some products still needed to meet some WCAG AA criteria fully. Some products, however, showed compliance while others faced challenges. The reasons given for failing to meet some of the criteria included a lack of knowledge, time, and resources. The self-assessment tool was somewhat helpful, although users had varying opinions on its user-friendliness. Our findings suggest that organizations could benefit from investing in training, involving accessibility experts, and increasing awareness to enhance the accessibility of their software products.

The remainder of this paper is organized as follows. Section 2 presents the research methodology. Section 3 reports on the case study results. Section 4 discusses the findings and introduces recommendations to practice. Section 5 concludes the study pointing out future directions.

2 Research Methodology

Our case study aimed to answer the following research questions: (RQ1) Are the Visma product teams complying with the WCAG 2.1 AA criteria and, therefore, considering accessibility requirements? and (RQ2) Does the self-assessment tool aid teams in meeting accessibility standards? We focused on the WCAG AA level given that it most laws and rules regarding accessibility requirements are usually based on the WCAG AA: This section presents the study design and data collection and analysis methods.

2.1 Case Setting

Despite only a small portion of Visma's products being legally required to be accessible, the company has taken an inclusive approach by striving to make

all products accessible. Additionally, Visma encourages its subsidiary product organizations to incorporate accessibility in their product development, ensuring that its products meet the needs of its users and align with global trends.

To improve the accessibility of their products, Visma has introduced a self-assessment tool for evaluating accessibility maturity. This self-assessment is comprised of 77 (out of the 78) WCAG success criteria organized into levels to allow the teams to progress in steps. The levels are, from the bottom to the top, as follows: *Bronze* – focuses on operability and comprehensibility, which means that the product meets the basic accessibility requirements defined by the company; *Silver* – focuses mainly on operability; *Gold* – focus on how perceivable is the product; and *Platinum* – level consists of 28 criteria that surpass the A and AA levels. It involves technical considerations, like readability and language clarity. The AAA guidelines require the use of accessibility tools, and meeting those standards can require a significant investment. As the level increases, the product becomes even more accessible since to be compliance with a certain level means that the previous ones were also attended.

While voluntary, teams are motivated to complete the assessment. The majority of products in Visma's portfolio are intended for professional use (e.g., invoice payments, human resources management) and require the Bronze level. However, products under the law (e.g., banking, health) must complete the 3 bottom levels of the self-assessment (Bronze, Silver and Gold). The Platinum level is optional. To be consider legally compliant, the Gold level must be attained. Table 1 provides a comprehensive overview of the criteria for each level, except for Platinum that implements the WCAG AAA (outside this paper scope).

2.2 Data Collection and Analysis Methods

Documentation Analysis - We reviewed 23 product self-assessments out of a total of 40 current products under development. It is worth noting that all self-assessments (SA) were anonymized, ensuring that neither the products nor the team members could be identified. By carefully analyzing each document, we assessed compliance with WCAG AA criteria.

Interview - We conducted two semi-structured interviews with the Visma Lead of Accessibility team, focusing on accessibility practices and challenges. The interviews lasted one hour each and were divided into three sections: open-ended questions about the self-assessment tool, open-ended questions about requirements elicitation and accessibility obstacles, and demographic information.

Survey Questionnaire - We conducted an online survey to gather more information from the product teams regarding the analysis of their self-assessment documentation. The survey questionnaire was divided into three sections: participant demographics, accessibility, and self-assessment related questions.

To evaluate the effectiveness of the self-assessment mechanism, we utilized a modified version of the Technology Acceptance Model (TAM) [4]. The TAM explains why individuals adopt new technologies and focuses on two main factors: perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which a person believes a system can enhance their job, while perceived

Table 1: Visma's SA Organization and WCAG Requirements

VISMA's Level	WCAG #	Criteria Name	Level	Principle
Bronze	1.3.5	Identify Input Purpose	AA	Perceivable
Bronze	1.4.1	Use of Color	A	Perceivable
Bronze	1.4.11	Non-text Contrast	AA	Perceivable
Bronze	1.4.13	Content on Hover or Focus	AA	Perceivable
Bronze	1.4.3	Contrast (Minimum)	AA	Perceivable
Bronze	1.4.5	Images of Text	AA	Perceivable
Bronze	2.3.1	Timing Adjustable	A	Operable
Bronze	2.5.2	Pointer Cancellation	A	Operable
Bronze	3.2.1	On Focus	A	Understandable
Bronze	3.2.2	On Input	A	Understandable
Bronze	3.2.3	Consistent Navigation	AA	Understandable
Bronze	3.2.4	Consistent Identification	AA	Understandable
Bronze	3.3.1	Error Identifications	A	Understandable
Bronze	3.3.2	Labels or Instruction	A	Understandable
Bronze	3.3.3	Error Suggestion	AA	Understandable
Bronze	3.3.4	Error Prevention (Legal, Financial, Data)	AA	Understandable
Silver	1.3.4	Orientation	AA	Perceivable
Silver	1.4.10	Reflow	AA	Perceivable
Silver	1.4.2	Audio Control	A	Perceivable
Silver	2.1.1	Keyboard	A	Operable
Silver	2.1.2	No Keyboard Trap	A	Operable
Silver	2.2.1	Timing Adjustable	A	Operable
Silver	2.2.2	Pause, Stop, Hide	A	Operable
Silver	2.4.2	Page Titled	A	Operable
Silver	2.4.3	Focus Order	A	Operable
Silver	2.4.4	Link Purpose (In Context)	A	Operable
Silver	2.4.6	Headings and Labels	AA	Operable
Silver	2.4.7	Focus Visible	AA	Operable
Silver	3.1.1	Language of Page	A	Understandable
Silver	3.1.2	Language of Parts	AA	Understandable
Silver	4.1.2	Name, Role, Value	A	Robust
Gold	1.1.1	Non-text Content	A	Perceivable
Gold	1.2.1	Audio-only and Video-only (Prerecorded)	A	Perceivable
Gold	1.2.2	Captions (Prerecorded)	A	Perceivable
Gold	1.2.3	Audio Description or Media Alternative (Prerecorded)	A	Perceivable
Gold	1.2.4	Captions (Live)	AA	Perceivable
Gold	1.2.5	Audio Description (Prerecorded)	AA	Perceivable
Gold	1.3.1	Info and Relationships	A	Perceivable
Gold	1.3.2	Meaningful Sequence	A	Perceivable
Gold	1.3.3	Sensory Characteristics	A	Perceivable
Gold	1.4.12	Text Spacing	AA	Perceivable
Gold	1.4.4	Resize text	AA	Perceivable
Gold	2.1.4	Character Key Shortcuts	A	Operable
Gold	2.4.1	Bypass Blocks	A	Operable
Gold	2.5.1	Pointer Gestures	A	Operable
Gold	2.5.3	Label in Name	A	Operable
Gold	2.5.4	Motion Actuation	A	Operable
Gold	4.1.1	Parsing	A	Robust
Gold	4.1.3	Status Messages	AA	Robust
§	2.4.5	Multiple Ways	AA	Operable

§ Not in ORG's SA but necessary to comply with AA WCAG

For AAA criteria: https://www.w3.org/TR/WCAG21/#later-versions-of-accessibility-guidelines

ease of use measures how easy or difficult a system is to operate. People are more inclined to adopt a system that they perceive as useful and easy to use [4].

By employing a combination of data collection methods, including the analysis of the SA of the products, the interview with the accessibility specialist, and the online survey, we could look into the phenomena in a broader manner. The collected dataset provided valuable insights into the adherence to accessibility criteria and shed light on how the a self-assessment instrument can help improve accessibility requirements.

3 Results

3.1 Are the Visma product teams complying with the WCAG 2.1 AA criteria? [RQ1]

We analyzed the self-assessment results of the 23 products in order to identify their compliance with the WCAG sucess criteria and Visma Bronze, Silver and Gold maturity levels. These included, in total, 49 out of 77 success criteria (the remaining 28 are related to the Platinum level). Table 2 summarizes the products' compliance levels while Table 3 offers a more detailed analysis of the WCAG criteria. A criterion can be defined as Compliant (C), Not Compliant (NC) and Not Applicable (NA). In addition, some criterion are marked as Blank (B) if the team has not provided any information. This table also highlights the products with the most compliant number of criteria in green and the least compliant in read. Cell colors in yellow highlight the products that most reported criteria that are not applicable to the product scope. As shown in Table 2, out of the 37 criteria pointed out as required by the respective product, Product 5 (P5) indicated the 37 as compliant. Only one criterion, addressing the operable principle, was left blank. Similarly, P19 achieved compliance with 35 out of 36 indicated as applicable criteria, with only one non-compliant robust principle criterion. On the other hand, other products encountered challenges complying with WCAG AA, as highlighted in red in Table 2. Specifically, P3, P6, P11, P18, and P22 are the least compliant products according to the self-reported data.

When looking at Table 3, we can also see the top 10 compliant criteria highlighted in green, the least compliant in red, and the not applicable in yellow. Considering the top 10 compliant criteria, 7 belong to the Bronze level (e.g., 1.4.1, column WCAG), 2 to the Gold level, and one to the Silver level. 5 out of ten compliant criteria fall under the understandable principle (e.g., 3.2.1, column Principle), followed by the perceivable principle. Only one criterion belongs to the operable principle and one to the robust principle.

When looking at the 10 top not-compliant criteria, 1 falls under the Bronze level, 4 are Gold and 5 are Silver. Half of the non-compliant criteria (5 out of 10) relate to the perceivable principle, followed by 2 in the operable level, 2 refer to the robust principle, and 1 criterion to the understandable principle.

Regarding the top 10 not applicable criteria, 7 belong to the Gold level and 3 to Silver. Most non-applicable criteria (6 out of 10) fall under the operable principle, followed by the perceivable principle.

Table 2: Project Compliance Overview

Project	Compliant	Not Compliant	Not Applicable	Blank
P1	19	8	8	14
P2	28	8	13	0
P3	21	15	13	0
P4	33	2	14	0
P5	37	0	11	1
P6	14	21	14	0
P7	29	9	11	0
P8	11	0	2	36
P9	27	8	14	0
P10	8	6	2	33
P11	18	18	13	0
P12	30	10	9	0
P13	27	11	11	0
P14	32	2	15	0
P15	26	10	11	2
P16	34	5	9	0
P17	19	3	19	8
P18	20	16	13	0
P19	35	1	13	0
P20	17	13	19	0
P21	28	10	11	0
P22	21	14	14	0
P23	24	13	12	0

Table 3: Visma's AA WCAG Project Compliance

	WCAG #	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	PRINCIPLE	C	NC	NA	B
Bronze	1.3.5	C	C	NC	C	C	NC	C	NA	C	C	NC	C	C	NA	C	C	C	NC	C	C	C	C	C	P	17	4	2	0
Bronze	1.4.1	C	C	C	C	C	NC	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	P	22	1	0	0
Bronze	1.4.11	B	C	C	C	C	NC	C	C	C	NC	C	C	C	C	C	C	C	C	C	NC	C	NC	C	P	18	4	0	1
Bronze	1.4.13	NA	NA	NA	NA	C	NA	NC	C	C	NA	C	NC	C	C	C	C	NC	NA	NA	NA	C	NA	NA	P	9	3	11	0
Bronze	1.4.3	B	C	C	C	C	NC	C	C	NC	NC	NC	C	C	C	C	C	NC	NC	C	NC	C	C	C	P	15	7	0	1
Bronze	1.4.5	C	C	C	NA	C	NA	NA	C	C	NC	NA	C	C	C	C	C	NA	C	C	C	C	C	C	P	17	1	5	0
Bronze	2.3.1	C	C	NA	NA	C	C	NA	C	C	NA	NA	C	C	C	C	C	NA	C	C	C	C	NA	C	O	16	0	7	0
Bronze	2.5.2	B	C	C	C	C	C	NC	B	C	C	C	C	C	C	B	C	C	NA	NA	NA	C	C	C	O	16	1	3	3
Bronze	3.2.1	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	NA	C	C	C	C	C	C	U	22	0	1	0
Bronze	3.2.2	C	C	C	C	C	NC	C	C	C	C	C	C	C	C	C	C	C	NC	C	NC	C	C	C	U	20	3	0	0
Bronze	3.2.3	C	C	C	NC	C	C	C	C	C	C	C	C	C	C	C	C	NA	C	C	C	C	C	C	U	21	1	1	0
Bronze	3.2.4	C	C	C	C	C	C	C	B	C	C	C	C	C	C	NC	C	NA	C	C	C	C	C	C	U	20	1	1	1
Bronze	3.3.1	C	C	NC	C	C	NC	C	B	NC	NC	C	C	C	NA	C	C	C	C	C	NC	C	NC	C	U	15	6	1	1
Bronze	3.3.2	B	C	NC	C	C	NC	C	B	C	NC	NC	C	C	C	NC	C	C	C	C	NC	C	NC	NC	U	13	8	0	2
Bronze	3.3.3	NC	C	NC	C	C	NC	C	B	NC	NC	NC	C	C	C	NA	C	C	C	C	C	NA	C	NC	NC	U	13	7	2	1
Bronze	3.3.4	NA	C	C	C	C	NC	C	B	C	C	C	C	C	C	NA	C	NA	C	C	C	C	C	C	U	18	1	3	1
Silver	1.3.4	C	NC	NC	C	C	NC	NC	C	NC	B	C	C	C	C	NC	NC	C	NC	C	NC	NC	NC	NC	P	10	12	0	1
Silver	1.4.10	C	NC	NC	C	C	C	C	C	C	B	NC	NC	NA	C	NC	NC	NC	NC	C	NA	NC	NC	NC	P	9	11	2	1
Silver	1.4.2	C	NA	NA	NA	NA	NA	NA	NA	C	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	C	NA	NA	P	3	0	19	1
Silver	2.1.1	B	C	NC	C	C	NC	C	B	NA	B	NC	NC	NC	C	NC	C	C	NC	C	NA	NC	NC	NC	O	8	10	2	3
Silver	2.1.2	C	C	C	C	B	NC	C	B	NA	B	C	NC	NC	NC	C	C	C	NC	C	NA	NC	NC	NC	O	10	8	2	3
Silver	2.2.1	C	NA	NA	C	NA	NA	NC	B	NA	B	NA	NC	NC	NA	NA	NA	NA	NA	NA	NC	C	NA	NA	O	3	4	14	2
Silver	2.2.2	NA	NA	NA	NA	NA	NA	NA	B	C	B	NA	NA	C	NA	NA	C	NA	NA	NA	NA	C	NA	NA	O	4	0	17	2
Silver	2.4.2	B	C	C	C	C	C	NC	B	C	B	NC	C	C	C	NC	C	C	C	C	NC	C	C	C	O	16	4	0	3
Silver	2.4.3	B	C	NC	C	C	NC	C	B	C	B	NC	NC	C	C	C	C	C	C	C	NA	NC	NC	NC	O	12	7	1	3
Silver	2.4.4	C	C	C	C	C	C	C	B	C	B	NC	C	C	C	C	C	C	NC	C	C	C	C	C	O	19	2	0	2
Silver	2.4.6	NC	NC	C	C	C	NA	C	B	C	B	NC	C	C	C	C	C	C	C	C	C	C	C	C	O	17	3	1	2
Silver	2.4.7	B	C	NC	C	C	NC	C	B	C	B	NC	NC	C	NC	C	C	C	C	NC	C	C	C	NC	O	13	7	0	3
Silver	3.1.1	C	C	C	C	C	C	C	B	NA	B	NC	NC	NC	C	C	C	B	NC	C	C	C	C	C	U	15	4	1	3
Silver	3.1.2	C	C	C	C	C	NC	NC	B	C	B	NC	NA	NA	NA	C	C	NA	C	C	C	NA	NA	C	U	12	3	6	2
Silver	4.1.2	B	C	C	C	C	NC	NC	B	NC	B	NC	NC	NC	C	NC	C	B	NC	C	NC	NC	NC	C	R	8	11	0	4
Gold	1.1.1	NC	NA	NC	C	C	NC	C	B	NC	B	C	C	NC	C	NC	NA	NA	NC	C	NC	NA	C	NC	P	8	9	4	2
Gold	1.2.1	NA	NA	NA	NA	NA	NA	NA	NA	B	NA	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	P	0	0	21	2
Gold	1.2.2	NC	NA	NA	NA	NA	NA	NA	B	NA	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	P	0	1	20	2
Gold	1.2.3	NC	NA	NA	NA	NA	NA	NA	NA	B	NA	B	NA	NA	NA	NA	NA	B	NA	NA	NA	NA	NA	NA	P	0	1	19	3
Gold	1.2.4	NA	NA	NA	NA	NA	NA	NA	B	NA	B	NA	NA	NA	NA	NA	NA	B	NA	NA	NA	NA	NA	NA	P	0	0	20	3
Gold	1.2.5	NC	NA	NA	NA	NA	NA	NA	NA	B	NA	B	NA	NA	NA	NA	NA	B	NA	NA	NA	NA	NA	NA	P	0	1	18	3
Gold	1.3.1	B	NC	NC	C	C	NC	NC	B	NA	B	NC	C	NC	C	NC	NC	NA	NC	C	NC	NC	NC	NC	P	6	12	2	3
Gold	1.3.2	B	NC	NC	C	C	C	C	B	C	B	C	C	C	C	C	C	C	C	C	NA	C	C	NC	P	16	3	1	3
Gold	1.3.3	C	C	C	C	C	C	C	B	C	B	C	C	C	C	C	C	NA	NC	C	C	C	C	C	P	19	1	1	2
Gold	1.4.12	B	NC	NC	C	NA	NC	C	B	NC	B	C	C	NC	C	C	NC	B	NA	NA	NA	NC	NC	C	P	7	8	4	4
Gold	1.4.4	C	NC	NC	C	C	NC	C	B	NC	B	NC	C	NC	C	C	NC	C	NC	C	NC	NC	NC	NC	P	9	12	0	2
Gold	2.1.4	NA	NA	NA	NA	NA	C	NA	B	NA	B	NA	C	NC	NA	C	NA	NA	NA	NA	NA	NA	NA	NA	O	3	1	17	2
Gold	2.4.1	B	NA	NA	NA	C	NA	NA	B	NA	B	NC	NC	NA	NA	NA	C	NA	NA	NA	NA	NA	NA	NA	O	2	2	16	3
Gold	2.5.1	NA	NA	C	NA	C	NA	NC	B	C	B	NA	C	NA	C	NA	C	NA	C	C	C	C	C	C	O	12	1	8	2
Gold	2.5.3	NC	NC	NC	C	C	NC	C	B	C	B	C	C	C	C	NC	C	NA	C	C	C	NA	C	NC	O	13	6	2	2
Gold	2.5.4	NA	C	NA	NA	NA	NA	NA	C	B	NA	B	NA	NA	NA	C	NA	C	NA	C	C	NA	NC	NA	NA	O	6	1	14	2
Gold	4.1.1	B	C	C	C	C	C	C	B	C	B	NC	C	C	C	C	C	B	C	C	C	C	C	C	R	18	1	0	4
Gold	4.1.3	NC	C	C	NC	C	C	C	B	NA	B	NC	C	NC	C	B	NC	B	NC	NC	NC	NA	NC	C	R	8	9	2	4

P = Perceivable O = Operable U = Understandable R = Robust
C = Compliant NC = Not Compliant NA = Not Applicable B = Blank

Based on the results of inspection of the self-assessment documentation, we had the chance to conduct 2 interview sessions of 1 hour each with the head of the accessibility team in order to gather details on the nature of Visma products and needs for accessibility requirements. For instance, we learned that criteria indicated as not applicable likely relate to the fact that audio and video functions are not required in Visma professional products. Blank criterion are safe to be interpreted as the team is yet not ready to implement the feature, no attention was given to it at the time of the self-assessment or time constraint took over, for example.

Figure 1 illustrates the reasons given by the respondents for the non-compliance of the top 10 criteria discussed in the previous section. The criteria that belong to the perceivable (e.g., Non-text Content (1.1.1)) principle, the main reason for its non-compliance was lack of knowledge, lack of specialists in the team, and product owner/manager little awareness of accessibility. In the operable principle (e.g., Keyboard (2.1.1) and No Keyboard Trap (2.1.1)), the main reason was lack of knowledge, lack of specialists, lack of time, and product owner/manager little awareness of accessibility. Under the understandable principle (Labels and Instructions (3.3.2)) the main reason was lack of time, lack of knowledge and product owner/manager little awareness of accessibility. And finally, both criteria that belong to the robust principle present lack of knowledge, product owner/manager little awareness of accessibility, and lack of time as the reasons.

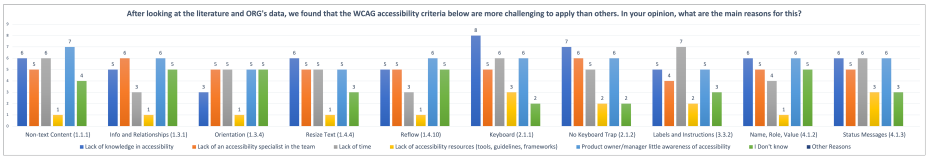

Fig. 1: Top Ten Non-compliant Reasons

When asked to elaborate on the reasons for the non-implementation of accessibility criteria, one participant pointed out that accessibility is often overlooked and not given enough importance, despite being a longstanding topic. They expressed hope for a change in this attitude and suggested that more campaigns could be run internally to increase awareness and empathy towards accessibility. Another participant added that many of the requirements mentioned involved responsive design, which could pose a challenge if the product was not already designed to work in different sizes.

3.2 Does the self-assessment tool aid teams in meeting accessibility standards? [RQ2]

Our online survey had the participation of 16 members from the product team. Their profile is listed in Table 4.

Table 4: Respondents Profile

ID	Job Function	Years of IT Experience	Project Nature	WCAG Familiarity
R1	Business Analyst	20	Human Resources	Not familiar at all
R2	Developer	23	Enterprise Resource Planning	Very familiar
R3	Product Design and Fullstack Dev	12	Financial	Extremely familiar
R4	Developer	3	Government, Healthcare	Extremely familiar
R5	Designer	7	Financial	Moderately familiar
R6	Business Analyst/UX-Designer	1	Internal systems	Very familiar
R7	Designer	2	Financial, Government, Human Resources	Moderately familiar
R8	Designer	8	Education	Very familiar
R9	Business Analyst	1	Human Resources	Slightly familiar
R10	Designer	15	Authentication	Very familiar
R11	Designer	15	Enterprise Resource Planning, Support	Moderately familiar
R12	Developer	22	Human Resources	Very familiar
R13	UX Lead	7	Education	Very familiar
R14	Designer	12	Enterprise Resource Planning	Very familiar
R15	UX Designer	8	e-Commerce and Invoice Handling	Very familiar
R16	Developer with UX Responsibilities	7	e-Commerce	Slightly familiar

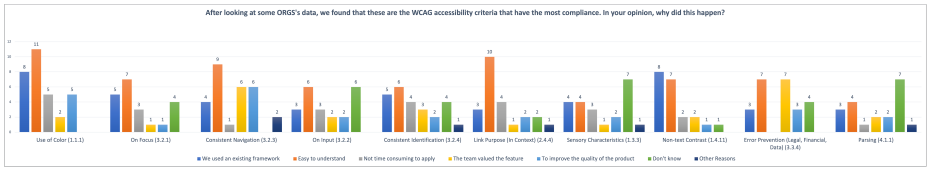

Fig. 2: Top Ten Compliant Reasons

Figure 2, we present the reasons for the top 10 most frequently applied criteria given in the previous section. The criteria belonging to the perceivable principle, Use of Color (1.1.1), stands out as one of the main reasons for its applicability and was easy to understand, followed by an existing framework. The other criteria that belong to this principle pointed out the reasons we used an existing framework and were easy to understand. Interestingly the criterion Sensory Characteristics (1.3.3), the respondents didn't know why it was among the top 10 most applicable. Under the operable principle (Link Purpose(In Context)(2.4.4)), the main reason was that the team valued the feature, not timing consuming to apply, and we used a framework. In the understandable principle (e.g., Consistent Identification (3.2.4)), the main reasons were, easy to understand, we used an existing framework, and not time-consuming to apply. And finally, in the robust principle, Parsing (4.1.1), the main reason was don't know, easy to understand, and we used an existing framework.

When asked to elaborate on the reasons for implementing accessibility, one person mentioned that implementing colors and styling is relatively easy. Another participant shared that if the team has a UX-designer, meeting specific accessibility requirements such as 3.2.3, 3.2.4, 2.4.4, and 1.3.3 may already be covered. As for 4.1.1, good coding practices should naturally ensure its fulfillment. One participant emphasized the importance of customer feedback in driving fixes. They also noted that the team applies coding standards to ensure consistency, which has the added benefit of improving accessibility.

The survey results 3 gave a detailed overview of the participants' opinions on the usefulness and effectiveness of the self-assessment (SA) tool.

Regarding the tool's effectiveness, 5 participants agreed that it was highly beneficial, while one disagreed. However, 4 participants did not have an opin-

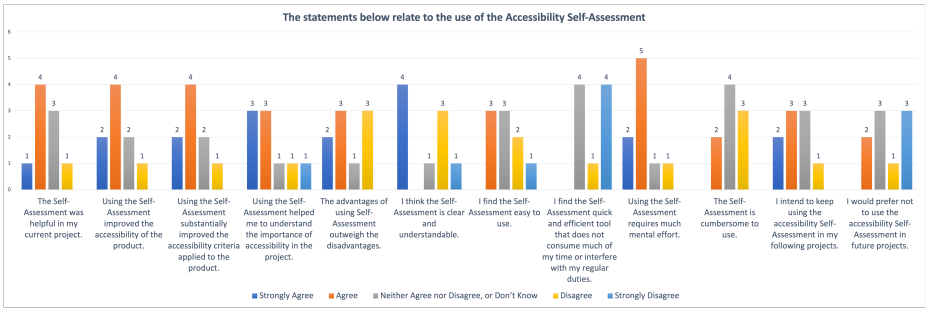

Fig. 3: Statements About the SA

ion. Likewise, 6 participants agreed that the tool was highly effective regarding accessibility, while 2 did not have an opinion, and one disagreed.

Participants also recognized that the SA tool significantly improved accessibility criteria, with 6 agreeing (2 strongly) and one disagreeing. 6 participants agreed that the tool helped them understand the importance of accessibility in the project. In contrast, one disagreed, and 2 did not have an opinion.

When weighing the tool's pros and cons, 5 participants agreed that the benefits outweighed the drawbacks, while 3 disagreed. One did not have an opinion.

Opinions regarding the clarity and understandability of the tool were mixed, with 4 participants highly rating its clarity, while 4 disagreed or strongly disagreed. Similarly, 3 participants disagreed or strongly disagreed that the tool was easy to use, 3 of them agreed. 3 did not have an opinion.

Regarding efficiency, one participant disagreed, 4 strongly disagreed that the tool was efficient, and 4 participants did not have an opinion. Participants perceived that using the SA tool required a significant mental effort, with 7 agreeing and one disagreeing. The opinions about the cumbersomeness of the tool were mixed, with 2 participants agreeing that it was cumbersome, 3 disagreeing, and 4 did not have an opinion.

Despite the varied opinions on usability, participants expressed their intention to continue using the SA tool in future projects, with 5 agreeing and one disagreeing. 3 participants did not have an opinion. However, when asked about their preference for using the SA tool in future projects, 2 participants agreed that they would prefer not to use it, while 3 strongly disagreed, and one disagreed. 3 participants did not have an opinion.

These survey findings provide valuable insights into participants' perceptions and experiences with the SA tool, highlighting agreement and disagreement regarding its effectiveness, usability, and preference for future use.

4 Discussion

4.1 WCAG AA Compliance (RQ1)

Accessibility is a crucial aspect of digital products and services, and compliance with the WCAG is essential to ensure effective access and use by people with disabilities (PWD). However, studies have shown that the level of compliance with WCAG criteria can vary across different products and services.

Several studies, including those by Yogarajah et al. [19], Keith et al. [8], Inal et al. [7], and Yu et al. [20], have examined WCAG criteria compliance and identified specific criteria that are commonly non-compliant. For example, Parsing , On Focus, On Input, Consistent Navigation, and Consistent Identification were found to be among the most compliant criteria in the study by Yogarajah et al. However, Inal et al. found non-compliance with Parsing and Link Purpose (In Context). Additionally, Error Prevention (Legal, Financial, Data) was non-compliant in Yogarajah et al.'s study but compliant in our own.

Our survey revealed that the primary reasons for noncompliance with WCAG standards in software development are lack of time, expertise, and awareness among product owners and managers. These factors were also identified in previous research by Patel et al. (2020). Ensuring accessibility in software development is a complex and time-consuming task that requires extensive research, planning, and code refactoring. Meeting specific accessibility criteria can be particularly challenging due to their intricate nature. For instance, criteria such as Info and Relationships, Labels and Instructions, Name, Role, Value, and Status Messages require extensive consideration of how information is organized, labeled, and presented to users with disabilities.

The Keyboard and No Keyboard Trap criteria are closely interconnected and can present technical challenges. To address these criteria successfully, development teams must pay meticulous attention to the design and implementation of keyboard navigation functionality within the software.

To ensure the highest levels of accessibility in digital projects, development teams must prioritize accessibility and allocate sufficient time and effort to understand and apply accessibility standards accurately. This may involve providing training opportunities for team members on accessibility guidelines, involving accessibility experts in the development process, and conducting thorough testing and validation to verify compliance with the standards.

Despite these challenges, investing in accurately implementing accessibility standards can result in software products that provide inclusive user experiences and equal opportunities to individuals with disabilities.

4.2 The Self-Assessment as an Aiding Tool (RQ2)

The survey was conducted to gather participants' opinions on the effectiveness of the SA tool in assessing accessibility in the project. The feedback obtained revealed that most participants found the tool to be highly helpful. However, a

few participants expressed concerns regarding the advantages and disadvantages, clarity, ease of use, efficiency, and mental effort required to operate it.

Despite the high rating on accessibility, some participants found the tool to be cumbersome to use, requiring too much mental effort. While most participants agreed that the benefits of the tool outweighed the drawbacks, there was a difference in opinion on the clarity and ease of use. The survey also revealed varied perspectives on the perceived benefits and drawbacks of the tools, with diverse intentions for future use and preferences.

It is essential to consider the context and experiences of the participants when interpreting the survey results, as their prior knowledge and experience with accessibility tools may have influenced their views. Some participants may have faced challenges that affected their perception. Overall, the survey results highlighted the perceived helpfulness of the SA tool in assessing accessibility in the project. However, concerns related to the ease of use and efficiency must be addressed to ensure that the tool meets practitioners' needs and expectations in future projects.

The survey feedback is valuable for improving the tool's accessibility, ease of use, and efficiency, ultimately benefiting practitioners and future projects.

4.3 Recommendations for Practice

While acknowledging that each company's situation is unique, our study's findings provide useful and practical recommendations for companies undergoing a similar transformation process as follows.

1. Invest in accessibility training and awareness: Ensure that employees at all levels of the organization receive adequate training and education on accessibility guidelines, best practices, and the importance of creating inclusive products and services. Foster a culture of accessibility awareness and make it a core value within the company.
2. Engage accessibility specialists: Incorporate accessibility specialists into the development process to provide expertise, guidance, and support. Specialists can contribute to evaluating accessibility requirements, assist in identifying potential barriers, and provide recommendations for improving accessibility.
3. Implement a comprehensive accessibility framework: Develop and implement an accessibility framework that outlines the necessary processes, guidelines, and checkpoints to ensure accessibility compliance throughout the development life-cycle. This framework should be tailored to the company's needs and cover design, development, testing, and ongoing maintenance.
4. Conduct regular accessibility audits and testing: Establish a systematic process for conducting regular accessibility audits and testing products and services. This will help identify any accessibility gaps or issues and enable timely remediation. Consider involving individuals with disabilities in the testing process to gain firsthand feedback and insights.
5. Foster collaboration and communication: Encourage collaboration and communication among different teams involved in the product development life-cycle, including designers, developers, testers, and accessibility specialists.

Facilitate ongoing discussions and feedback loops to ensure that accessibility considerations are integrated from the early stages of development.

6. Seek user feedback and engagement: Actively involve individuals with disabilities in user testing and gather their feedback throughout the development process. Incorporate their perspectives and experiences to improve the accessibility and usability of the products.

5 Conclusion

This research aimed to examine the accessibility practices in software development and find ways to improve them. The study analyzed 23 Visma's product accessibility self-assessments and found that some teams faced challenges in meeting accessibility standards. This highlights the need to enhance the accessibility practices of software development teams to create more inclusive software for all.

To improve compliance with WCAG criteria, organizations must address issues like time constraints, knowledge gaps, lack of accessibility specialists, and awareness. This can be achieved by investing in training and education for product owners and managers, involving accessibility specialists throughout the development process, and raising awareness about the importance of accessibility.

It is important to note that the sample of accessibility self-assessments analyzed in this research does not represent all Visma products. However, it does provide insights into some of the organization's practices. The analysis highlights the ongoing challenges and opportunities to improve accessibility practices within the software development industry.

Our future goal is to create a framework that helps software professionals easily integrate accessibility features into their products at every development stage. We aim to provide a practical reference that equips practitioners with the necessary knowledge and techniques to ensure their software applications are inclusive and accessible to all users.

Compliance with WCAG criteria is crucial to ensure the accessibility and inclusivity of digital products and services. By prioritizing and addressing these criteria, designers and developers can create a more inclusive ICT environment that benefits all users. It is important to remember that compliance with WCAG criteria should be ongoing rather than a one-time task as technology and accessibility requirements evolve.

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