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Factors influencing the integration of web accessibility in Moroccan public e-services

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ABSTRACT

Governments worldwide are increasingly digitizing their services to enhance efficiency, transparency, and accessibility for citizens. Morocco has made significant strides in adopting information and communication technology (ICT) and has implemented various initiatives to promote digital transformation across sectors. However, ensuring that digital content and e-services are accessible to everyone, including people with disabilities, is crucial to building an inclusive digital environment. Against this background, this study, based on a qualitative analysis, explores the main factors influencing the integration of web accessibility in the Moroccan public sector from the perspective of web developers and information technology (IT) managers. Through semi-structured interviews and thematic analysis, the findings reveal key barriers such as limited awareness, training deficiencies, and lack of legal framework and available guidelines. Additionally, the study highlights the need for robust managerial backing and greater collaboration with stakeholders, including people with disabilities. By raising awareness and providing actionable insights, this study offers valuable recommendations for policymakers and moves the field forward, providing a foundation for future strategies to enhance web accessibility in the Moroccan public sector.

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1. INTRODUCTION

Global commitments have addressed the needs and rights of people with disabilities (PWDs), exemplified by international agreements such as the convention on the rights of PWDs (CRPD) [1], adopted by the United Nations in 2006, and opened for signature and ratification in 2007, CRPD is a landmark treaty promotes inclusivity, equality, and non-discrimination, fostering a world where a person with disability can fully participate in all aspects of society. As a universal call to action, the sustainable development goals [2] also aim to promote the rights of PWDs and incorporate specific targets and indicators related to disability, precisely goal 10 for reducing inequalities and promoting inclusion of all. Despite those efforts, a significant gap persists in realizing and enforcing the rights of PWDs globally, including inclusivity and equal access to information and e-services. As digitalization plays an integral part in our daily lives, from education to employment and social interaction, ensuring that digital content and e-services are accessible to everyone is crucial. This fundamental human right aligns with the principles of equality and non-discrimination.

The World Wide Web Consortium (W3C) and the Web Accessibility Initiative (WAI) [3] have been at the forefront of efforts to promote and foster web accessibility for PWDs by providing guidelines such as

the web content accessibility guidelines (WCAG) [4], to enhance the accessibility of web content, ensuring that websites and e-services are accessible for PWDs, and propel the implementation of accessible design practices.

Developers play a pivotal role in implementing these principles, contributing to a more equitable digital environment that empowers everyone, regardless of their abilities, to engage fully with e-services. Web accessibility is not just about theory; there are tools and guidelines that web developers can use to make their e-services accessible. Governments worldwide are increasingly digitizing their services to enhance efficiency, transparency, and accessibility for citizens as they transition to e-services; it is paramount to prioritize awareness about web accessibility to ensure that online services are inclusive and accessible to all, including PWDs. Studies conducted in this area has primarily focused on the accessibility of government portals and websites. Boussarhan *et al.* [5] evaluated the accessibility of three Moroccan e-government websites. This evaluation was based on the AccessiWeb methodology, developed by the BrailleNet Association, to identify accessibility issues and verify compliance with the WCAG. Azzaoui and Lakhouaja [6] conducted an exploratory study on the accessibility of three categories of Moroccan websites using an automatic evaluation tool, and the results were underwhelming. In our prior research [7], we conducted a systematic literature review in which we presented the state of the art regarding Moroccan government initiatives for accessible portals.

Morocco has made significant strides in adopting information and communication technology (ICT) and enhancing network readiness in recent years; investments in broadband infrastructure and the expansion of high-speed internet access have contributed to improved connectivity nationwide to position Morocco as a regional hub for technology-driven initiatives. According to the International Telecommunications Union (ITU)'s 2023 report [8], Morocco tops the African ICT development index (IDI) ranking with a score of 85.1. Despite the progress in adopting ICT and connectivity, Morocco's ranking on the e-government development index (EGDI) remains moderate; the Kingdom is ranked 101st in the 2022 edition. The Moroccan government has implemented various initiatives to promote digital transformation across sectors. Some organizations are more digitally mature and advanced than others. Additionally, the delivery of public sector services in Morocco integrates new public management (NPM) practices, a methodology imported from the private sector [9]. This study explores the state of the art regarding web accessibility integration in Moroccan public e-services. It highlights the factors that could influence the integration of web accessibility from the perspectives of both web developers and IT managers in the public sector.

Previous studies have outlined four prominent models aimed at addressing web accessibility and exploring its implementation within digital environments. Each model offers perspectives and methodologies tailored to different aspects of accessibility integration. These models, namely the composite practice model (CPM), the holistic model (HM), the contextualized model (CM), and the web accessibility integration model (WAIM):

The CPM prioritizes the utilization of assistive technologies (AT) to cater to the accessibility needs of PWDs. Leung *et al.* [10] employed the CPM framework to characterize and elucidate the prevailing practices concerning AT service delivery within post-secondary educational institutions across Australia. The holistic model (HM) advocates for a unified and inclusive design, taking into account PWD needs and contextual issues, to emphasize the integration of accessibility considerations throughout the entire development process [11]. The CM underscores the significance of considering the specific contextual factors influencing accessibility, such as user needs, technological constraints, and environmental conditions [12]. Finally, the WAIM systematically integrates accessibility principles and guidelines into web development processes [13].

Web accessibility has garnered research interest for many years worldwide. However, studies focusing on integrating web accessibility through the web development process remain modest [14]. Researchers have undertaken various approaches to studying the integration of web accessibility within the development process; some researchers focused on user experience designers or user experience professionals as key stakeholders for ensuring accessibility in many websites and development projects. Other researchers attempted other approaches, shifting their attention towards webmasters and developers as critical stakeholders in implementing web accessibility issues [13]-[16]. Other studies integrated IT managers due to their influence over organizational goals and strategic decisions [17].

This study consists of exploratory interviews inspired by and based on similar works conducted to explore to what extent accessibility is considered within the e-services digitalization process and the hurdles that impede the integration of web accessibility in the public sector. The study also aims to investigate the perception of web accessibility by Moroccan web developers and IT managers in the public sector. The interviews are conducted with web developers and IT managers in the public sector; this purposive sampling helps ensure a nuanced understanding of the challenges and practices followed in implementing web accessibility standards within the public sector in Morocco. Additionally, we integrated both public

ministries and agencies in the sample. Nine interviewees, including four web developers and five IT managers with different levels of responsibilities, including directors, heads of divisions, and heads of services, were chosen from eight different departments, six ministries, and two agencies. This exploratory study aims to investigate and answer the following research questions:

- Is accessibility considered within the e-services digitalization process in Morocco?
- What factors could influence the integration of web accessibility in the public sector in Morocco?
- What are web developers' and IT managers' perceptions of web accessibility?

The remainder of this paper proceeds as follows: the following section details the adopted methodology, the third section presents key findings and future research recommendations, and the last section summarizes the key contributions of the study.

2. METHOD

This section describes how we designed and conducted this exploratory study with web developers and IT managers involved in developing public e-services in Morocco. A semi-structured interview was used as a research instrument. Five steps were adopted in our methodology as follows section below.

2.1. Theoretical background identification

As a first step, we conducted a literature review and a comparative analysis in the context of web accessibility integration to explore the different factors and models that could impact the integration of web accessibility. The research revealed three distinct integration models that align with our research questions:

- Web accessibility integration model: Figure 1 illustrates the model of web accessibility integration created by Lazar *et al.* [13], which incorporates three areas of influences on web accessibility: The first area focuses on societal foundations such as education, training, policy, and law, and statistics on inaccessibility. The second area concerns stakeholders' perceptions, including web developers, and the last area covers web development aspects such as guidelines and tools.
- Expanded web accessibility integration model: Figure 2 illustrates the expanded web accessibility integration model [18] that rests on the web accessibility integration model developed by Lazar *et al.* [13]. It extends and updates Lazar *et al.* [13] model by adding factors such as attitudes toward disability, customer demand, and advocacy efforts.
- E-government accessibility development model: Agangiba and Kabanda [19] proposed a specific model in the e-government context and argued that by considering all its constructs, as illustrated in Figure 3, e-government services developed will be accessible to PWDs. This model is also based on Lazar *et al.* [13] model with the adjustment of some factors, such as replacing client knowledge with knowledge of government agencies and the management and re-design factors by the evaluation factor, as regards categories, e-government accessibility development model maintains the three components of influence, namely societal foundations, stakeholder perceptions, and web development process.

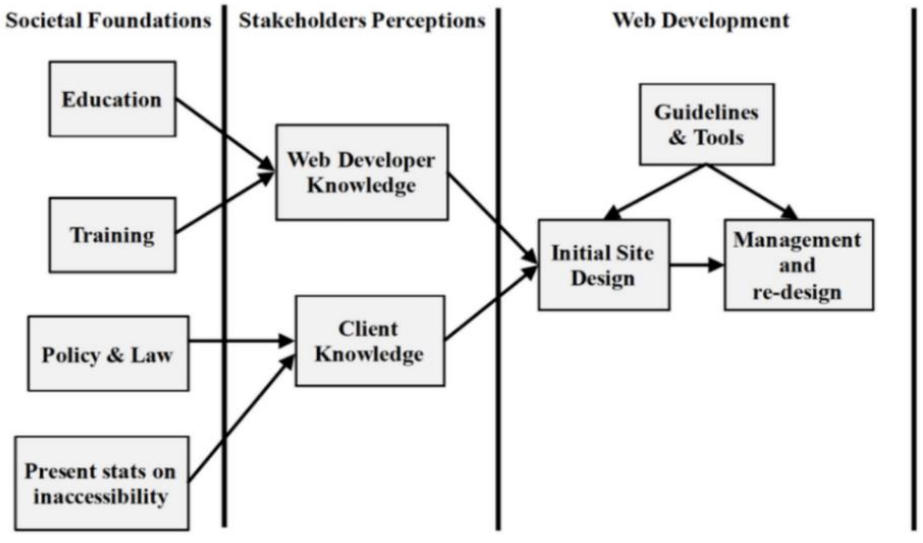

Figure 1. Web accessibility integration model developed by [13]

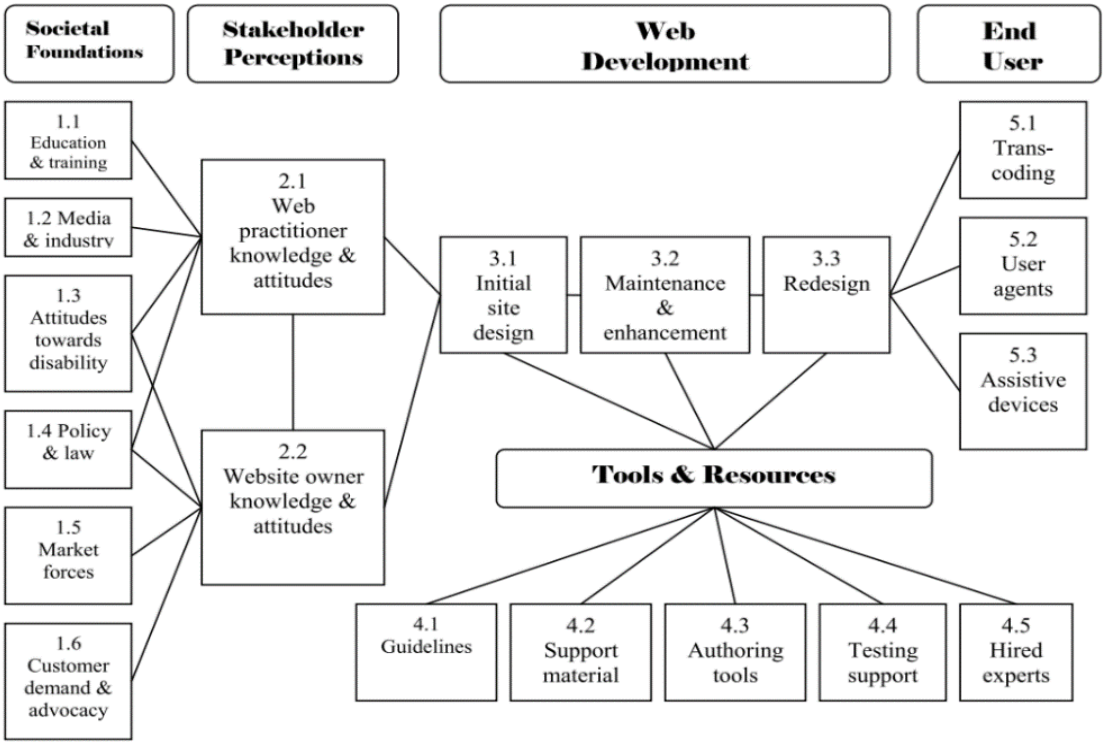

Figure 2. The Expanded web accessibility integration model by [18]

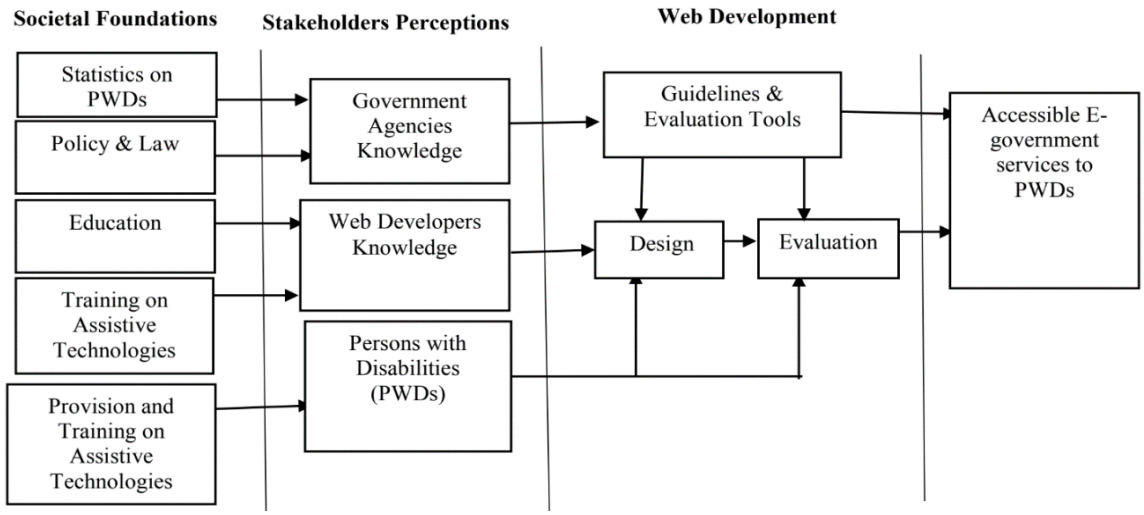

Figure 3. E-government accessibility development model by [19]

We did not include other models because they rely on different theories, such as the analytical framework [20], which describes the factors behind the adoption of WCAG 2.0 standards by local governments and based on innovation adoptions in public management. The theoretical framework that relies on the technology acceptance model and is limited to the educational and training aspects [21], and the proposed model for adopting and implementing web accessibility, based on the diffusion of innovations model and examined the factors related to the adoption process of accessibility standards for websites within municipalities [22]. A qualitative approach has been adopted to contextualize and adapt the integration model to the Moroccan government context by drawing on the analysis of the three previously presented integration models: the web accessibility integration model, the expanded web accessibility integration model, and the e-government accessibility development model.

2.2. Interview design

As a second step, we elaborated on the interview guide based on the in-depth exploration of the existing literature, as well as the different integration models and their factors and components. The average time to complete each interview was about 50 minutes. The interview was divided into eight sections. Each question aligns seamlessly with the overarching goal and objectives of this exploratory study: Section 1 concerns general information about the interviewee's age, level of education, and professional expertise related to the digitalization process of e-services. Section 2 is about digitalization and evaluation. The aim is to understand the practices, methods, and tools used in e-services digitalization. Section 3 sheds light on the positioning of web accessibility within the web development and evaluation processes and whether practitioners include it or overlook it. Section 4 covers questions about web developers' and IT managers' knowledge of PWDs and assistive technologies. Section 5 focuses on practitioners' knowledge of web accessibility standards, guidelines, and technical requirements. Section 6 concerns practitioners' knowledge about policies and laws regarding the rights of PWDs. This section also aims to comprehend the state of the art regarding national web accessibility guidelines. Section 7 explores the barriers or factors to integrating web accessibility in the public sector. Section 8 gives an in-depth understanding of web developers' and IT managers' perceptions towards web accessibility.

2.3. Participants selection

As a third step, it was decided to interview people involved in the digital process of public e-services in Morocco, specifically web developers and IT managers in the public sector. The aim was to gain a holistic understanding. Web developers offer technical expertise, while managers provide strategic direction and organizational insights, enabling a comprehensive exploration of factors influencing accessibility integration. Interviews were conducted with key practitioners involved in public e-services digitalization, including four web developers and five IT managers.

2.4. Data collection

The fourth step concerns data collection; all our interviews were conducted as video interviews on Google Meet using our student account linked to the university. All interviews were arranged at a scheduled time, recorded after the participant's consent, and then transcribed. We conducted interviews until we reached a saturation point after nine interviews. Furthermore, saturation analysis in NVivo was used to measure the similarity between each source using the pearson correlation coefficient metric, and the similarity index was higher. Four principles were regarded in this study, as presented by the Swedish Research Council, which involve the participant's right to be informed about the research purpose and their role in the research, getting consent from participants before collecting data, the confidentiality of collected data, and respecting the scope of research and avoiding a misuse of data [23]. In our study, we added an introduction about the purpose of the study in the interview guide, and we outlined the aim of the study at the beginning of each interview; we also asked the participants about their agreement to record the interviews. Besides, all items that include personally identifiable information were anonymized to protect the participants' privacy. The IDs provide a means to distinguish between participants and maintain anonymity. Table 1 summarizes demographic information about the interviewees.

Table 1. Demographic information about the interviewees

Participant code	Department code	Position	Gender	Age	Experience (year)
M1	D1	Head of division	M	51	19
M2	D2	Head of service	F	33	8
M3	D3	Director	M	57	15
M4	D4	Head of service	M	40	10
M5	D5	Head of service	M	35	6
Dev1	E1	Web developer	M	30	6
Dev2	D6	Web developer	F	29	3
Dev3	D1	Web developer	M	43	12
Dev4	E2	Web developer	M	34	3

2.5. Data analysis

The last step aims to analyze the collected data based on content and thematic analysis using NVivo software. The thematics used in our coding stem from analyzing content based on the provisional coding method [24]. This coding stage serves as a foundation for further analysis, facilitating the organization and categorization of data while maintaining flexibility to adapt, revise, delete, or expand codes [25].

In our case, we initially started with a list of codes derived from an initial investigation based on a review of the literature and existing web accessibility integration models [13], [18], [19]. As we progressed through the literature, we discerned prominent themes. Each code was meticulously formulated to represent a particular aspect or dimension of the phenomenon under study.

3. RESULTS AND DISCUSSION

This study investigated the factors influencing the integration of web accessibility in Morocco. Earlier studies focused on evaluating web accessibility in Morocco but have not addressed its integration into public e-services. The lack of research on the challenges and opportunities in the public sector leaves a significant gap in understanding how to enhance the integration of web accessibility in Morocco. The interviews revealed several critical insights regarding the web development process, awareness about PWDs, assistive technologies, and knowledge of guidelines and laws.

3.1. State of the art

3.1.1. Web development and evaluation process

Before discussing web accessibility, it is paramount to understand and gain invaluable insights into the current landscape of digitalization in the public sector, knowing that Morocco started transforming their public service delivery by incorporating digitalization [26]. Interviewees highlighted initiatives to streamline public processes and improve access to services through digital platforms. They expressed a shared vision of transitioning from partial digitalization towards a fully digitalized public sector. Dev2/: "Yes, we have digitalized the e-services and are still working on a complete digitalization". M2/: "There are services with full digitalization, others with partial digitalization; for example, the citizen can submit his request and check the status of his request, but to receive the decision, a physical interaction is required". Hence, by prioritizing web accessibility, the government can guarantee equitable access to essential services and information for all citizens, regardless of their abilities. When asked about IT profiles and approaches adopted to digitize services, most interviewees confirmed that they adopt an agile approach, particularly in the case of outsourced projects, to respond more effectively to changing requirements and priorities. Dev2/: “We adopt an agile approach with a scrum development framework". M2/: "Since 2023, we have adopted an agile methodology for projects to the greatest extent possible. It is not easy to apply agile; it requires additional resources, the involvement of the business entity, and its availability. But I think adopting an agile methodology is very interesting and relevant for public services”.

However, participants expressed significant challenges regarding profiles and highlighted the importance of diversifying IT profiles to foster a more robust and agile workforce. Apart from a few organizations equipped with a digital factory composed of a cross-functional team, we are talking about the agency for digital development (ADD) and the Ministry of Interior; the other public organizations struggle to get diverse IT profiles, such as UX designers, and business analysts. Dev3/: "The team comprises full-stack profile development engineers and project managers. We do not have other profiles like UX designers or business analysts". M1/: "There was pressure to strengthen the team due to budgetary constraints. We have software engineering profiles but not specific profiles such as software testers, and business analysts". M3/: "For the profiles involved, we lack profiles such as UX designer, which is considered a luxury that we cannot afford in terms of our structure. However, we have highly competent developers who work on the front end, back end, and full stack". The need for more specific profiles can compel ministries and public departments to externalize services and engage service providers to meet their needs. All participants admitted adopting a hybrid approach, using internal resources and outsourcing services to external providers to build digital services. Dev1/: "We adopt a hybrid approach; it depends on the typology of the projects. Given the urgency, we opt for internal developers; otherwise, for complex projects, we outsource services to external providers, and as developers, we elaborate initial functional and technical requirements and participate in the procurement process".

As for technologies used in the public sector, there is a deliberate move away from mandating specific development technologies in tender processes, apart from specifying if it is about open source or proprietary solutions, to preserve competition, promote fairness, and ensure equal opportunity for service providers. Most interviewees confirmed using open-source technologies based on PHP, Java/J2EE, and .NET for server-side scripting and JavaScript frameworks such as React JS and Angular for client-side scripting. However, two interviewees mentioned a notable shift towards embracing low-code solutions for more intuitive visual interfaces and rapid deployment of digital services. Dev4/: “We use Java/J2ee Spring Boot for the backend, and for the front end, we use React js or Angular, which are open source, and recently, we plan to rely on low code technologies like Mendix”. M3/: “Our department is very open to technology. If I might say parenthetically, we don’t have a religion, to say that we are not restricted to a particular technology.

However, the most used technologies are J2EE and .Net, and low code platforms that ensure intuitive interfaces and rapid deployment".

3.1.2. Awareness of people with disabilities and assistive technologies

We found that interviewees demonstrated varying levels of awareness regarding the challenges faced by PWDs in accessing online services. Three participants confirmed that they have no idea how PWDs use web services, contrary to others who displayed moderate knowledge and mentioned tools such as screen readers, keyboard navigation tools, and colour contrast. Dev1/: “I think there are tools to make web pages easier to navigate, like screen readers, which help to read the text, and that generally helps people with visual impairments”. M2/: “Honestly, I have no idea”. Dev4/: "It depends on the disability. For blind people, I think some tools convert text into speech, and there are specific keyboards for navigation. Otherwise, I don't have extensive knowledge about that”. When talking about disability, most participants mentioned only visual impairments, and among interventions, one participant reported that only blind people can’t use web services; as for the other PWDs, they can access services without problems. Dev2/: “Apart from blind people, I think other PWDs can access e-services without problems”.

3.1.3. Knowledge of laws and guidelines

When developers and IT managers were asked about Moroccan framework law No. 97.13 on protecting and promoting the rights of PWDs, four participants confirmed that they didn't know the law. Others mentioned that they had heard about it but didn't have enough details, and only three participants stated that they knew about the framework law. The three participants are from a department and agency that advocates for PWDs and whose responsibilities include promoting the rights of PWDs. Dev3/: “I know the law, but I don’t have details; I know that it covers the rights of PWDs and the government commitments towards this category”. M4/: “No, I have no idea about this law”. When we asked participants if there are any national guides or best practices that govern the digitalization of government services in Morocco, they indicated a few initiatives and references published by the Moroccan general directorate of information systems security (DGSSI), the references concern much more security aspects of software development. They also mentioned a light reference to digital transformation published by ADD. Dev3/: “Yes, for security issues, there is the DGSS), which offers guides on software development standards and all aspects related to security”. M2/: “There is a best practices guide, especially on the security side, published on the DGSSI website, and a light document produced by the ADD regarding best practices for e-services development. Apart from that, at the national level, I think these are the two entities that have produced guides in this regard”. M3/: “Not to my knowledge unless it is integrated into the details of other laws, such as law 54-19 for public services, but I am unaware of standards or references for best practices related to digitalization of government services in Morocco”.

Similarly, we asked interviewees about national guidelines that frame the integration of the specific needs of PWDs when digitizing public services in Morocco. Only one participant disclosed that his department intends to elaborate a national guideline for web accessibility and highlighted the importance of making a law that outlines the legal framework for implementing web accessibility to ensure adherence. DEV3/: “The ministry intends to elaborate a national web accessibility guideline. I believe this guide will play an important role, but it must also be supported by legislation that mandates its implementation in e-services. Without an obligation, people are unlikely to comply”. Another intervention pointed out that there are guides for physical accessibility but not web accessibility. M1/: “I don’t know, but to my knowledge, there are primarily architectural guides for physical accessibility but not for web accessibility”. One participant attributed the lack of awareness about guidelines to the fact that they had never worked on these aspects of accessibility before. DEV1/: “I have never worked with these guides because we have never integrated these aspects of web accessibility so far”.

3.1.4. The positioning of web accessibility within the web development and evaluation process

A set of questions was addressed to the interviewed developers and IT managers to better understand the positioning of web accessibility within the web development and evaluation process. Seven key sub-themes emerged related to this theme: (i) consideration of web accessibility in digital projects, (ii) web accessibility standard integration, (iii) incorporating PWDs as end users, (iv) awareness about evaluation tools, (v) web accessibility evaluation, (vi) claims management, and (vii) continuous improvement for e-services. When the question was asked about considering web accessibility in digital projects, most participants stated that they do not consider web accessibility in their projects and listed different reasons:

- There is no obligation; the requirements proposed in the portal charter concern websites and not e-services M5/: “Truth is, there hasn’t been a need to integrate web accessibility into e-services; for the website, it was a requirement mentioned in the portal charter”.

- Responsive web design provides a certain level of accessibility for e-services. M3/: “Our e-services are based on responsive design, which provides a certain level of accessibility.”
- Lack of a clear vision about PWDs' needs and what to implement regarding accessibility. DEV3/: “There needs to be a clear vision regarding the specific needs of persons with disabilities to implement it”.
- The product owner and business entities have not expressed web accessibility needs. DEV2/: “These needs could have been taken into account if we had received requests from the business entities or product owners regarding the consideration of the needs of persons with disabilities”.
- The incapability of providers to implement web accessibility needs. M2/: “For web accessibility, we tried to ask a provider to adapt one public platform to the needs of visually impaired individuals who have vision difficulties, but so far, we have not received a favourable response to address those needs, as apparently, they are not aware of the techniques and technologies that enable making the platform accessible.”

Six out of nine participants attested to not implementing web accessibility standards integration. Some participants indicated that it was the first time they had heard about those standards, and others mentioned that it's not a priority given the urgency in which they are working. M3/: "No, for the moment, we don't use them because, given the urgency in which we are working, it's not the top priority. But in the future, they will certainly be addressed with experts". M2/: "This is my first time getting acquainted with web accessibility". DEV2/: "I don't think the web accessibility aspects for PWDs are integrated". Participants who are aware of web accessibility mentioned implementing basic recommendations proposed in the portal charter, such as zooming and resizing text, and other basic requirements, such as changing colour contrast and using a screen reader, despite their high cost. M1/: "For now, we rely on the Prime Minister's circular (dates back to 2013), which serves as the institutional charter for portals. We are attempting to integrate some basic functionalities, such as the screen reader for text content, as well as features for text zoom and resize and colour contrast. We are mindful of web accessibility within the ministry, particularly considering that PWDs are among the direct beneficiaries of the Ministry's services". DEV3/: "We implement them indirectly based on a few basic recommendations, such as colour contrast and font sizes for visually impaired individuals, but not all standards, to be honest".

All the interviewees stated that they did not incorporate PWDs as end users in the development process. The use of agile methods and inclusive approaches does not extend beyond the integration of business entities and does not include citizens, including PWDs. DEV2/: "We work in an agile way, following the scrum development framework. We have sprints to adhere to, and at the end of each sprint, we organize ceremonies with the product owners to present the work and gather feedback and corrections to implement. This process is iterative. However, we do not involve end-users, including PWDs". M1/: "At the moment, there is no involvement of end users, but considering the current approach focusing on new development methods, especially citizen-centric ones, it would be ideal to integrate a sample of beneficiaries during the development process". M3/: "When conducting internal developments or working with service providers, we involve mixed business and development teams. During the testing phase, we verify the customer experience. However, and to be honest, catering to PWDs is not the top priority, given the time constraints. We aim to reach the majority of users as quickly as possible". M4/: "Our department operates on cross-cutting projects, and we do not have this category of users accessing our platforms".

An interesting intervention from DEV1 revealed that the department received complaints from colleagues with disabilities, especially those with visual impairments, about the lack of consideration for their specific needs regarding web accessibility. It is essential to mention that since 2018, the Moroccan government has organized a national unified competition entirely dedicated to PWDs every year, getting access to the public sector. DEV1/: "We didn't involve PWDs, but we received complaints from colleagues with disabilities, especially those with visual impairments, regarding the lack of consideration for their specific needs". Only three interviewees claim to be aware of the evaluation tools due to their departments' commitment to people with disabilities. However, they have never utilized them and lack knowledge of their functionalities. DEV3/: "I know that there are tools to assess the accessibility of e-services, but I have no idea personally; I've never used them". DEV4/: "I know there are tools, but I have no idea about them". M1/:" We are aware of the existence of the tools; as I mentioned before, the beneficiaries of the ministry are people with disabilities". The other participants had never heard about those tools and had no idea about them, but they showed interest in their usage. M2/: "Actually, no. But that's an interesting concept, honestly". DEV1/: "Honestly, I am not sure if there are tools that do that, but if they exist, we can take advantage of them and assess the maturity level of our services regarding web accessibility". All respondents unequivocally confirmed that they had never undertaken a web accessibility evaluation for their e-services. M1 explained that evaluating the e-services requires the availability of a national guideline for web accessibility. M1/: "There is not yet a national web accessibility guideline that requires compliance by all public departments". M2 pointed out that his department received reports about the portal's inaccessibility and is waiting for the

suggestion of their external provider. M2/: "No such evaluation was made before, but we have received reports that the portal is inaccessible. Hence, we asked our external provider about possible adaptation and are still awaiting his proposition". As for M3, he confirmed that they evaluate their services in accordance with the department quality management system, including user satisfaction, but this does not concern web accessibility.

3.2. Factors influencing the integration of web accessibility

Web developers and IT managers highlighted 17 key factors influencing the integration of web accessibility in public services. Table 2 below shows the distribution of sources and references across different nodes or factors, sorted by the number of sources. Among the 17 factors discussed and raised by interviewees, six factors stood out. They garnered the most attention from interviewees: awareness and training (8 sources), followed by law and procurement and hired experts (7 sources), customer demand and advocacy and guidelines (6 sources), followed by budget and leadership (5 sources), policy, tools, and public and private civil society collaboration (4 sources), knowledge (3 sources), web development, stats on PWD, and inclusive approach (2 sources) and time and education (1 source). Figure 4 below provides a graphical representation of the factors influencing the integration of web accessibility, with the x-axis delineating these factors and the y-axis depicting the frequency with which they were mentioned across the collected sources. Moreover, the varying heights of the bars on the y-axis indicate the degree of attention accorded to each factor, serving as a quantitative indicator of its significance for the interviewees.

Table 2. The distribution of sources and references across all factors

Factors	Sources	References
Awareness	8	15
Training	8	21
Law	7	15
Procurement and hired experts	7	9
Guidelines	6	14
Customer demand and advocacy	6	12
Budget	5	5
Leadership	5	6
Policy	4	5
Public-private-civil society collaboration	4	7
Tools	4	14
Knowledge	3	4
Inclusive Approach	2	3
Stats on PWD	2	4
Web development	2	3
Education	1	1
Time	1	2

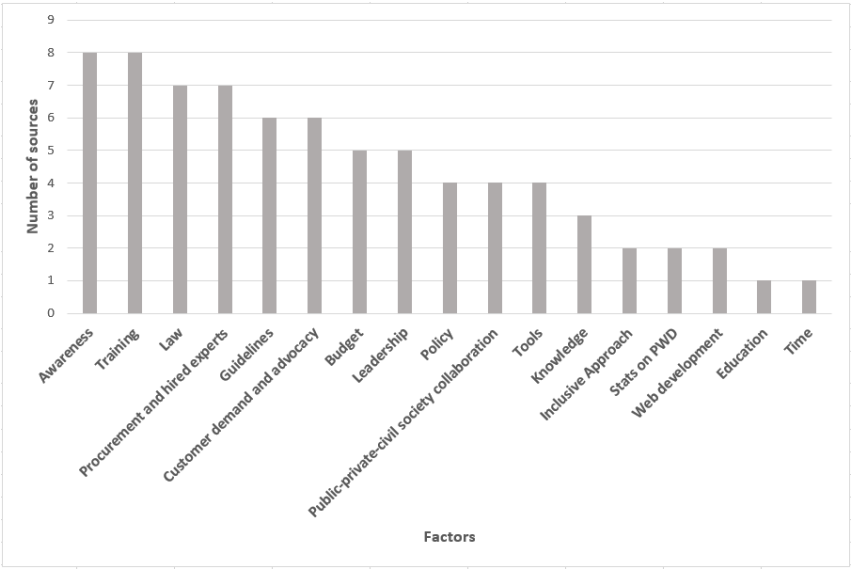

Figure 4. Graphical representation of the factors influencing the integration of web accessibility

Awareness and training were the most mentioned factors, a view shared by both web developers and IT managers, indicating a significant recognition of the importance of raising awareness about web accessibility issues among developers and IT managers and the perceived importance of providing training and resources to empower developers in implementing accessibility measures effectively. DEV2/: "For me, the prerequisites for integrating web accessibility into public e-services are training on web accessibility, being informed and sensitized about this aspect". DEV4/: "Among barriers that could prevent the integration of web accessibility is the lack of awareness among decision-makers". M2/: "Sensitize and raise awareness about this important concept, starting with letting people know this need exists. Awareness is precious".

To explore the data from different dimensions and identify potential relationships, we used Matrix coding queries in Nvivo. Figure 5 displays queries based on intersections between participants' responsibility attributes and factors influencing the integration of web accessibility. Through this visual representation, we can see that certain factors are emphasized by IT managers but downplayed by developers and vice versa. For example, managers prioritize budgetary allocation, time constraints, guidelines, policies, law considerations, and collaborative enforcement, especially with private and civil society, as main factors that interfere with their responsibilities and reflect their strategic oversight. While web developers focus on aspects related to the target population characteristics, as reflected here by PWD statistics, they are also interested in the web development process as the expression of needs from the initial stages of development. The implication and commitment of leaders: web developers perceived themselves as executors and operational, while managers were acknowledged to hold pivotal roles in decision-making processes.

One interviewed web developer highlighted the importance of integrating web accessibility into the Moroccan national curriculum. Both managers and developers have emphasized five key factors: awareness, training, tools compatibility, customer demand and advocacy, and inclusive approach. This convergence suggests a shared recognition of the significance of these factors in fostering accessibility within the public sector.

Awareness is a crucial component for managers and developers alike. Both parties agreed that it’s critical to comprehend accessibility-related laws, guidelines, and best practices. While developers recognize the need to be aware of accessibility standards to properly apply them in their projects, managers acknowledge the importance of fostering organizational awareness to ensure the consideration of accessibility in decision-making processes. Training emerges as another vital factor emphasized by both managers and developers. Managers and developers recognize that equipping teams with the necessary skills and knowledge about accessibility standards, including assistive technologies, is essential for a successful integration. As for tool compatibility, managers and developers alike understand the importance of utilizing tools and technologies that support accessibility features and standards, such as coding frameworks and libraries that could facilitate the integration of web accessibility. However, they expressed their worries about compatibility with existing tools and the potential technical difficulties that could emerge. Lastly, customer demand appears to be a significant driving force for managers and developers. However, opinions differ, and developers argue that the onus falls on product owners to express and require the integration of web accessibility aspects as part of product requirements. Developers pointed out that web accessibility needs might be integrated if the product owners and business entities formulated them or if the requirements stemmed from decision-makers. As for managers, PWDs should militate for their rights because they are best positioned to articulate their specific accessibility requirements and advocate for their rights.

3.3. Participants’ perception of web accessibility

3.3.1. Definition of web accessibility

When we asked participants to define web accessibility, a multifaceted understanding shaped by diverse perspectives emerged. For some participants, it embodies a fundamental right, ensuring equitable access to information and services. M1/: "It is a right of access to information that prioritizes people with disabilities so that they can similarly access information to other citizens". Others frame it within the context of no discrimination, emphasizing the need to dismantle barriers that hinder participation and inclusion online. M2/: “I define it as a necessity to avoid discriminating against this category of citizens”. M3/: "For me, accessibility, in two words, is to leave no one behind and be inclusive to all population categories". M4/: "I think web accessibility means giving users with disabilities the same opportunity to access information as other users. Without restrictions”. According to some participants, accessibility is seen as a universal imperative, catering not only to the needs of individuals with disabilities but also to older people and all populations who may face challenges navigating digital content and services. DEV1:/ "Web accessibility is a way of designing and developing web services so that they are intended for anyone facing difficulties, such as PWDs and elderly people". M1:/ "It is the set of tools, recommendations, and requirements to be implemented to make the content of a website or service understandable, accessible, and

easy to use for people with disabilities and other users." DEV2/: "Web accessibility makes the web easy to manipulate for everyone at any time."

3.3.2. Participants' self-esteem of web accessibility knowledge

We asked participants about their level of knowledge of web accessibility; most of the participants classified themselves as novice (4 participants) and nonexperimental (4 participants), and only one participant stated having an intermediate level of knowledge about web accessibility, as shown in Table 3.

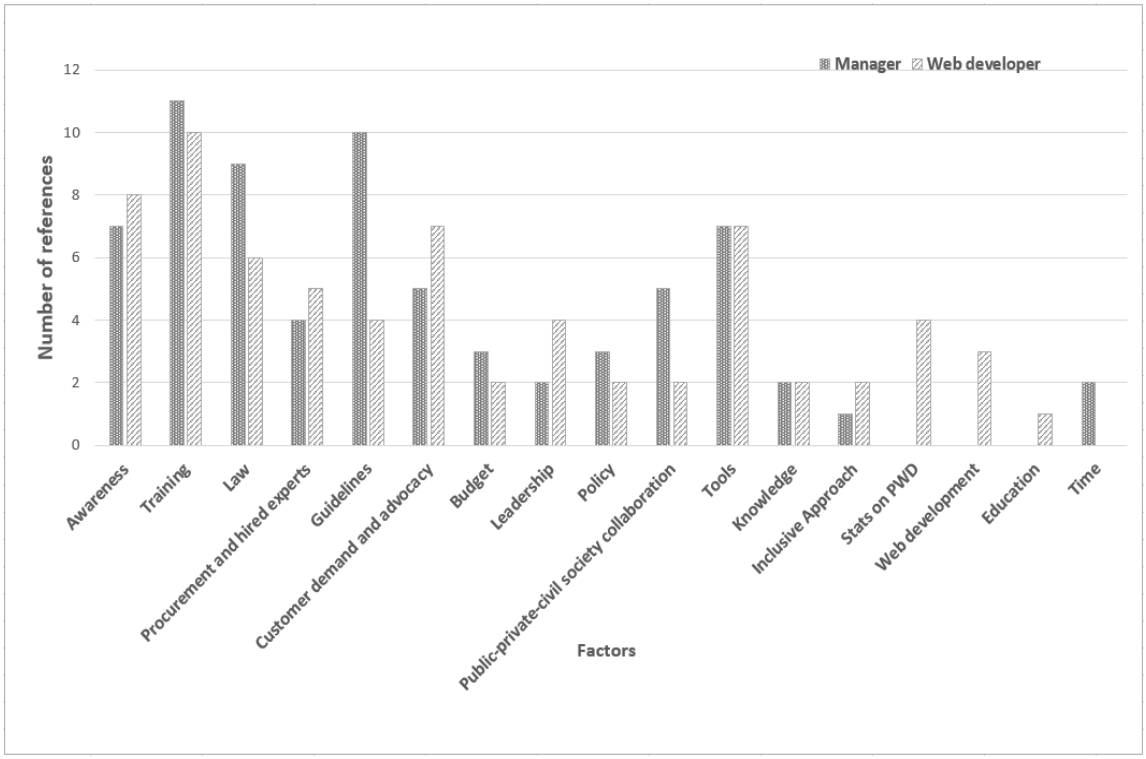

Figure 5. Graphical representation of participant's responsibility attribute and factors influencing the integration of web accessibility

Table 3. Participants' level of knowledge regarding web accessibility

Participant	Estimated level of knowledge
DEV1	Novice
DEV2	Nonexperimental
DEV3	Novice
DEV4	Nonexperimental
M1	Novice
M2	Nonexperimental
M3	Nonexperimental
M4	Novice
M5	Intermediate

The insights gleaned from this qualitative study contributed to constructing an initial understanding in response to our research questions. Q1: s accessibility considered within the e-services digitalization process in Morocco? Most participants reported that they do not consider web accessibility in their projects for different reasons, including the absence of legal obligation, lack of a clear vision about PWDs' needs, no requirements expressed by product owners and business entities, and providers' incapability to implement web accessibility needs. Q2: what factors could influence the integration of web accessibility in the public sector in Morocco? Web developers and managers highlighted seventeen key factors influencing the integration of web accessibility in public services; the recurring factors in the interviews were the lack of awareness and training and the absence of legal obligations to comply with. Interviewees highlighted the challenges to integrating web accessibility requirements within the procurement process due to the lack of a

national guideline about web accessibility and expertise in the subject. Furthermore, using agile methods and inclusive approaches does not extend beyond the integration of business entities and does not include citizens, including PWDs. Q3: what are web developers' and IT managers' perceptions of web accessibility? Interviewees held a generally positive attitude toward web accessibility. Some participants considered it a fundamental right to ensure equitable access to information and services. For others, it is seen as a universal imperative, catering not only to the needs of individuals with disabilities but also to older people and all populations who may face challenges navigating digital content and services.

Previous studies have explored similar results; a study of factors hindering web accessibility [27] presented lack of awareness and limited training as critical factors hindering web accessibility, which aligns with our finding in the Moroccan context, where lack of awareness and training were also cited as significant barriers. Also, during the interviews, several participants mentioned the critical role of external providers and accessibility experts in ensuring the integration of web accessibility standards throughout the web development process; this finding aligns with the conclusions of a recent scoping review [28] about the pivotal role that play experts in offering training and necessary feedback. However, a previous study [29] noted the challenges in recruiting such experts; this is relevant in our research, where interviewees pointed out that the reliance on external providers and experts was often constrained by limited availability or lack of competence. Similarly, [30] focused on perceptions towards web accessibility among developers; the study found that legal enforcement and business commitment were equally mentioned by participants, which is in line with our research; legal obligations also emerged as significant challenges, revealing that web accessibility is deprioritized compared to other IT concerns. In their systematic review of factors affecting the accessibility of IT artifacts, [31] pointed to the importance of involving PWDs, and [32] highlighted the valuable contribution of caregivers who are familiar with the specific needs of PWDs. This factor was emphasized in our study, and results showed that IT practitioners did not incorporate PWDs as end users in the development process; the applied agile practices give primary consideration to ensure rapid delivery and do not necessarily guarantee the integration of accessibility needs. Notably, this point was highlighted in a recent study [33], which noted that accessibility is often sidelined during agile sprints and treated as an afterthought. Awoyelu [34] identified prioritization of web accessibility as one of the key factors that rely on the type of organization and its goals; our research highlights this point through leadership, a robust managerial backing found to be essential in prioritizing web accessibility and ensuring that adequate resources, training, and policy enforcement are provided.

This study is based on a qualitative interview, which provides in-depth insights but also presents certain limitations. The findings concern the public sector in Morocco and do not capture the experiences within the private sector. Further studies may be needed to confirm and generalize results. Future research should aim to include a broader range of departments and agencies. It would also be beneficial to conduct a quantitative study to gain a holistic understanding of factors influencing the integration of web accessibility and its relationships. Our findings highlighted the lack of practical integration of web accessibility in the public sector due to different factors pointed out by web developers and IT managers; addressing these gaps could significantly enhance the accessibility of web services in Morocco.

4. CONCLUSION

This research explored the perspectives of web developers and IT managers to unravel the underlying factors influencing the integration of web accessibility in Moroccan e-government services. Based on semi-structured interviews and thematic analysis, the study identified 8 out of 17 pivotal factors cited by more than half of the participants: awareness, training, legislation, procurement and hired experts, guidelines, customer demand and advocacy, budget, and leadership. Furthermore, interviewees showed a positive attitude towards web accessibility, even if most reported moderate knowledge about web accessibility standards and guidelines. These findings align with previous research highlighting the importance of awareness, training, and other key factors in fostering web accessibility. However, this study also sheds new light on the significance of procurement practices and external demand (e.g., customer advocacy) in shaping web accessibility while capitalizing on and using agile's approach and best practices to ensure that end products align with end users' needs and expectations. By revealing these gaps and offering practical insights, the study gives valuable insights for policymakers and moves the field forward, providing a foundation for future strategies to enhance web accessibility in the Moroccan public sector.

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