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Web Accessibility and Search Engine Optimization: Best Approach for Building Corporate Websites

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Abstract - The rapid digitization of products and services necessitates the development of safeguards to enforce equitable access to internet resources. Although legislative measures have been implemented to compel public-sector organizations to provide accessible web and mobile applications, most websites are still not fully accessible. There is an urgent need for organizations to integrate accessibility into current and future developments. The integration of solutions derived from decades of accessibility research into organizational processes and initiatives is beneficial to all users. This study provides a guide for businesses and organizations to improve their web accessibility and Search Engine Optimization (SEO). This research covers the fundamentals of SEO and web accessibility, along with user requirements, and legal obligations. It also includes recommendations on significant concerns and compares the results of two test approaches for evaluating accessibility. The main section outlines user-focused accessibility criteria based on technical standards and relevant user requirements. The systematic literature review method, designed as a repeatable method to reduce bias, was used to evaluate and analyse data extracted from published studies. The research methodology also combines qualitative and quantitative research approaches along with Design Science Research Methodology (DSRM) to develop a practical solution by answering the research questions. This thorough literature review identified definitions, rules, and user requirements that were validated through 65 carefully selected studies. The consolidated results have expanded the framework for web accessibility and SEO and are included in the recommended guide. This study has numerous theoretical and practical implications, as it aims to develop a comprehensive blueprint to guide businesses and practitioners on best practices for integrating web accessibility and SEO into building inclusive corporate websites. By extension, it investigates the intersection between SEO and web accessibility in building a better online experience for people with impairments as well as other web users.

Keywords— Web Accessibility, Accessibility, Search Engine Optimization, Systematic Literature Review, Web Accessibility Evaluation, Lighthouse

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1. INTRODUCTION

The Internet has transitioned from a simple research network to the largest repository of information, and the primary means of communication [1]. According to the World Bank 2021 Internet statistics report, an estimated 63% of the world's population has Internet access, with an average yearly increase of about 4% [2]. More businesses and organizations recognize the importance of building a digital presence [3]. Tim Berners-Lee, W3C Director and inventor of the World Wide Web famously said "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect" [4].

The Web Accessibility Initiative (WAI) was founded by the World Wide Web Consortium (W3C) to create and promote guidelines for web accessibility [5]. To achieve this, the WAI have published an internationally recognized set of guidelines and principles to improve web content accessibility. The WCAG publication undergoes intermittent revisions by the WAI, and each iteration significantly improves on its predecessor, which builds on requirements inherited from prior versions. The primary objective of the WCAG is to eliminate barriers that prevent people with disabilities from fully engaging with digital content.

On the other hand, Search Engine Optimization (SEO) encompasses various techniques for improving the organic traffic a website or web page generates directly from search engines [6]. It involves modifying the website or webpage content to improve search engine discoverability [7]. Effectively implementing SEO improves the chances of a webpage appearing at the top of a Search Engine Results Page (SERP) [8]. Higher search rankings increase the potential for discovery by new customers.

Although research on web accessibility is not new, most websites are yet to be fully accessible [9]. Governments impose mounting regulatory pressure on public agencies and corporations to comply with accessibility standards to achieve digital inclusion. W3C has developed technical resources, such as Web Content Accessibility Guidelines 2.0 (WCAG 2.0), to establish a uniform way to achieve accessibility [10]. Web accessibility is increasingly recognized by governments globally as a serious, world-wide societal concern, and as such legislation has been passed to mandate web accessibility. Despite the joint efforts of various governments and the W3C, little progress has been made in eradicating accessibility barriers present in a large percentage of websites. An evaluation of a million website homepages drawn from the Majestic Millions list revealed that 98.1% of the websites had WCAG 2.0 deficiencies [9]. This result supports [9] claim that most websites are not prioritized for accessibility. This clearly indicates that despite the existence of web accessibility standards, there is a lack of clear implementation strategies for organizations to follow when integrating web accessibility into existing applications or new developments. According to [11], perceived complexity of accessibility standards and lack of clear guidelines or toolkits to facilitate implementation are the primary reasons for the sub-par adoption of web accessibility by organizations. Similarly, limited availability of structured manuals and accessibility training resources, and lack of both tangible and intangible resources are cited by [5] as corresponding issues. There is a lack of actionable steps to implement these guidelines and inadequate employee expertise regarding these concepts.

A recent survey of website statistics conducted by Netcraft revealed that as of 2024, there are over 1 billion registered domain names, with 192 million active websites [12]. Therefore, it can be argued that before a website is deemed accessible, it must first be visible. Owing to the vast amount of information available worldwide, search engines have evolved to simplify the process of information discovery and retrieval [13]. Website owners are no longer content with just search rankings appearances, as they realize that most users visit only the top-ranked webpages [14]. This results in a highly competitive process, as businesses and other entities strive to distinguish themselves from competitors by improving their SERP ranking. A previous study by [15] revealed a strong correlation between website quality and business success. Customers dissatisfied with the user experience of a website are more inclined to terminate their session, notwithstanding that the website provides high-quality information [16]. Improvements in web accessibility translate directly to better usability and user experience [17]. Previous studies reveal government agencies and academic institutions, legally obligated to comply with accessibility standards, display higher levels of compliance than corporate websites [18]. [19] suggest that a large percentage of private sector organizations remain noncompliant with contemporary accessibility requirements. Corporate Social Responsibility (CSR) has proven an ineffective driver for accessibility implementation; however, business impact is sufficient motivation [19]. For web accessibility to be successfully implemented in an organization, direct leadership and support from senior management is required to develop policies, procedures, and practices [20]. According to [5], improper technical understanding of how to implement accessibility standards ranked high as why many corporate websites are still inaccessible. [21] conducted a study to investigate the overlap between accessibility and SEO, and the results indicated a strong relationship between web accessibility

requirements and SEO on-page parameters. This demonstrates that overlaps exist between web accessibility and SEO as both share comparable web design structures [8]. This intersection allows practitioners to develop strategies to simultaneously address accessibility and SEO concerns.

From our extended study in the area of Web Accessibility and SEO, as presented in section 3 of this paper, it appeared that overlaps between these two areas have attracted little attention in the literature. Most of the existing works focus either on the improvement of Web Accessibility or SEO in isolation. This may result in misconception that web accessibility and SEO are disparate issues rather than overlapping aspects of web development. However, using intelligible and readable language, providing alternative text for non-textual content, and providing transcripts for various multimedia formats are strategies that cut across web accessibility and SEO. This study contributes to the discussion by examining the overlap between accessibility and SEO, and its effects on web performance. Following the identification of overlaps between accessibility and SEO, this research develops a comprehensive blueprint to guide businesses, and practitioners on best practices for integrating web accessibility and SEO into building inclusive corporate websites. More specifically, in this research work we identify effective ways to create websites that offer improved user experience for people with disabilities as well as other web users and improves search engine ranking of the websites. Understanding the interaction between these important aspects of web development can provide a perspective for businesses that seek to provide a better and more inclusive experience for their audience, as well as grow their digital presence. We have also presented the design, implementation and evaluation of a proof-of-concept web application to demonstrate the applicability of the guidelines that we have developed.

The rest of the paper is structured as follows, in Section 2 we provide an overview of the methodology applied for our research, in Section 3 we summarise our findings by analysing the recent developments in the area of web accessibility, in Section 4 we discuss the development of a guideline to help organizations and practitioners create inclusive corporate websites that are also search engine optimized, in Section 5 we present the design, implementation and evaluation of a proof-of-concept web application to demonstrate the applicability of the developed guidelines, and finally in Section 6 we provide concluding remarks and recommendations for future direction of our research.

2. METHODOLOGY

In our study we utilize Design Science Research Methodology (DSRM) to develop a practical solution by answering a set of research questions. This framework formulated by [22] is tailored towards research in the information systems domain and provides a systematic method for conducting research involving the design and development of IT artifacts. The set of research questions in our study are designed to draw attention to the real-world problems faced by organizations attempting to implement or improve the accessibility and search ranking of their corporate websites. These questions are listed below,

- RQ1: What are the definitions of web accessibility and SEO and their relationship?
- RQ2: What processes, techniques, methods, or approaches can be used to evaluate web accessibility and SEO performance?
- RQ3: What hindrances prevent developers from integrating accessibility and SEO into the development process?
- RQ4: In what ways can development be revised to ensure accessibility and SEO are a priority during any future website rebuilds?

To investigate the field of web accessibility and SEO, and answer the defined research questions, a Systematic Literature Review (SLR) has been adopted as the applied research technique for this study. This approach has three (3) distinct phases: a) Planning, b) Execution, and 3) Reporting as shown in Figure 1. In sub-sections 2.1 and 2.2 we briefly explain planning and execution phase respectively. The reporting phase is described in Section 3, which presents the findings from the SLR.

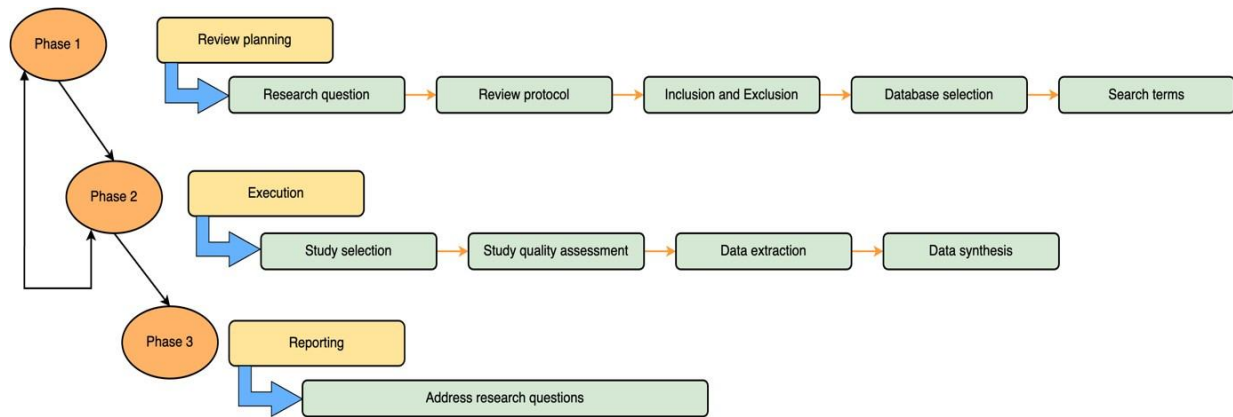


Figure 1. Flowchart of Proposed Systematic Literature Review (SLR)

2.1 Planning Phase of SLR

This phase is comprised of different activities that establish the structure of the review. It includes selection of academic databases, definition of inclusion and exclusion criteria for selection of relevant studies, and definition of search terms.

2.1.1 Selection of Academic Database

Selecting appropriate academic databases is crucial for identifying high-quality, relevant, and updated scientific publications. The opinions of other researchers, the platform's popularity, and Internet ranking were considered in the selection. Databases with advanced search functionality have taken precedence over other available options, as they provide a more refined mechanism for extracting relevant literature. Selected scientific repositories are listed in Table 1.

Table 1. List of Selected Scientific Databases

Scientific Database	URL
IEEE Xplore	https://ieeexplore.ieee.org/Xplore/home.jsp
Elsevier	https://www.sciencedirect.com/browse/journals-and-books
Scopus	https://www.scopus.com/home.uri
ACM Digital Library	https://dl.acm.org
Google Scholar	https://scholar.google.com

2.1.2 Selection of Search Terms

To develop a comprehensive search string, the research questions were segmented into key concepts and ideas. The main keywords and concepts were identified and selected. The keywords were refined by conducting a preliminary search in all the previously mentioned scientific databases to understand the existing literature. Finally, the keywords were organized into logical groups based on related concepts as shown in Table 2 below. The selected set of keywords were combined into sophisticated search strings using Boolean operations ("AND", "OR") in order to perform searches in the repositories mentioned in Section 2.1.1.

2.1.3 Inclusion and Exclusion Criteria

A set of criteria have been defined to help filter available publications based on their eligibility. This ensures only studies relevant to the research topic, aim and objectives, or research questions are included in the study. A paper

must conform to the complete list of inclusion criteria and none of the exclusion criteria to be included in the review. The inclusion criteria are:

- The paper must be a scientific journal, magazine, technical report, conference paper, or book chapters.
- The paper must be written fully in English.
- The paper must be published in 2014 or later.
- Studies conducted in related fields such as computer science, engineering, design, and management can be considered.

Papers are excluded from selection if they meet any of the following exclusion criteria:

- Papers that do not focus on web accessibility, inclusive design, user experience and accessibility, SEO, accessibility guidelines or regulations, SEO and accessibility integration, or any related discipline covered by the project scope.
- Papers written in a language other than English.
- Duplicate studies appearing in multiple electronic databases will be considered once.

Table 2. Keyword Groupings

G1	G2	G3	G4	G5	G6
Website	Accessibility	Guideline	SEO	User experience	disability
Web application	Web Accessibility	Standard	Search Engine Ranking	Usability	impairment
Web portal	Digital Accessibility	Law	Organic Search Optimization		barrier
Web development	Inclusive Design	Checklist	Search Engine Marketing		hinderance
Web page		Framework	Digital Marketing		
Application		Requirement	SEO		

2.1.4 Quality Assessment

The importance of identifying high-quality and relevant literature cannot be overstated and as such, study quality analysis and data extraction techniques were employed to guide the interpretation of findings and assess the validity of conclusions. Therefore, an assessment guideline was followed during the complete text reading and analysis of selected primary studies. A set of questions, assigned to a numerical scale, were defined to serve as a checklist of criteria to be assessed for each study. Table 3 lists the evaluation metrics used for the selected studies. Each question is assigned a rating of 0, 0.5, or 1. A paper that completely answers an assessment question receives a grade of 1, partial or incomplete answers receive a grade of 0.5, while papers not pertinent to the assessment question receive a score of 0. This assessment enabled us to ascertain the quality of primary studies selected.

Table 3. Questionnaire for Quality Assessment of Selected Primary Studies

Questionnaire	Weights
Is accessibility comprehensively defined in the paper?	(+1) Yes/ (+0.5) Partially/ (0) No
Are web accessibility guidelines and regulations properly explained?	(+1) Yes/ (+0.5) Partially/ (0) No
Is SEO and its techniques described in detail within the study?	(+1) Yes/ (+0.5) Partially/ (0) No
Are web accessibility and SEO evaluation tools, methods, approaches or processes sufficiently discussed?	(+1) Yes/ (+0.5) Partially/ (0) No
Does the study present any notable findings?	(+1) Yes/ (+0.5) Partially/ (0) No

2.2. Execution Phase of SLR

In this section we detail the execution phase of the systematic literature review. It includes an initial liberal search across the academic repositories mentioned in Table 1, followed by a study selection process that employs the Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) technique. Figure 2 details the PRISMA flow diagram.

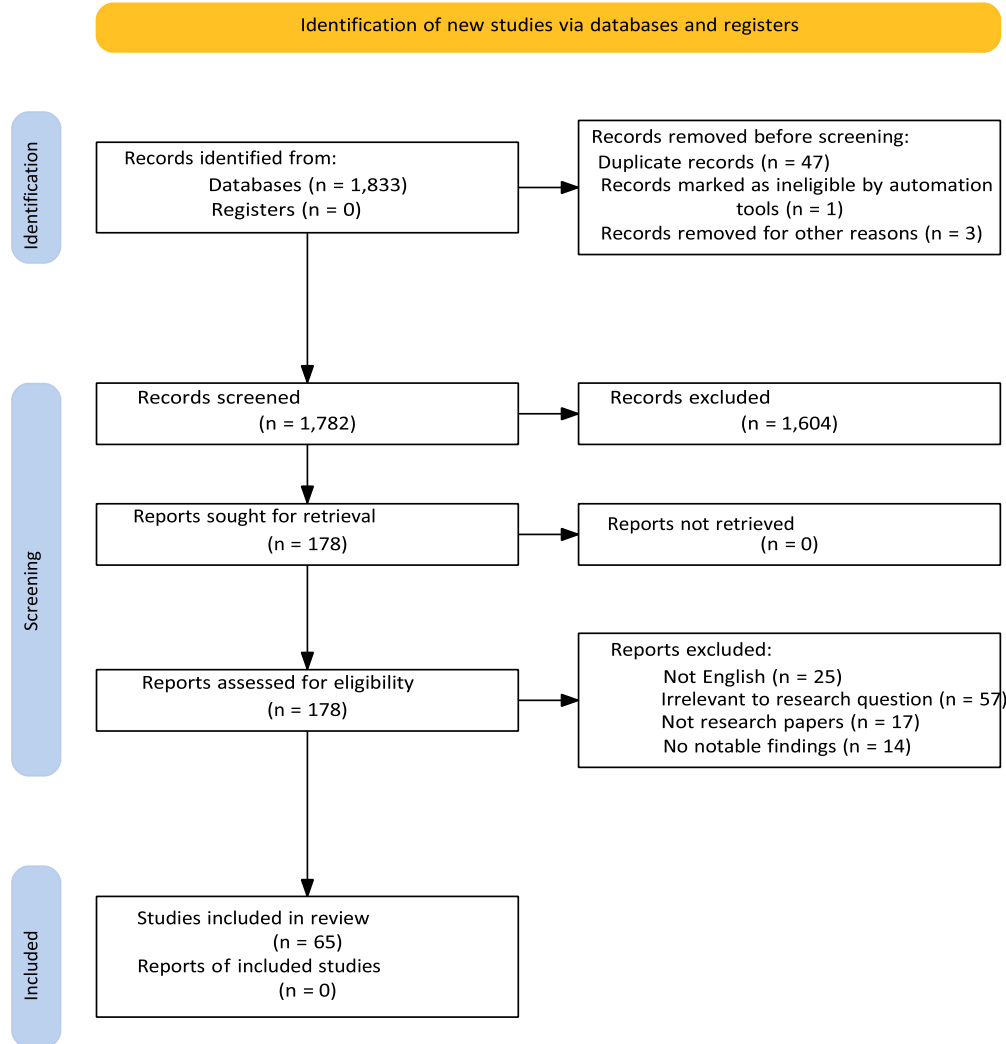


Figure 2: Study Selection PRISMA Flow Diagram

The preliminary search of five (5) academic databases returned 1,833 papers after filtering by keywords and applying the defined inclusion criteria. From the total studies retrieved: Google Scholar returned 736 papers, IEEE 74 papers, ACM Digital Library 482 papers, Elsevier 258 papers, and Scopus 283 papers. A final count of 65 publications is selected to address the specified research issues after applying the exclusion criteria (as described in Section 2.1.3) and assessing each result based on the abstract, title, and finally the full text. The selected papers are identified using labels P(1 - 65), shown in appendix A.

Quality verification is performed to ascertain and assure the Caliber of the selected papers and out-comes. The assessment questions formulated in section 2.1.3 are employed in the validation process. Question 5 was applied to all papers to indicate the quality of research findings. Only articles that provide answers to the corresponding research questions RQ1, RQ2, RQ3 and RQ4 are eligible to use questions 1, 2, 3, 4 and 5. The total results for each

paper are divided by the total number of questions answered in the assessment. There can be a maximum of five questions and a minimum of one. Appendix B contains the documented calculations.

The maximum score of 100% was attained by eight (8) of the reviewed papers, indicating that all applicable questions had a "yes" response (1 point). A further 72% of the research papers assessed received a score of 75% or above. Only 15% of the papers received a score between 50 and 70%. At least two (2) of the first four questions are answered in the affirmative for eight of these ten papers. This signifies that something noteworthy was added to the review by their inclusion. The low ratings can be attributed to the fact that papers primarily focused on SEO do not comprehensively define web accessibility or explain its guidelines. Nonetheless, the introduction offered and associated work in the publications can also provide solutions, particularly for RQ1 and RQ2. As a result, the quality assessment of the articles was adequate, this review would not have included any papers having an overall quality rating of less than 50% otherwise. An overview of the assessment result is shown in Table 4. The final scores, expressed as a percentage of the maximum score of 100%, are shown in the first row. The number of papers that attained the respective score is displayed in the second row. The third row shows the percentage distribution. Since 85% of the papers receive a quality score of 75% or higher, the articles' overall quality can be assessed favourably. The average quality of assessed papers is 83% (median).

Table 4. Quality Assessment of Selected Publications

Score [%]	50	67	70	75	80	83	88	90	100
No. of Papers	2	5	3	17	4	9	14	3	8
Distribution [%]	3	8	5	26	6	13	22	5	12

3. RELATED WORK (REPORTING PHASE OF SLR)

In this section we present the findings of the systematic literature review. We have organized this section by classifying the reviewed articles that provided the answers to the posited research questions presented in section 2.

3.1 Web Accessibility and SEO - RQ1: What are the definitions of web accessibility, SEO, and their relationship?

The data extracted from 65 carefully selected studies form the basis for answering this question. The gathered data primarily focuses on providing definitions for the terms SEO and web accessibility as well as characterizing their relationship. Furthermore, consideration is given to the credibility of the data sources, which may be derived from related research or from the primary investigations of other authors. Of the total studies, 60 papers cite definitions found in other research and sources. However, additional definitions are provided in two papers as a result of the authors' own studies (P29, P34). Majority of the reviewed papers (51) provided definitions for web accessibility; however, significantly fewer papers defined SEO (23). As a result, 42 papers do not define SEO and 14 papers do not define accessibility, but they do use both terms as keywords or in the titles or abstracts of their papers. Surprisingly, only twelve papers acknowledge or address the relationship between SEO and accessibility in some capacity, whereas 46 papers do not address this subject area.

As shown in Table 5, the definitions of accessibility are categorized into four groups based on their shared and unique characteristics.

- A1 with emphasis on the unrestricted usage of the internet by individuals with disabilities, including the elderly (29 papers)
- A2 with an emphasis on everyone's unrestricted access to the internet, regardless of disability (15 papers)
- A3 with an emphasis on compliance with web accessibility standards (2 papers)
- A4 with a generalized view of web accessibility encompassing elements such as usability and user experience (5 papers)
- The A2 explanation of web accessibility discusses the improved usability and user experience derives from more accessible web content. The usability of a web application is linked in part to its discoverability which ties directly to SEO. 23 publications provide definitions or explanations for the term SEO. 9 papers describe SEO in relation to their use in the automated performance evaluation of a website. SEO was predominantly used to improve the search ranking of educational websites or applications (7 papers). An

under researched segment was the application of SEO in improving business outcomes or growing customer base (3 papers).

- With respect to the A3 grouping which defines web accessibility in the context of standards and regulatory guidelines, a further analysis is required. From the 65 selected papers, a total of 9 guidelines, 17 national laws, and 1 EU directive can be extracted (Table 6).

Table 5. Different Definitions of Web Accessibility Grouped by Similarity

No.	Group Theme	Papers	No. of Papers
A ₁	Definitions emphasizing the need to improve the accessibility of web content for people with disabilities	P1, P3, P5, P6, P10, P11, P12, P13, P14, P19, P21, P23, P24, P25, P26, P27, P28, P29, P30, P32, P33, P48, P49, P50, P52, P53, P59, P61	29
A ₂	Definitions focusing on a better and more inclusive web experience for all users regardless of disabilities	P2, P4, P7, P15, P18, P22, P31, P36, P38, P40, P44, P45, P46, P47, P60	15
A ₃	Definitions tied to adherence to established standards and regulatory frameworks	P20, P35	2
A ₄	General definitions not explicitly related to any one aspect	P9, P34, P43, P48, P63	5

As shown in Table 6, The different iterations of the WCAG 2.0, 2.1, 2.2 received the most attention (47 papers). The second most referenced law is Section 508 of the Rehabilitation Act (16 papers). National laws from Japan, Italy, Germany, Russia etc. are discussed multiple times in the selected papers. Furthermore, other standards from the W3C WAI are mentioned in addition to the WCAG. These include UAAG - User Agent Accessibility Guidelines (4 papers), ATAG –

Authoring Tool Accessibility Guidelines (4 papers), and WAI-ARIA - Accessible Rich Internet Applications (3 papers). Additionally, there are a few notable mentions of accessibility directives in several International Organization for Standardization (ISO) guidelines, particularly ISO 9241, ISO 29110, and ISO 40500. These standards address human-system interaction, systems and software engineering, and WCAG.

The final section explores the relationship between web accessibility and SEO as discussed in the reviewed literature. Of the 65 selected studies, only 20 papers examine this connection between both terms in some capacity. The idea that web accessibility and SEO are closely inter-connected attributes that enhance the user experience for all users, regardless of the individual's disability, is supported by 10 of the 20 publications (P1, P2, P10, P55, P56, P58, P59, P60, P61, P63).

Like web accessibility, SEO ought to be incorporated into the development workflow from project initiation rather than during final testing. Both factors are complementary and should be addressed simultaneously. The remaining ten papers (P4, P9, P12, P13, P14, P15, P16, P17, P18, P62) provide an alternative perspective by characterizing the relationship between web accessibility and SEO as distinct fields but acknowledge that web accessibility can have a positive impact on SEO.

3.2 Web Accessibility and SEO Evaluation Techniques - RQ2: What processes, techniques, methods, or approaches can be used to evaluate web accessibility and SEO performance?

Understanding the user requirements that impact the accessibility and search ranking of a web page is a prerequisite for improving both aspects. Finding answers for the third research question entailed reviewing all 65 selected publications for pertinent insights into the subject matter. Thorough examination of the studies produced a significant number of user requirements for web accessibility and SEO. Duplicate requirements are consolidated into a total of 44 user specifications.

Table 6. Overview of Publications Addressing Standards

Standards	Region	Papers	No. of Papers
WCAG (WCAG)	Global	P1, P2, P3, P4, P5, P6, P7, P10, P11, P12, P13, P14, P15, P18 – P42, P44 – P53, P58 – P63	47
Section 508 of the Rehabilitation Act	US	P1, P6, P14, P15, P19, 21, P22, P25, P26, P27, P28, P29, P30, P35, P44, P58	16
Barrierefreie-Informationstechnik-Verordnung (BITV)	Germany	P1, P15, P42	3
User Agent Accessibility Guidelines (UAAG)	Global	P2, P3, P22, P38	4
Authoring Tool Accessibility Guidelines (ATAG)	Global	P2, P3, P22, P38	4
Austrian E-Government Act	Austria	P3	1
Accessibility Model in Electronic Government (e-MAG)	Brazil	P5, P22, P36, P40, P45, P46	6
Americans with Disabilities Act (ADA)	US	P11, P19, P20, P26, P28	5
United Nations Convention on the Rights of Persons with Disabilities (UNCRPD)	Global	P11, P19, P52	3
Equality Act 2010	UK	P11	1
GOST R	Russia	P14	1
ISO/IEC 29110 standard	Global	P18	1
Israeli Standard SI 5568	Israel	P19	1
Accessible Rich Internet Applications (WAI-ARIA)	Global	P22, P23, P27	3
ISO/IEC 40500:2012	Global	P25, P26	2
EN 301 549 (European standard for ICT accessibility)	Europe	P25	1
Référentiel Général d'Accessibilité pour les Administrations (RGAA)	France	P42	1
ISO 9241-171 standard	Global	P32	1
ISO 9241-20 standard	Global	P29	1
British Standards Institute (BSI) Web Accessibility Code of Practice	UK	P29	1
National laws	Chile, Colombia, Ecuador, Argentina, Peru, Chile, Brazil, Venezuela, Korea, Japan, UAE, Italy	P5, P21, P23, P27, P33, P42	6

That extracted data emphasizes the need for alternative text to be provided for non-textual content such as images, graphs, charts, etc. (25 papers). Eighteen papers discuss the importance of high and adjustable contrast between page elements to people with visual impairments e.g. low vision, blindness. In addition, a simplified layout and consistent navigation reduce the mental capability needed for basic interactions (11 papers). Equivalent keyboard actions must be provided as an alternative to all mouse dependent interactions on a web page (12 papers). HTML code void of syntactic errors and adheres to correct semantic rules is essential for accurate interpretation by various user agents (14 papers). Table 7 shows a complete breakdown of the identified requirements. As shown in Table 7, we have categorised identified requirements under WCAG Principles [23] and WCAG Success Criterion [23]. More specifically, four principles of WCAG Web Accessibility guidelines, which are Perceivable, Operable, Understandable and Robust, appeared in the WCAG Principle column of the table, and the WCAG Success Criterion column shows the corresponding success criteria.

Table 7. Identified User Requirements from Selected Studies and Mapping of the Requirements to WCAG Success Criterion

#	Summarized Requirements	Papers	No. of Papers	WCAG Principle	WCAG Success Criterion
1	Provide alternative text for non-textual content	P2, P4, P7, P9, P10, P12, P14, P15, P18, P19, P20, P21, P28, P30, P32, P33, P39, P43, P44, P46, P47, P48, P59, P60, P61	25	Perceivable	1.1.1 Non-text Content
2	Sufficient colour contrast between foreground and background; adjustable contrast	P2, P3, P7, P8, P10, P12, P14, P15, P18, P19, P21, P30, P31, P33, P36, P39, P44, P47	18	Perceivable	1.4.3 Contrast (Minimum) 1.4.11 Non-text Contrast
3	Consistent layout and navigation across multiple pages	P11, P18, P19, P30, P31, P34, P36, P44, P45, P46, P48	11	Understandable	3.2.3 Consistent Navigation
4	Use simplified language that is easy to read and understand	P21, P25, P31, P32, P45, P46, P52	7	Understandable	3.1.5 Reading Level
5	Provide closed captions, transcripts, and audio descriptions	P2, P7, P15, P20, P25, P28, P38, P43, P63	9	Perceivable	1.2.1 Audio-only and Video-only (Prerecorded) 1.2.2 Captions (Prerecorded)
6	Use larger touch targets that minimize the need for precise gestures	P51	1	Operable	2.5.5 Target Size
7	Enable complete keyboard navigation capability, without the need for a mouse	P4, P7, P8, P14, P21, P25, P33, P39, P43, P46, P47, P59,	12	Operable	2.1.1 Keyboard, 2.1.2 No Keyboard Trap, 2.4.5 Multiple Ways
8	Link purpose can be determined from link text	P2, P4, P10, P14, P18, P28, P34, P45	8	Perceivable	2.4.4 Link Purpose (in context)
9	Provide accurate labels for form control elements	P2, P7, P10, P14, P15, P19, P28, P33, P39	9	Perceivable	2.4.6 Headings and Labels
10	Ensure HTML code follows correct semantic structure	P3, P7, P8, P10, P11, P18, P20, P27, P28, P31, P33, P34, P39, P43	14	Perceivable	
11	Layout responds the user's device orientation	P9, P11, P21, P31, P46	5	Perceivable	1.3.4 Orientation
12	Headers and titles effectively convey meaning	P3, P4, P9, P18, P19, P28, P34, P47	8	Operable	2.4.6 Headings and Labels
13	Avoid time dependent interactions / adjustable timing functionality	P10, P11, P21, P25, P34, P46	6	Operable	2.2.1 Timing Adjustable
14	Ensure no content is lost through text resizing and zooming	P8, P10, P14, P33, P34, P36, P47	7	Perceivable	1.3.1 Info and Relationships, 1.4.4 Resize Text
15	Provide descriptive page titles	P10	1	Perceivable	2.4.2 Page Titled
16	Stop pause hide	P10, P31, P34, P47	4		
17	Enable visible focus to allow users easily discover content using a keyboard	P10, P14, P31	3	Operable	2.4.7 Focus Visible
18	Ensure section headings can be programmatically determined	P10, P44	2	Perceivable	3.1.1 Language of Page
19	Avoid using images of text in place of text	P11	1	Perceivable	1.4.5 Images of Text

20	Use valid CSS structure	P11, P27	2	Perceivable	
21	Language of page and language of parts can be programmatically determined	P4, P14, P15, P19, P28, P34, P39, P47	8	Understandable	3.1.1 Language of Page
22	Use unique element identifications	P15, P28		Robust	3.2.4 Consistent Identification
23	Avoid blinking or flashing content / disable functionality	P19, P34	2	Operable	2.3.1 Three Flashes or Below Threshold
24	Ensure focus order follows a logical order that preserves context	P20, P34	2	Operable	2.4.3 Focus Order
25	Provide input assistance to help avoid or identify mistakes	P21, P34, P44, P46	4	Understandable	3.3.2 Labels and Instructions, 3.3.7 Redundant Entry
26	Simplified website navigation: breadcrumbs	P25	1	Understandable	2.4.5 Multiple Ways, 2.4.8 Location
27	Proper use of ARIA attributes to ensure content is accessible to different user agents	P27	1	Robust	4.1.2 Name, Role, Value
28	Avoid opening new tabs without user permission	P28	1	Understandable	
29	Ensure tables are accessible for navigation	P28, P48	2	Perceivable	2.4.5 Multiple Ways
30	Large and adjustable font size	P31	1	Perceivable	1.4.4 Resize Text
31	Provide indications for mandatory form fields	P31, P48	2	Understandable	3.3.2 Labels or Instructions
32	Provide content searching mechanism as an alternative form of navigation	P31, P36, P45, P48	4	Operable	2.4.5 Multiple Ways
33	Provide helpful error alerts and messages	P4, P31	2	Understandable	3.3.1 Error Identification, 3.3.3 Error Suggestion
34	Ensure functions are clearly understood and operational	P31	1	Understandable	
35	Ensure functionality is predictable	P31, P46	2	Understandable	
36	Avoid using colour alone to convey meaning	P8, P34, P47	3	Perceivable	1.3.3 Sensory Characteristics, 1.4.1 Use of Colour
37	Provide mechanism to skip repeated content	P4, P34	2	Navigable	2.4.1 Bypass Blocks
38	Provide shortcuts for commonly performed actions	P34, P36, P38, P48	4	Operable	2.1.4 Character Key Shortcuts
39	Provide controls for speed, volume, pitch, play, replay, stop, etc.	P34, P38	2	Perceivable, Operable	1.4.2 Audio Controls
40	Make text-based PDFs accessible	P39, P48	2	Perceivable	
41	Avoid pop-up interruptions, manage focus and active windows	P48	1	Perceivable, Operable, Understandable	3.2.1 On Focus
42	Allow cancellation of current operation	P48	1	Operable	2.2.2 Pause, Stop, Hide
43	Provide feedback for actions and interactions or changes on page	P48	1	Operable, Understandable, Robust	3.2.2 On Input
44	Ensure accessible screen reader interaction	P59	1	Perceivable, Operable	

The data extracted from the 65 selected publications reveal a significant reliance on automatic web evaluation tools for conducting accessibility assessments, as evidenced by their occurrence in 45 papers. The mainstream adoption of automatic Web Accessibility Evaluation (WAVE) tools can be attributed to their ability to provide a quick, inexpensive alternative for identifying accessibility violations across numerous web pages. 16 papers reference manual accessibility checks, highlighting the importance of human judgement and intervention. Although time consuming, manual evaluation offers a more personalized approach to detection of accessibility defects, especially contrasted against the broad catchall approach of automatic tools with a high rate of false positives.

Expert evaluation combines the nuanced approach of manual evaluations with industry-specific in-sights. 10 papers cite incorporating expert opinions or assessments into accessibility evaluation workflows, indicating the importance of specialized knowledge in conducting comprehensive and accurate web accessibility evaluations. User evaluation is also prominently represented with 6 papers. The importance of engaging actual people with disabilities during the evaluation process cannot be over-stated. This approach helps validate theoretical solutions against real-world effectiveness. The other evaluation methods mentioned are not as commonly used in the evaluated sample. Figure 3 illustrates the distribution of evaluation methods.

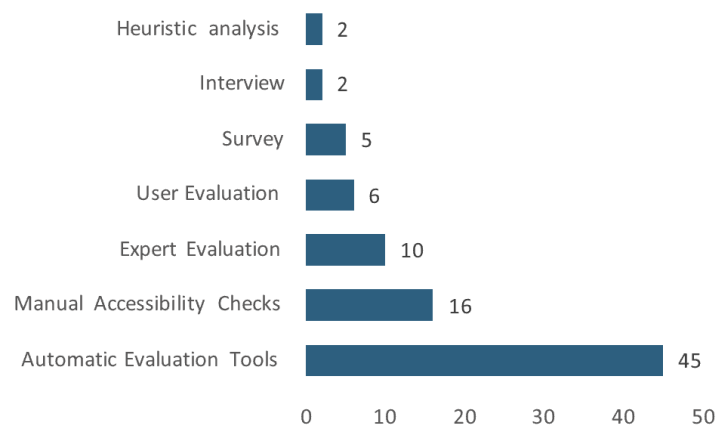


Figure 3. Distribution of Evaluation Methods

Further analysis reveals that 50% of reviewed studies used a combination of two or more evaluation techniques. According to the statistics, automated tools are often paired with either manual checks or expert assessments. This is because automated evaluation or manual evaluation in isolation suffers from its own deficit and it is necessary to employ a combination of the methods in order to conduct a reliable accessibility assessment [24], [25], [26]. This provides a more robust approach that combines the speed and coverage offered by automatic tools with the more thorough, nuanced approach of professional or manual evaluation. Figure 4 depicts a Venn diagram of the relationship between automatic tools, manual accessibility checks, and expert assessment.

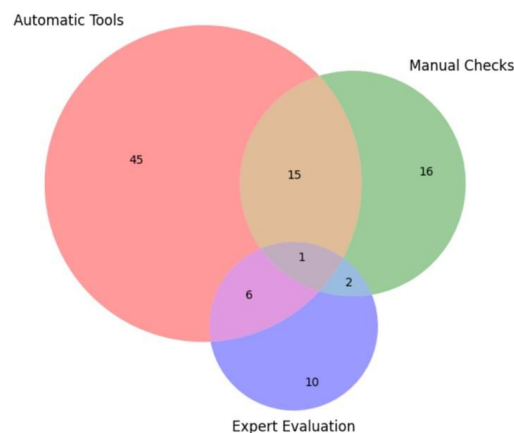


Figure 4. Venn Diagram of Evaluation Methods

Regarding the most prominent WAVE, a vast majority of reviewed publications (23 papers) utilized the WAVE suggesting it is the preferred choice amongst accessibility evaluators. The availability of a WAVE browser plugin, simple design and comprehensive feature set are possible indicators for its mass adoption. 18 papers assessed web applications using AChecker, making it the second most popular option. Its frequent usage by practitioners can be due to its extensive support for various accessibility guidelines and standards from across the globe. The TAW evaluation tool, which appears in 12 publications, is another significant application in the evaluation process, well trusted by industry experts. Other lesser-known tools mentioned in the publication have niche applications, such as: HTML and CSS validation services which analyse the structure and styling of web pages for syntactic mistakes. Figure 5 illustrates the distribution of evaluation tools.

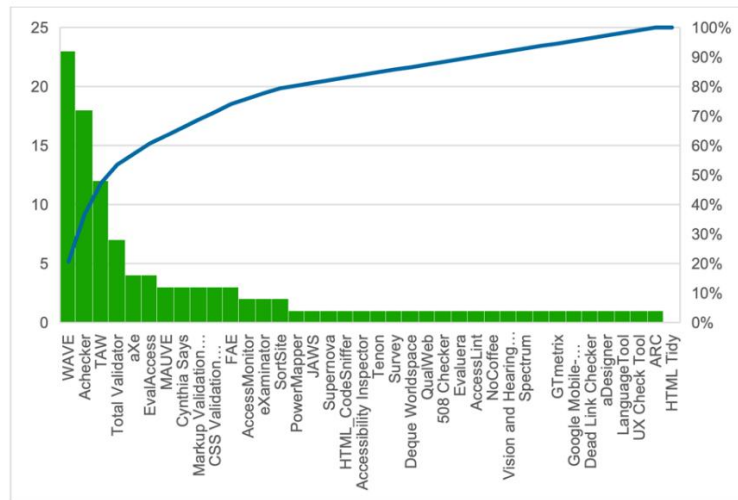


Figure 5. Distribution of Evaluation Tools

3.3 Accessibility and SEO Integration Challenges - RQ3: What hindrances prevent developers from integrating accessibility and SEO into the development process?

This section describes the accessibility challenges that prevent software practitioners from integrating accessibility and SEO into the software engineering process. Among the 65 papers, five (5) studies were related to accessibility challenges (representing 7.69% of the total literature).

The study presented in [5] reviewed the literature from the period and discovered various challenges preventing the implementation of web accessibility. They developed a unique taxonomy that categorized web accessibility challenges into three (3) sections: challenges with accessibility standards, impediments during design and development, and difficulties in website accessibility evaluation. The challenges during the design and development phase were associated with the inherent complexity of the WCAG guidelines, ambiguity of the WCAG guidelines, inadequate expertise and lack of motivation, lack of publicly available accessibility training resources, and inaccuracy of evaluation methods. The negative impact of accessibility challenges on higher levels of web accessibility is also highlighted in [5].

Investigation on whether accessibility is currently incorporated into the software engineering process, and how software projects address accessibility concerns are presented in [27]. This study adopted a combination of quantitative and qualitative research approaches, comprising 15 interviews and 365 surveys from respondents across 28 countries. The research focuses on identifying and understanding real-world accessibility issues and challenges. The study identifies several key obstacles, accessibility is treated as a secondary concern during the development process, requires specialized knowledge on standards and impairments. Additionally, the research highlights numerous obstacles hindering accessible web development, such as more time spent eliciting requirements, increased communication with outside stakeholders, requires larger and more diverse teams etc. The study emphasizes the need for greater executive support, collaborative company culture, accessibility-oriented requirement identification and so on.

The challenges and strategies for facilitating and promoting the implementation of web accessibility in the private sector are discussed in [19]. They invited managers from twelve (12) different organizations whose job functions involved accessibility implementation for interviews. An analysis of the extracted data reveals that accessible webpage development requires a substantial initial investment, considerable senior management support, significant web accessibility awareness and understanding, high-quality assurance overhead, and increased development time. These obligations are crucial in improving the accessibility of corporate web channels. However, these obligations are highly dependent on the organization's culture, size, financial resources, priorities, etc. Therefore, ensuring these necessities is comparatively challenging.

In a recent study, [28] highlighted the need for improved developer awareness regarding cognitive disabilities in Brazil. According to [28], the available accessibility standards disproportionately concentrate on visual impairments while neglecting neurological disabilities. An exploratory survey of 105 software practitioners was conducted to ascertain their understanding of techniques for eliminating barriers for users with cognitive impairments. The responses revealed that individual disabilities were not considered due to time constraints, inadequate user testing, lack of information resources, and management not prioritizing accessibility. Consequently, web development professionals experience significant challenges in incorporating accessibility into projects.

3.4 Improvement Directions for Website Accessibility and SEO - RQ4: In what ways can development be revised to ensure accessibility and SEO are a priority during any future website rebuilds?

This section discusses future developments pertaining to accessible development. Eight (8) articles out of 65 articles (12.3% of the overall literature), were devoted to improvement directions. Few studies concentrate on the technological side of accessible development while discussing improvement directions. Web developers and related authorities should select the typeface and colour scheme in accordance with the organization's identity; according to [29]. It is not always simple to address accessibility issues through this approach, although inaccessible fonts, colours, and contrasts affect how a design or development is performed for individuals with impairments, such as those with impaired vision. They recommended that during the development stage, colours, typefaces, and supporting elements should be accurately interpreted. A Content Management System (CMS) should be followed when encoding development to improve the user experience for a larger audience. Several technical suggestions within the framework of an accessible prototype design to address accessibility issues are offered in [30]. A website's Quality Assurance (QA) team should verify and examine all accessibility standards. Based on their extensive research on enhancing website accessibility and readability, [31] offered a few recommendations. The tips for enhancing readability pertain to the structural elements of websites, including picture alt-text and hyperlinks. A variable weight-based strategy for various webpage elements should be implemented to guarantee these functionalities. To increase the readability of a website in terms of accessibility, website dynamism should also be considered when calculating the readability score. According to [32] it is important to adhere to WCAG guidelines to ensure websites are accessible, including using proper text alternatives for images and structured headings while addressing identified problems from accessibility tools, such as ensuring ALT text for images and improving navigation for better usability. Many accessibility rules are available to assist designers in creating an accessible website, such as the WCAG. Every guide has checkpoints that allow designers to determine which particular region a particular aid should be used. In [33], an analysis is presented that focuses on improvement of web traffic by improving accessibility in tourism related web sites. This work distinguishes accessibility between technical accessibility (how easily users and technologies can access/interact with the site) and informational content accessibility (how easily users can understand and find information). The analysis concludes that there is strong correlation between web traffic and technical accessibility, however, there is no significant correlation between web traffic and informational content accessibility. The study presented in [34] states that the primary benefit of digital learning materials is their improved accessibility for those with disabilities when compared to traditional paper-based resources, provided they are appropriately constructed. Among the crucial rules are ensuring that the documents have an appropriate heading structure to facilitate effective navigation for screen-reader users, providing table headers in a semantic manner to facilitate comprehension, refraining from placing floating boxes to preserve the reading order, and properly placing hyperlinks within the documents. The readability of these publications must be kept at a level that the intended audience can easily understand. The default accessibility testing functions of authoring tools must be used to verify accessibility before resources are uploaded.

4. GUIDELINE FOR IMPROVING WEB ACCESSIBILITY AND SEO

This section describes the preparation, implementation, and validation of a set of guidelines aimed at simultaneously improving web accessibility and SEO. In section 3.2 (Table 7) we have synthesized the results obtained from the systematic literature review and available best practices from industry experts into a comprehensive list of actionable requirements and mapped these requirements with Success Criterion from WCAG guidelines. We have analysed SEO guidelines from leading search engines like Google [35] and Bing [36], and it appears that there are many parallels and overlaps between the SEO criteria and accessibility requirements that seem to be the driving force behind the high search ranking. In Table 8, we have listed 15 factors affecting both web accessibility and SEO. Following the table, we provide detailed descriptions for improving web accessibility and SEO.

Table 8. SEO and Web Accessibility Overlapping Factors

Factor No	SEO Guideline	WCAG Success Criterion & Description
1	Meaningful Page Titles	2.4.2 Page Titled - Use descriptive or meaningful page titles
2	Language of Page	3.1.1 Language of Page - Page language can be programmatically determined
3	Alternative Text	1.1.1 Non-text Content - Provide text alternative for non-textual content that conveys the same meaning
4	Good Link Text	2.4.4 Link Purpose (in context) - The link's purpose should be easily determined from the link's text or a combination of the text and content
5	Headings and Labels	2.4.6 Headings and Labels - Provide descriptive headings and labels
6	Descriptive Alt Text to Image	1.4.5 Images of Text - Images of text are substituted for text wherever possible
7	Navigation	2.1.1 Keyboard - Provide keyboard equivalents for all pointer actions except freehand movements 2.4 Navigable - Provide ways to help users navigate, find content, and determine where they are.
8	User Interactions	2.1.1 Keyboard - Provide keyboard equivalents for all pointer actions except freehand movements
9	Proper Use of Headings	2.4.6 Headings and Labels - Provide descriptive headings and labels
10	Readability	3.1 Readable - Make text content readable and understandable.
11	Video and Audio Transcripts	1.2.1 Audio-only and Video-only (Prerecorded) - Provide alternative texts conveying equivalent information for prerecorded audio-only or video-only content
12	Breadcrumb Links	2.4.8 Location - Users know where they are in a set of pages
13	Metadata Descriptions	5.3.2 Optional Components of a Conformance Claim - metadata used to both describe and find resources. Note: This is not a WCAG success criteria, rather an optional component.
14	Use of Proper Semantics	1.3.1 Info and Relationships - Presentation can be adapted without losing original meaning
15	Sitemaps	2.4.5 Multiple Ways - Provide multiple means of navigating content

1. Meaningful Page Titles - Success Criterion 2.4.2

A good page title clearly communicates the company's name, page purpose, and expected user action. Page titles help users quickly determine if a web page is relevant without reading the entire page content as well as appearing as the heading in search engine result lists. Websites launched with the aid of screen readers are read to the user, with the page title read first to set the context. Keywords within the page title are also analysed by search engine crawlers to determine the search engine page ranking. While having a descriptive page title is a requirement for compliance, titles should not be too wordy or stuffed with keywords, as this could negatively impact the search engine ranking.

2. Language of Page - Success Criterion 3.1.1

The language attribute of the semantic HTML element establishes the primary language of a webpage. Assistive technologies, such as screen readers, use the chosen language to determine the correct accent, cadence, and pronunciation to announce a web page's content. Incorrect or missing language attributes can conflict with the screen reader's default language preset, causing difficulty in understanding content meaning or context.

Furthermore, defining the page language helps search engine crawlers to index the page more accurately, leading to better SEO performance.

3. Alternative Text - Success Criterion 1.1.1

Text alternatives serve as the primary method for creating accessible content because information can easily be transformed into different sensory modalities (auditory, tactile, and visual) depending on the user's needs. A good alternative text should be accessible to screen readers and crawlers, use simple wordings, be relevant to the content it describes, and convey meaning in 150 characters or fewer. For purely decorative non-textual content, a blank alt attribute (alt=""), ARIA role = "presentation", or CSS back-grounds should be used to inform assistive technologies to ignore the content.

4. Good Link Text - Success Criterion 2.4.4

Assistive technologies such as screen readers associate the presence of a href attribute with hyperlinks. These technologies crawl web pages and aggregate all the links found. Descriptive link text helps users immediately decide what links in the list they would like to visit. Although there are currently no stipulations for the acceptable length of link texts, clear and concise language is recommended to avoid confusing impaired users. Good anchor text is informative and effectively communicates the purpose of each link. An added benefit of meaningful anchor text is, search engines can easily determine the topic and relevance of the destination page.

5. Headings and Labels - Success Criterion 2.4.6

Whenever headings or labels are used, they must sufficiently communicate the structure and meaning of the webpage content. Section titles enable users with reading or memory disabilities to understand the relationship between title and content.

6. Descriptive Alt Text to Image - Success Criterion 1.4.5

Images of text should be substituted for text alternatives, except in situations where doing so would fundamentally change the information conveyed. Textual alternatives are preferred, as text can be rendered in different ways to meet a user's specific needs. Whereas the properties of images of text cannot be easily adjusted. This change allows screen readers and search engine crawlers to accurately interpret the information present on a webpage. It is also important to note image of text do not include pictorial representations of information that may include text such as graphs, charts, and diagrams.

7. Navigation - Success Criterion 2.1.1, Success Criterion 2.4

A core tenet of accessibility is providing adequate navigation mechanism, irrespective of a user's disability status. Keyboard navigation is the primary alternative to mouse-dependent interactions and is crucial for the development of accessible web applications. Impaired users must be able to replicate all mouse-based functionalities solely using a keyboard. Moreover, simplified, and consistent navigation such as dropdowns and accordions can be employed to enhance the readability and discoverability of information using assistive technology and site crawlers.

8. User Interactions - Success Criterion 2.1.1

It is recommended that the number of physical interactions present on a website be limited. Actions such as button clicks, accordion interactions, or revealing hidden content on hover require user's permission before screen readers can execute the action. Consequently, it is necessary to include all text content in dropdowns, accordions, and hidden text within the source code to enable screen readers and site crawlers accurately ingest content without requiring user interaction.

9. Proper Use of Headings - Success Criterion 2.4.6

The HTML semantic H1-H6 tags are used to markup content as headings, with the H1 tag being the top-level heading on a page. Best practices discourage the use of multiple H1 tags on a single page. A H1 tag should be used to communicate the page's main content, typically limiting its length to 70 characters. It is also important for headings to be correctly nested, and for heading levels not to be skipped to avoid confusing screen readers. Properly formatted content headings improve user readability, content scan ability, and search engine visibility.

10. Readability - Success Criterion 3.1

Readability is a broad topic that encompasses legibility and cognition. Accessibility requirements mandate that text be readable and easily distinguishable from its background. Font size, font family, line spacing, letter width, and text colour should be effectively managed for users with dyslexia or colour blindness. Simple language should be used to explain complex concepts.

11. Video and Audio Transcripts - Success Criterion 1.2.1

Transcripts for multimedia files allow users with visual, auditory, or neurological impairments interact and understand various content formats. Because search engines cannot directly understand video or audio content, transcripts provide a text alternative through which multimedia content can be indexed accurately. Furthermore, transcripts enhance content discoverability as users and search engines can search transcript texts for keywords.

12. Breadcrumb Links - Success Criterion 2.4.8

Breadcrumb links are used to display the navigation path from the source page to the destination. These are secondary navigation mechanisms that help trace a user's current orientation relative to the main page. This is particularly beneficial to users with short attention spans or poor memory because it is a visual representation of the sequence of steps from the original page. Websites with complex navigation structures implement breadcrumb links to improve the site's internal linking and help site crawlers and screen readers understand the website's structure.

13. Metadata Descriptions - 5.3.2 Optional Components of a Conformance Claim

Simply put, metadata descriptions are machine readable values that provide additional information used to describe data. Typically, 160 characters, it provides a short explanation of a webpage's subject matter or publication date. It provides assistive technology and site crawlers context required to fully understand a webpage's content. Though not explicitly a WCAG directive, it falls under 5.3.2 optional components of a conformance claim.

14. Use of Proper Semantics - Success Criterion 1.3.1

Content must adhere to syntactic rules that constitute a valid markup syntax. This includes elements with appropriate opening and closing tags, maintaining unique IDs except in instances where the specifications permit otherwise, unique element attributes, accurate element nesting, etc. This is because search engines and assistive technology prioritize keywords included in semantic tags over those in non-semantic tags. For example, `<article>` and `<section>` should be used instead of `<div>` where permissible, as it conveys more meaning.

15. Sitemaps - Success Criterion 2.4.5

Although not directly addressed by existing WCAG directives, sitemaps play a crucial role in improving the discoverability of webpage content. For websites with complex navigation structures, on-site sitemaps help users to easily locate their desired information. Sitemaps are important for both SEO and web accessibility, as they provide an overview of all important pages and map the link connection between pages on the site. This is especially useful to crawlers in scenarios where links are isolated from other pages.

4.1. Organizational Accessibility Consciousness

Some of the initiatives required to improve accessibility fall outside the purview of the organization, such as the administration of penalties for accessibility non-compliance by regulatory authorities. Many opportunities still exist within organizations that seek to improve organizational culture towards accessibility.

From the SLR findings and suggestions from accessibility practitioners, the following recommendations aim to overcome the existing barriers to a positive company culture regarding accessibility.

- **Develop Organizational Policies:** An accessibility policy should be documented and approved by senior management, detailing the organization's commitment to accessibility.
- **Appoint an Accessibility Steward:** Management should create an accessibility governance role within the organizational structure tasked with spearheading and overseeing accessibility compliance.

- **Conduct Initial Assessments:** Perform a comprehensive audit of all existing digital channels to ascertain the current level of accessibility compliance and document the accessibility violations discovered.
- **Remediate Identified Accessibility Issues:** Violations should be resolved according to the established procedures documented within the accessibility policy. This process should encompass updating design documents, software, and copy writes to adhere to accessibility standards.
- **Integrate Accessibility into Design and Development Processes:** Accessibility should be incorporated into the design and development workflows at the beginning of projects to avoid significant complications and delays resulting from high number of design and code modifications.
- **Accessibility Testing:** A combination of manual tests, expert opinions, and automated tools should be used to evaluate accessibility during each phase of the software development lifecycle. Regular accessibility audits should be conducted to enforce compliance with the latest WCAG guidelines.
- **Continuous Monitoring:** Continually monitor accessibility, particularly during feature integration or a complete overhaul to avoid reintroducing defects. The life cycle of an accessibility violation should be tracked from identification to resolution.
- **Promote Organizational Awareness:** Developers, designers, and any other roles interfacing with accessibility should receive frequent training on current best practices and standards to communicate the importance of accessibility and reduce the likelihood of reoccurring issues. A process for reporting accessibility issues should be created and communicated to users.

5. IMPLEMENTATION & EVALUATION OF ACCESSIBLE AND SEARCH ENGINE OPTIMIZED WEB APPLICATION FOLLOWING THE DEVELOPED GUIDELINE

In this section we discuss the design, implementation and evaluation of a lightweight proof-of-concept web application for assessing the practicality and effectiveness of the proposed guidelines in improving both web accessibility and search ranking of web applications. We named the developed application Edenlife, which provides lifestyle automation services for decluttering schedules and improves overall quality of life. Based on the three (3) most likely visited pages of this website, the scope of development was limited to the following web pages: Landing, About Us, and Companies.

5.1 Design and Implementation of Edenlife – Application of the Guideline

The design process consists of two phases: low and high-fidelity design. During the low fidelity design phase, initial hand-drawn sketches of webpages were produced, each prioritized layout and functionality rather than design specifics. A free-hand approach was selected overusing specialized wireframing software because it presents a free, quick, and easy way to design the layout of webpages. During high fidelity design phase, Figma design application was used to convert low fidelity designs into high-quality page-layout elements. During this phase, design representations for various device screen sizes are created, complete with typography, colours, and graphical assets. Description of each web page that resulted from the low fidelity and high-fidelity design phases are given below.

• Landing Page

This is the home page of the Edenlife web application and represents the first impression users have about the company. It displays a call-to-action message encouraging website visitors to sign up for an Edenlife service, as well as a tutorial demonstrating the registration process. Additionally, it displays the current service offerings of the company, including laundry, food, home cleaning, and gifting. The navigation panel at the top and bottom of the page enables users to switch between multiple pages. The following sections are also included on the landing page: Frequently Asked Questions (FAQ), testimonials, corporate sponsors, media partners, and app download options (Figure 6).

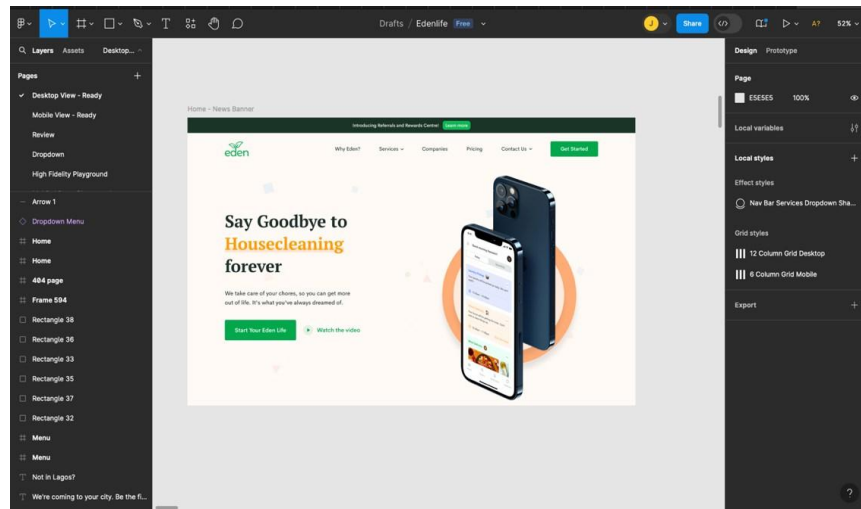


Figure 6. High-Fidelity Design of Landing Page

• Companies

The companies page displays pertinent information about enrolling a company to a service of Edenlife App. The navigation panel is affixed to the top of the webpage, whereas the page footer is positioned at the bottom. A call-to-action, corporate partners, enrolment form, service offerings, and testimonials are also presented on this page (Figure 7).

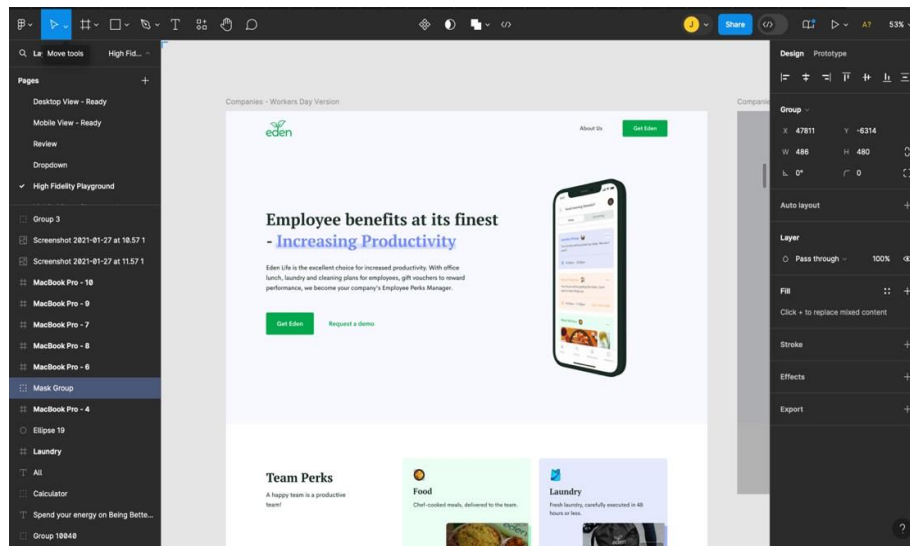


Figure 7. High-Fidelity Design of Companies Page

• About Us

This page presents information about the company, including details of the management structure and team composition. It adopts a navigation scheme similar to the other webpages, with the navigation menu and footer affixed to the top and bottom of the page, respectively (Figure 8).

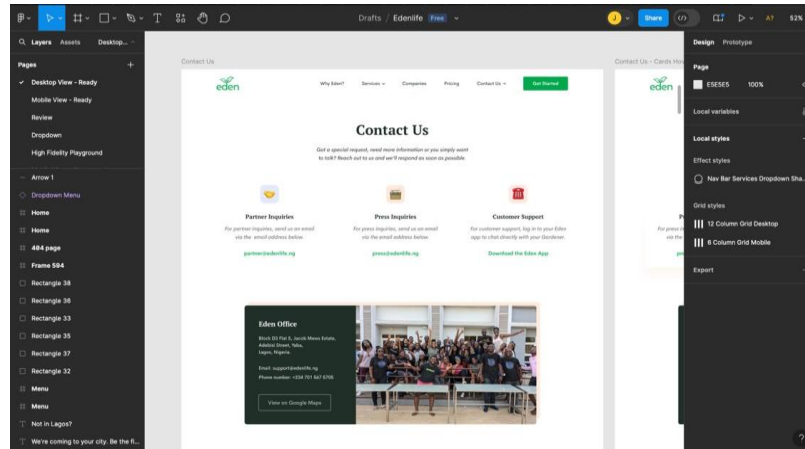


Figure 8. High-Fidelity Design of About Us Page

Edenlife is developed as a Next.js application and was hosted on Vercel platform [37]. During the implementation of this proof-of-concept application, at the code level we applied a subset of the guideline that we presented in Section 4. More specifically, Table 9 below summarises the SEO and Web Accessibility overlapping factors that are applied in the implementation of Edenlife.

Table 9. Application of SEO and Web Accessibility Overlapping Factors in the Implementation of Edenlife

SEO Guideline	WCAG Success Criterion	Application in Edenlife Code
Proper Use of Headings	Success Criterion 2.4.6	Descriptive section headings that adhere to syntactic rules were set.
Good Link Text	Success Criterion 2.4.4	Where applicable, link text has been worded to provide additional information about the links purpose
Descriptive Alt Text to Image	Success Criterion 1.4.5	Descriptive alternative text was set for each image
Alternative Text	Success Criterion 1.1.1	
Use of Proper Semantics	Success Criterion 1.3.1	Meta data was set for each page title.
Language of Page	Success Criterion 3.1.1	The page language has been set to English to ensure screen readers and crawlers can accurately parse the webpage's content.
	Success Criterion 3.1.5	Text has been formatted to improve legibility and readability

5.2 Evaluation of Edenlife

Following our discussion in Section 3.2 we have chosen WAVE to evaluate Edenlife application. Table 10 shows the WAVE evaluation results for all the 3 pages of Edenlife application.

Table 10. WAVE Evaluation Results

	Errors	Contrast Errors	AIM Score (10)
Landing Page	0	2	9
About Us Page	0	0	9.9
Companies Page	0	3	9

As shown in Table 10, none of the analysed webpages showed major accessibility issues. The results revealed minor accessibility barriers (5) pertaining to insufficient colour contrast between icons and the background colour. More importantly, the WAVE Accessibility Impact (AIM) score is reported as very high (90% or above) for all three pages, where AIM score provides a measure of impact of page accessibility issues on users with disabilities.

We have also used the Google Lighthouse tool to assess the webpages of Edenlife on four key metrics: SEO, performance, accessibility, and best practices. Table 11 shows the Google Lighthouse evaluation results for the 3 pages of Edenlife application. The results revealed excellent accessibility and SEO ratings across all evaluated pages. Each assessed webpage scored over 90% across accessibility and SEO metrics.

Table 11. Google Lighthouse Evaluation Results

Webpage	Accessibility	Performance	SEO	Best Practices
Landing	100%	99%	100%	100%
About	100%	100%	100%	100%
Companies	92%	100%	100%	100%

6. CONCLUSION

A primary contribution of this work was the identification and analysis of user requirements in the area of Web Accessibility and then mapping these requirements to WCAG web accessibility compliance level criteria. Our study demonstrated that certain requirements were completely excluded from the compliance level criteria, whereas others matched pertinent user requirements.

As a second contribution, this study explored the intersection between SEO and web accessibility to create a better online experience for users with impairments and other web users. A thorough guideline is presented that would enable organizations and practitioners to create inclusive corporate websites that are also search engine optimized. As a proof of concept, an artifact was designed, implemented and evaluated to demonstrate the applicability of the presented guideline.

Although a thorough research process was employed to develop the research findings, it is important to note that several study limitations exist. There are a few generalizability limitations to the empirical research of this work, meaning the recommendations apply to a broad set of corporate websites but might not be suitable for specialized web applications such as social media. Another limitation is the fact that Real-world company websites might be more intricate than the study's proof of concept. Also, the proof-of-concept artifact was evaluated using only automated tools. Though the evaluation results are highly positive, further manual evaluation needs to be performed to consolidate automated evaluation results.

As future direction of this study, we recommend the incorporation of web accessibility into organizational procedures. More specifically, the individual components of the developed guideline could be integrated into project management frameworks. For example, accessibility guidelines should be incorporated into the design and development workflows at the beginning of development projects. Also, combination of manual tests, expert opinions, and automated tools should be used to evaluate accessibility during each phase of the development lifecycle. Regular accessibility audits should be conducted to enforce compliance with the latest WCAG guidelines.

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AUTHOR CONTRIBUTIONS

Jeremiah Charles: Conceptualization, Formal Analysis, Methodology, Writing – Original Draft Preparation;
Khaled Mahbub: Project Administration, Supervision, Writing – Review & Editing.

CONFLICT OF INTERESTS

No conflict of interest was disclosed.

ETHICS STATEMENTS

Our publication ethics follow guideline from The Ethical Review Manager (ERM) (<https://ethicalreviewmanager.com/>)

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analysed in this study.

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APPENDIX A: List of Publications Used for Systematic Literature Review

P1	Abuaddous, H. Y., Jali, M. Z., & Basir, N. (2016). Web Accessibility Challenges. In <i>IJACSA International Journal of Advanced Computer Science and Applications</i> (Vol. 7, Issue 10). www.ijacsa.thesai.org
P2	Acosta-Vargas, P., Acosta, T., & Lujan-Mora, S. (2018). Challenges to assess accessibility in higher education websites: A comparative study of Latin America universities. <i>IEEE Access</i> , 6. https://doi.org/10.1109/ACCESS.2018.2848978
P3	Leitner, M. L., Strauss, C., & Stummer, C. (2016). Web accessibility implementation in private sector organizations: motivations and business impact. <i>Universal Access in the Information Society</i> , 15(2). https://doi.org/10.1007/s10209-014-0380-1
P4	Acosta-Vargas, P., Salvador-Acosta, B., Salvador-Ullauri, L., & JadánGuerrero, J. (2022). Accessibility challenges of e-commerce websites. <i>PeerJ Computer Science</i> , 8. https://doi.org/10.7717/PEERJ-CS.891
P5	Pichiliani, T. C. P. B., & Pizzolato, E. B. (2019). A survey on the awareness of brazilian web development community about cognitive accessibility. <i>IHC 2019 - Proceedings of the 18th Brazilian Symposium on Human Factors in Computing Systems</i> . https://doi.org/10.1145/3357155.3358448
P6	Bi, T., Xia, X., Lo, D., Grundy, J., Zimmermann, T., & Ford, D. (2022). Accessibility in Software Practice: A Practitioner's Perspective. <i>ACM Transactions on Software Engineering and Methodology</i> , 31(4). https://doi.org/10.1145/3503508
P7	Ismail, A., & Kuppusamy, K. S. (2022). Web accessibility investigation and identification of major issues of higher education websites with statistical measures: A case study of college websites. <i>Journal of King Saud University - Computer and Information Sciences</i> , 34(3). https://doi.org/10.1016/j.jksuci.2019.03.011
P8	Almukhtar, F., Mahmood, N., & Kareem, S. (2021). Search engine optimization: A review. <i>Applied Computer Science</i> , 17(1), 69–79. https://doi.org/10.23743/acs-2021-07
P9	Kwangawad, A., Jattamart, A., & Nusawat, P. (2019). The Performance Evaluation of a Website using Automated Evaluation Tools. <i>TIMES-ICON 2019 - 2019 4th Technology Innovation Management and Engineering Science International Conference</i> . https://doi.org/10.1109/TIMESiCON47539.2019.9024634
P10	Windriyani, P., Ferdiana, R., & Najib, W. (2014). Accessibility evaluation using WCAG 2.0 guidelines webometrics based assessment criteria (case study: Sebelas Maret University). <i>Proceedings - 2014 International Conference on ICT for Smart Society: "Smart System Platform Development for City and Society, GoeSmart 2014"</i> , ICISS 2014. https://doi.org/10.1109/ICTSS.2014.7013192
P11	Akram, M., & Bt, R. (2017). A Systematic Literature Review to Determine the Web Accessibility Issues in Saudi Arabian University and Government Websites for Disable People. <i>International Journal of Advanced Computer Science and Applications</i> , 8(6). https://doi.org/10.14569/ijacsa.2017.080642
P12	Faizin, M. A., Nevin, M., & Yuhana, U. L. (2024). Indonesia EGovernment Website Performance and Accessibility Evaluation using Automated Tool Lighthouse. <i>2024 2nd International Conference on Software Engineering and Information Technology, ICoSEIT 2024</i> , 210–215. https://doi.org/10.1109/ICoSEIT60086.2024.10497521
P13	Lehat, M. L., Munnirah, C. T., Shafee, N. M., Fauziah, N., Bakar, A., Shamala, P., Jamil, A. A., & Rosnan, S. (n.d.). <i>Assessing Web Performance Of Malaysian University Website</i> . https://doi.org/10.1109/ICRAIE59459.2023.10468308
P14	Pudich, A. S., Grif, M. G., & Bakaev, M. A. (2022). Computer Vision Based Assessment of University Websites' Accessibility and Inclusiveness. <i>2022 IEEE International Multi-Conference on Engineering, Computer and Information Sciences, SIBIRCON 2022</i> . https://doi.org/10.1109/SIBIRCON56155.2022.10016785
P15	Dias, J., Carvalho, D., Reis, A., Barroso, J., & Rocha, T. (2022). Identifying Concerns On Automatic Tools For Accessibility Assessment: A Comparative Case Study On Two Portuguese Universities' Websites. <i>Proceedings - 2022 5th International Conference on Information and Computer Technologies, ICICT 2022</i> . https://doi.org/10.1109/ICICT55905.2022.00008
P16	Khandare, S. S., Gawade, S., & Turkar, V. (2018). Survey on website evaluation tools. <i>International Conference on Recent Innovations in Signal Processing and Embedded Systems, RISE 2017, 2018-January</i> . https://doi.org/10.1109/RISE.2017.8378225
P17	Zarish, S. S., Habib, S., & Islam, M. (2019). Analyzing usability of educational websites using automated tools. <i>2019 International Conference on Computer and Information Sciences, ICCIS 2019</i> . https://doi.org/10.1109/ICCISci.2019.8716462
P18	Ogbuju, E., Ayodeji, B., & Azeez, A. (2022). Performance and Accessibility Evaluation of University Websites in Nigeria. <i>Proceedings of the 5th International Conference on Information Technology for Education and Development: Changing the Narratives Through Building a Secure Society with Disruptive Technologies, ITED 2022</i> . https://doi.org/10.1109/ITED56637.2022.10051461
P19	Laufer Nir, H., & Rimmerman, A. (2018). Evaluation of Web content accessibility in an Israeli institution of higher education. <i>Universal Access in the Information Society</i> , 17(3). https://doi.org/10.1007/s10209-0180615

P20	Palaskar, A., Gondkar, S. R., & Gondkar, R. R. (2021). Web Accessibility test approach on developed websites. <i>SSRN Electronic Journal</i> . https://doi.org/10.2139/ssrn.3835104
P21	Ali, L. (2021). Accessible websites for everyone — a case of uae universities websites. <i>International Journal of Information and Education Technology</i> , 11(4), 164–170. https://doi.org/10.18178/ijiet.2021.11.4.1506
P22	Antonelli, H. L., Rodrigues, S. S., Watanabe, W. M., & De Mattos Fortes, R. P. (2018). A survey on accessibility awareness of Brazilian web developers. <i>ACM International Conference Proceeding Series</i> . https://doi.org/10.1145/3218585.3218598
P23	Baazeem, I. S., & Al-Khalifa, H. S. (2015). Advancements in web accessibility evaluation methods: How far are we? <i>17th International Conference on Information Integration and Web-Based Applications and Services, IiWAS 2015 - Proceedings</i> . https://doi.org/10.1145/2837185.2843850
P24	Edelberg, J., & Verhulsdonck, G. (2021). Addressing Accessibility as Advocacy: Special Needs Users in Industry Web Development Processes. <i>Proceedings of the 39th ACM International Conference on the Design of Communication: Building Coalitions. Worldwide, SIGDOC 2021</i> . https://doi.org/10.1145/3472714.3473663
P25	Buzzi, M. C., Buzzi, M., Perrone, E., & Senette, C. (2019). Personalized technology-enhanced training for people with cognitive impairment. <i>Universal Access in the Information Society</i> , 18(4). https://doi.org/10.1007/s10209-018-0619-3
P26	Costa, D., & Duarte, C. (2017). Visually impaired people and the emerging connected TV: a comparative study of TV and Web applications' accessibility. <i>Universal Access in the Information Society</i> , 16(1). https://doi.org/10.1007/s10209-016-0451-6
P27	Luján-Mora, S., Navarrete, R., & Peñafiel, M. (2014). Egovernment and web accessibility in South America. <i>1st International Conference on EDemocracy and EGovernment, ICEDEG 2014</i> . https://doi.org/10.1109/ICEDEG.2014.6819953
P28	Crespo, R. G., Espada, J. P., & Burgos, D. (2016). Social4all: Definition of specific adaptations in Web applications to improve accessibility. <i>Computer Standards and Interfaces</i> , 48. https://doi.org/10.1016/j.csi.2016.04.001
P29	Petrie, H., Savva, A., & Power, C. (2015). Towards a unified definition of web accessibility. <i>W4A 2015 - 12th Web for All Conference</i> . https://doi.org/10.1145/2745555.2746653
P30	Alismail, S., & Chipidza, W. (2021). Accessibility evaluation of COVID19 vaccine registration websites across the United States. <i>Journal of the American Medical Informatics Association</i> , 28(9). https://doi.org/10.1093/jamia/ocab105
P31	Patsoule, E., & Koutsabasis, P. (2014). Redesigning websites for older adults: A case study. <i>Behaviour and Information Technology</i> , 33(6). https://doi.org/10.1080/0144929X.2013.810777
P32	De Oliveira, R. C., Freire, A. P., Paiva, D. M. B., Cagnin, M. I., & Rubinsztein, H. (2014). A framework to facilitate the implementation of technical aspects of web accessibility. <i>Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)</i> , 8516 LNCS(PART 4). https://doi.org/10.1007/978-3-319-07509-9_1
P33	Bhagat, S., & Joshi, P. (2019). Evaluation of accessibility and accessibility audit methods for e-governance portals. <i>ACM International Conference Proceeding Series, Part F148155</i> . https://doi.org/10.1145/3326365.3326394
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P36	Zitkus, E., Brigatto, A. C., Ferrari, A. L. M., Bonfim, G. H. C., Carvalho Filho, I. F. P., Reis, T. D., Medola, F. O., & Paschoarelli, L. C. (2016). Accessibility and usability of websites intended for people with disabilities: A preliminary study. <i>Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)</i> , 9747. https://doi.org/10.1007/978-3-319-403557_66
P37	Ojha, P. K., Ismail, A., & Kundumani Srinivasan, K. (2021). Perusal of readability with focus on web content understandability. In <i>Journal of King Saud University - Computer and Information Sciences</i> (Vol. 33, Issue 1). https://doi.org/10.1016/j.jksuci.2018.03.007
P38	Villena, J. M. R., Ramos, B. C., Fortes, R. P. M., & Goularte, R. (2014). An accessible video player for older people: Issues from a user test. <i>Procedia Computer Science</i> , 27. https://doi.org/10.1016/j.procs.2014.02.020
P39	Kuppusamy, K. S., & Balaji, V. (2023). Evaluating web accessibility of educational institutions websites using a variable magnitude approach. <i>Universal Access in the Information Society</i> , 22(1). https://doi.org/10.1007/s10209-021-00812-4

P40	Teracine, E. C., & Matsumoto, F. C. (2014). Proposals for an assessment method of accessibility and usability in web software. <i>Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and in Bioinformatics)</i> , 8512 LNCS(PART 3). https://doi.org/10.1007/978-3-319-07227-2_9
P41	Ten, A. C., & Paz, F. (2017). A systematic review of user experience evaluation methods in information driven websites. <i>Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)</i> , 10288 LNCS. https://doi.org/10.1007/978-3-319-58634-2_36
P42	Schiavone, A. G., & Paternò, F. (2015). An extensible environment for guideline-based accessibility evaluation of dynamic Web applications. <i>Universal Access in the Information Society</i> , 14(1). https://doi.org/10.1007/s10209-014-0399-3
P43	Sanchez-Gordon, S., Sánchez-Gordón, M., Yilmaz, M., & O'Connor, R. V. (2019). Integration of accessibility design patterns with the software implementation process of ISO/IEC 29110. <i>Journal of Software: Evolution and Process</i> , 31(1). https://doi.org/10.1002/smr.1987
P44	Alshamari, M. (2016). Accessibility Evaluation of Arabic E-Commerce Web Sites Using Automated Tools. <i>Journal of Software Engineering and Applications</i> , 09(09). https://doi.org/10.4236/jsea.2016.99029
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P48	Pereira, L. S., Ferreira, S. B. L., & Archambault, D. (2015). Preliminary Web Accessibility Evaluation Method through the Identification of Critical Items with the Participation of Visually Impaired Users. <i>Procedia Computer Science</i> , 67. https://doi.org/10.1016/j.procs.2015.09.251
P49	Fogli, D., Parasiliti Provenza, L., & Bernareggi, C. (2014). A universal design resource for rich Internet applications based on design patterns. <i>Universal Access in the Information Society</i> , 13(2). https://doi.org/10.1007/s10209-013-0291-6
P50	Rashida, M., Islam, K., Kayes, A. S. M., Hammoudeh, M., Arefin, M. S., & Habib, M. A. (2021). Towards developing a framework to analyze the qualities of the university websites. <i>Computers</i> , 10(5). https://doi.org/10.3390/computers10050057
P51	Nunes, F., Silva, P. A., Cevada, J., Correia Barros, A., & Teixeira, L. (2016). User interface design guidelines for smartphone applications for people with Parkinson's disease. <i>Universal Access in the Information Society</i> , 15(4). https://doi.org/10.1007/s10209-015-0440-1
P52	Nietzio, A., Naber, D., & Bühler, C. (2014). Towards techniques for Easyto-Read Web content. <i>Procedia Computer Science</i> , 27. https://doi.org/10.1016/j.procs.2014.02.038
P53	Acosta-Vargas, P., Antonio Salvador-Ullauri, L., & Lujan-Mora, S. (2019). A Heuristic Method to Evaluate Web Accessibility for Users with Low Vision. <i>IEEE Access</i> , 7. https://doi.org/10.1109/ACCESS.2019.2939068
P54	Shahzad, A., Jacob, D. W., Nawi, N. M., Mahdin, H., & Saputri, M. E. (2020). The new trend for search engine optimization, tools and techniques. <i>Indonesian Journal of Electrical Engineering and Computer Science</i> , 18(3). https://doi.org/10.11591/ijeecs.v18.i3.pp1568-1583
P55	Aryani, D., Shine Pintor Siolemba Patiro, Setiawan, A., & Tjahjono, B. (2023). Comparative Analysis Of On-Page And Off-Page White Hat Search Engine Optimization (SEO) Techniques On Website Popularity. <i>International Journal of Science, Technology & Management</i> , 4(3). https://doi.org/10.46729/ijstm.v4i3.815
P56	Ziakis, C., Vlachopoulou, M., Kyrkoudis, T., & Karagkiozidou, M. (2019). Important factors for improving Google search rank. <i>Future Internet</i> , 11(2). https://doi.org/10.3390/fi11020032
P57	Dramilio, A., Faustine, C., Sanjaya, S., & Soewito, B. (2020). The effect and technique in search engine optimization. <i>Proceedings of 2020 International Conference on Information Management and Technology, ICIMTech 2020</i> . https://doi.org/10.1109/ICIMTech50083.2020.9211171
P58	Ata, B. M. A. (2014). The Effect of Web Accessibility and Usability on User Preference and Search Engine Ranking. <i>2014 World Symposium On Web Applications and Networking</i> .
P59	Grant, J., Sumilang, G., Providenti, M., Cho, S., & Reichler, D. (2021). Accountability for the hidden codes toward a better user experience: Case study of HRsimple communication design for web accessibility and SEO. <i>Proceedings of the 39th ACM International Conference on the Design of Communication: Building Coalitions. Worldwide, SIGDOC 2021</i> . https://doi.org/10.1145/3472714.3473664
P60	Ferraz, R. (2015). Exploring Web Attributes Related to Image Accessibility and their Impact on Search Engine Indexing. <i>Procedia Computer Science</i> , 67. https://doi.org/10.1016/j.procs.2015.09.261

P61	Ferraz, R. (2017). Accessibility and search engine optimization on scalable vector graphics. <i>IEEE 4th International Conference on Soft Computing and Machine Intelligence, ISCMi 2017, 2018-January</i> . https://doi.org/10.1109/ISCMi.2017.8279605
P62	Giannakouloupoulos, A., Konstantinou, N., Koutsompolis, D., Pergantis, M., & Varlamis, I. (2019). Academic excellence, website quality, SEO performance: Is there a correlation? <i>Future Internet, 11</i> (11). https://doi.org/10.3390/fi11110242
P63	Iglesias, V. (2018). Beyond the mandates: The far-reaching benefits of multimedia accessibility. <i>Learned Publishing, 31</i> (1). https://doi.org/10.1002/leap.1153
P64	Xu, H. (2022). Website Link Structure Optimization Based on SEO Algorithm. <i>2022 IEEE Asia-Pacific Conference on Image Processing, Electronics and Computers, IPEC 2022</i> . https://doi.org/10.1109/IPEC54454.2022.9777341
P65	Su, A. J., Hu, Y. C., Kuzmanovic, A., & Koh, C. K. (2014). How to improve your search engine ranking: Myths and reality. <i>ACM Transactions on the Web, 8</i> (2). https://doi.org/10.1145/2579990

APPENDIX B: Quality Assessment of Selected Publication

Paper	Q1	Q2	Q3	Q4	Q5	Count	Sum	Score
P1	1.0	1.0		0.5	1.0	4	3.5	88
P2	1.0	0.5	1.0	0.5	1.0	5	4	80
P3	1.0	1.0	1.0	0.5	1.0	5	4.5	90
P4	1.0	0.5	0.5	0.5	1.0	5	3.5	70
P5	1.0	1.0			1.0	3	3	100
P7	1.0			0.5	1.0	3	2.5	83
P8			0.5	0.5	1.0	3	2	67
P9	1.0		1.0	0.5	1.0	4	3.5	88
P10	1.0	0.5	1.0	0.5	1.0	5	4	80
P11	1.0	1.0		0.5	1.0	4	3.5	88
P12	1.0	1.0	0.5	0.5	1.0	5	4	80
P13	1.0	1.0	0.5	0.5	0.5	5	3.5	70
P14	1.0	1.0	0.5	1.0	1.0	5	4.5	90
P15	1.0	1.0		1.0	1.0	4	4	100
P16				0.5	1.0	2	1.5	75
P17			1.0	0.5	1.0	3	2.5	83
P18	1.0	0.5	0.5	0.5	1.0	5	3.5	70
P19	1.0	1.0		0.5	1.0	4	3.5	88
P20	1.0	1.0		0.5	1.0	4	3.5	88
P21	1.0	1.0		0.5	1.0	4	3.5	88
P22	1.0	1.0			1.0	3	3	100
P23	1.0	1.0		0.5	1.0	4	3.5	88
P24	1.0	0.5		1.0	1.0	4	3.5	88
P25	1.0	1.0		0.5	1.0	4	3.5	88
P26	1.0	1.0		0.5	1.0	4	3.5	88
P27	1.0	1.0		0.5	1.0	4	3.5	88
P28	1.0	1.0		0.5	1.0	4	3.5	88
P29	1.0	1.0			1.0	3	3	100
P30	1.0	1.0		1.0	1.0	4	4	100
P31	1.0	0.5			1.0	3	2.5	83
P32	1.0	0.5		0.5	1.0	4	3	75
P33	1.0	0.5		0.5	1.0	4	3	75
P34	1.0	0.5		0.5	1.0	4	3	75
P35	1.0	0.5		0.5	1.0	4	3	75
P36	1.0	0.5		0.5	1.0	4	3	75
P37		0.5			0.5	2	1	50
P38	1.0	0.5			1.0	3	2.5	83
P39		0.5		0.5	1.0	3	2	67
P40	1.0	0.5			1.0	3	2.5	83
P41		0.5			1.0	2	1.5	75
P42		0.5		0.5	1.0	3	2	67
P43	1.0	0.5		0.5	1.0	4	3	75
P44	1.0	0.5		0.5	1.0	4	3	75
P45	1.0	0.5			1.0	3	2.5	83
P46	1.0	0.5			1.0	3	2.5	83
P47	1.0	0.5		0.5	1.0	4	3	75
P48	1.0	0.5			1.0	3	2.5	83
P49	1.0	0.5		0.5	1.0	4	3	75
P50	0.5				0.5	2	1	50
P51	0.5				1.0	2	1.5	75
P52	1.0	0.5		0.5	1.0	4	3	75
P53	1.0	0.5		0.5	1.0	4	3	75
P54				0.5	1.0	2	1.5	75
P55			1.0	0.5	0.5	3	2	67
P56			1.0		1.0	2	2	100
P57			1.0	0.5	0.5	3	2	67
P58	1.0		1.0	0.5	1.0	4	3.5	88
P59	1.0	0.5	1.0	1.0	1.0	5	4.5	90
P60	1.0	0.5	1.0	0.5	1.0	5	4	80
P61	1.0	0.5	1.0		1.0	4	3.5	88
P62		0.5	0.5	1.0	1.0	4	3	75
P63	1.0		0.5		1.0	3	2.5	83
P64			0.5		0.5	2	2	100
P65			0.5		1.0	2	1.5	75