

ACCESSIBILITY EVALUATION ON ETHIOPIAN AND SOUTH AFRICAN AIRLINES WEBSITE AND MOBILE APPLICATIONS

Bisrat Betru¹ and Uchenna Kelechi Ogbonna²

¹Kesed IT Solutions, Addis Ababa, Ethiopia

²Faculty of Technology, Art and Design, Department of Information Technology Human machine interaction and universal design of ICT, Oslo Metropolitan University, Oslo, Norway

ABSTRACT

Air transport is one of the major transportation modes in Africa. It has been showing a growth due to significant increase of tourist flights and intercontinental flights. Ethiopian Airlines and South African Airlines are the leading airlines in Africa in terms of working capacity and annual profit. Both Ethiopian and South African Airlines have a website that lets their customers search and book a flight. They also have a mobile application for both android and iOS platforms.

The airline industry in Africa is facing market competition from different airlines outside the continent. The competition is getting intense due to the usage of different technological artifacts in the air transport infrastructure by competitors. The development of an accessible and usable website and mobile application for flight booking and related services can help African airlines to compete well.

This paper is about evaluating the accessibility of Ethiopian and South African airlines' websites and mobile applications using manual and automatic accessibility evaluation techniques. As per the evaluation result, both airlines shall work hard to inclusively design their interactive online reservation systems. To do so, they need to consider the seven principles of Universal Design whenever they enhance their interactive systems.

KEYWORDS

Universal Design, Universally-designed Interactive Systems, Accessibility Evaluation, Air Reservation Systems

1. INTRODUCTION

Air transport is one of the transportation modes that have been used in Africa. Due to the notable growth in aviation infrastructure in some of the African countries and the general economic growth across the continent, air transportation is showing significant growth [1]. The air transport growth will continue as the number of tourist flights, intercontinental flights, and local flights are also increasing.

In 2017, about 63 million people visited Africa which showed a 9% growth from the previous year [2]. According to ICAO (International Civil Aviation Organization) report, the total number of passengers that have used air transport mode reached 4.1 billion globally in 2017 [3]. Africa shared more than 2% of this figure which showed a 7.2% growth from the previous year. The report also indicated that international scheduled passenger traffic grew by 8.4 percent in RPKs

(Revenue Passenger Kilometers) in 2017, compared to the 7.7 percent growth recorded in 2016 [3]. African carriers, which account for 3 percent of international RPKs, grew by 8.1 percent. Domestic scheduled passenger traffic also grew by 2.2 percent in RPKs in 2017 [3].

Even though the number of passengers in Africa showed progress, it is quite difficult to get a figure on how many passengers have been using African airlines' websites or mobile applications to book their flight. But, the number of passengers cannot be less and insignificant as the Internet connectivity and availability of smartphones are improving across the continent. Moreover, we are living mobile-first world where people use their smartphones for different kinds of socio-economic activities. As it is stated in Google Data in 2016, people primarily tend to use their mobiles for interaction with the web [4]. Apart from the mobile first tendency, the rise of online payment platforms in Africa has also made an impact in using online reservation systems [5].

According to SKYTRAX, one of the trusted organizations in the sector that awards airlines and a website that publishes aviation facts about Africa, Ethiopian Airlines and South African Airlines are the leading airlines in Africa [6, 7]. Ethiopian Airlines was founded on December 30, 1945 and started its services on April 8, 1946 [8]. It is a member of Star Alliance and the most profitable, largest, and fastest-growing African airline [8, 9]. South Africa Airways is established in February 1934 after the government acquire Union Airways and rebranded it to South African Airways [10]. It is currently working with hubs at Johannesburg and Cape Town and categorized as the biggest in the industry across Africa and became a member of the Star Alliance in 2006 [10, 11].

Both Ethiopian and South African Airlines have a website that lets their customers search and book a flight. They also have a mobile application for both android and iOS platforms. The website of Ethiopian Airlines is <https://www.ethiopianairlines.com/> whereas the South African is <https://www.flysaa.com/>. Their mobile applications are called Ethiopia Airlines and FlySAA respectively.

The airline industry in Africa is facing market competition from different airlines outside the continent [8]. The competition is getting intense because the competitors have been deploying different technological artifacts in their air transport infrastructure. The development of an accessible website and mobile application for flight booking and related services can help African airlines to compete well.

This paper is about evaluating the accessibility and usability of Ethiopian and South African airlines websites as well as their mobile applications. The rest of the sections are organized as follows. Section two focuses on the methodology of the study. Section three deals with review of related literature works. Results and discussion are covered in section four. Conclusion and future works are presented in section five.

2. METHODOLOGY

2.1. Literature Review

For the purpose of understanding the core concepts involved in this paper and to identify how they can fit to this study; literature works are reviewed regarding African Airlines Industry, Interactive Systems, Usercentered Design, Website Accessibility Guidelines, Mobile Application Accessibility Guidelines, and Evaluation Methods.

2.2. Selected Airlines and Functionalities

Ethiopian Airlines and South African Airlines are selected for evaluation due to their leading performance in the last decade across the continent. For accessibility evaluation, the ‘searching for a flight’ and ‘booking a flight’ activities are selected as essential functionality to evaluate the websites as well as the mobile applications. The homepage of the websites is also evaluated as it is the door to the selected essential functionalities.

2.3. Selected Testing Suite

The authors use Google Chrome installed in Windows 10 operating system as a user agent for evaluating the websites since it is the current leading browser [12]. Moreover, only the Android-based version of their mobile application is selected because of its dominance in the continent. According to the latest statistics, Android has 82.79% of share from mobile operating system market share in Africa [13].

2.3.1. Assistive Technologies

The authors have used Windows Narrator and JAWS (Job Access with Speech) as screen readers for evaluating websites. Google’s accessibility service Talkback is used to evaluate mobile applications.

2.3.2. Evaluation Technique

Both manual and automatic approaches are used to evaluate the interactive systems. The combination of heuristic and automatic techniques have been used for a purpose of getting a better result with minimum time. The online automatic accessibility checking tools called WAVE, FAE (Functional Accessibility Evaluator), a11y Color Contrast Accessibility Validator, and Power Mapper used for automatic evaluation.

2.3.3. Accessibility Guideline

WCAG 2.0 (Web Content Accessibility Guideline 2.0) from W3C (World Wide Web Consortium) is used as a guideline to evaluate the websites. Some of the relevant checkpoints or specifications of WCAG are selected to evaluate whether the websites are accessible to people with disabilities. WAI-ARIA (Web Accessibility Initiative-Accessible Rich Internet Application) is also used as a technical specification to evaluate advanced UI (User Interface) components of the websites developed by JavaScript and HTML5.

3. LITERATURE REVIEW

3.1. Interactive Online Systems

The development of websites and other interactive applications in consideration of human factors is becoming significant. This consideration ensures the developed interactive system to be used by a wider range of people. An accessible interactive system results in a better financial benefit for the organization that owns it. However, owning a usable website by applying UD (Universal Design) principles shall not only intend for a better return on investment but also for addressing ethical issues, moral values, and legal obligations. Currently, organizations are compelled to comply with local and international standards and legislations to make their interactive system accessible and usable.

According to the UNCRPD (United Nations Convention on the Rights of Persons with Disabilities) Article 9, the development of a product should include users at the early stage of development rather than participating users at the final stage [14]. The consideration of human factors is quite expensive as it involves frequent and efficient communication among development team and target users throughout the development phases [15]. However, the human-centered development approach has several advantages. This includes [15, 16]:

- Return on Investment
 - ✓ Consideration of human factors increases product acceptability that reduces the burden on the helpdesk.
 - ✓ Reduces training cost which increases “*throughput and sale of the product*” [16].
 - ✓ Results effective commercial sites and productive users
- Safety
 - ✓ Accessible and usable interactive systems reduce faults.
 - ✓ Considers situational context of usage
- Ethics
 - ✓ The notion of universally designed interactive systems is not only for monetary values but also for ethical issues to include all users regardless of their diversity.
- Legal Obligations
 - ✓ Discriminating a given diversity of users is become a legal issue globally, continentally, and locally.

3.2. Interactive Online Flight Reservations Systems

The use of ICT systems in a variety of airlines services is becoming an inevitable part of the service operation. Airlines have also understood the benefit of incorporating ICT systems in their services for better competition in the market. Flight booking websites and mobile applications are some of the interactive systems they have been implementing in their service operations. These interactive systems should consider a wider range of diverse users and usage contexts for better accessibility and usability.

Some studies reveal that online reservation systems are not able to meet user requirements in terms of providing a “*pleasant online environment*” [17]. This is simply because of the design approach followed to develop the interactive systems which does not consider human factors. The general requirement of users about a given e-commerce platform is the overall usefulness of the system [18]. As stated in [18] “*perceived usefulness and ease of use*” are the leading factors to use online airlines ticket reservation systems. These factors are yet critical in interacting with online reservation systems.

As it is stated in [19], the “*Airline Passengers*” have been showing a dynamic behavior regarding their flight preferences. The constant change of their perception against online airline services will continue in the next five years and the airlines industry should consider the following issues whenever they design their online reservation systems [19].

- ✓ The geographical diversity of travelers will increase.
- ✓ There will be more elderly passengers than today.
- ✓ The general trend is showing that passengers are looking for a simple flight booking service. The same research [19] showed that “*43% of leisure passengers and 51% of business passengers want to spend less time*” in searching for flights.

3.3. Evaluation of Interactive Systems

According to ISO 13407:1999 which is a standard for “*human-centered design process for interactive systems*” user-centered assessment is one of the processes that focus on evaluating the solution against the specified user and organizational requirements [20]. These requirements are evaluated based on “*effectiveness, efficiency, and satisfaction*” of end-users and the “*allocation of function between users and the system*” [21].

3.4. Manual Evaluation

3.4.1. Heuristic evaluation

Heuristic evaluation refers to “*a number of methods in which a person trained in HCI (Human-Computer Interaction) and interaction design examines a proposed design to see how it measures up against a list of principles, guidelines or ‘heuristics’ for good design*” [16]. This is done manually to evaluate whether a product is complying with some sort of accessibility principles.

3.4.2. Design Walkthrough

It is an evaluation approach based on theories from assessment of end-users and identification of scenarios that represent both common and uncommon activities in the interactive system [16].

3.5. Automatic Evaluation

It is a method of evaluating websites using a software tool. The tool might exist either online or offline.

This includes validating HTML codes against a given specification and standard criteria. WAVE, ATestesr, Dymomapper, PowerMapper, A11Y, AATT, and Access Alchemy are examples of the existed automatic evaluation tools.

4. EVALUATION

4.1. Evaluation Scope

The evaluation only focuses on the pages that are used by clients to book a given flight online. It doesn’t include evaluating other pages apart from this functionality. The flight booking activity can be done from the website homepage for both airlines. So, the evaluation includes the homepage for their website and the home screen for their mobile application. However, the evaluation of the homepage and home screen aims to evaluate the general accessibility of the page as it is the door to other pages or functionalities. The selected pages and their function presented in Table 1.

Table 1. Selected pages and their functionalities

Essential Pages Functionality	Description
Homepage	A door to overall access.
Search a flight	Activity is done by a user that is supported by the system to search a flight route.
Book a flight	Activity is done by the user to book for a given flight online.

4.2. Mobile Application Evaluation Heuristics

The authors have used heuristic evaluation to evaluate the mobile applications used by both airlines. This evaluation is based on the methodology proposed in [22] and the authors have considered visual impairment and cognitive impairment diversity groups. As a result, the identified heuristics presented in Table 2.

Table 2. Heuristics for mobile application evaluation

Heuristics ID	Name	Explanation	Problem
MEH001	Image Content Perception	It is about evaluating whether image contents are accessible for people with visual impairment using a screen reader as assistive technology.	Images without alternative text
MEH002	Mobile for perception	It is about evaluating whether a mobile form is accessible for people with visual impairment using a screen reader as assistive technology.	Content is different when it is presented using an auditory channel
MEH003	Position important page elements before the screen scroll.	It is about evaluating whether important UI components are positioned well or not before screen scrolling.	Important text fields, buttons, and other UI components of a form are at the bottom part of the screen.
MEH004	Touch Target Size and Spacing	It is about the size and spacing of touchable and actionable UI components.	Small button difficult to identify and tap, very narrow space between text field and button
MEH005	Provide easy methods for data entry	It is about evaluating how a data entry to the system by all users is simple.	Text fields without a proper placeholder.
MEH006	Contrast	It is about evaluating the contrast ratio of a screen.	Contrast ration without the minimum requirement
MEH007	UI perception	It is about evaluating how a UI and its component are easy to perceive by a user for interaction.	Complex UI arrangement, Poor semantical relationships between UI components
MEH008	Error suggestion and correction	It is about evaluating the error suggestion and correction is used by a system for correct data entry.	Poor input validation, inaccessible placeholder

4.3. Color Contrast Evaluation

The flight booking functionalities of both websites will be evaluated against the color contrast ratio guideline in WCAG 2.1. The evaluation is done automatically using an online tool suggested by W3C which is called “*a11y Color Contrast Accessibility Validator*”.

5. RESULTS AND DISCUSSION

5.1. Ethiopian Airlines Website Evaluation Result

The following evaluation results are discovered after a repetitive manual and automatic evaluation of Ethiopian Airlines website content based on WCAG 2.0 success criteria. For a better reading purpose, the results are summarized in Table 3 and a screenshot of ‘departure date selection’ page is presented in Figure 1.

Table 3. Ethiopian Airlines website evaluation result

Essential Functionality	WCAG 2.0						
	Perceivable			Operable		Understandable	
	Text alternative for non-text content	Content can be presented in different ways	Easier for users to see & hear content	All functionality available from a keyboard	Users navigate & find content	Text readable & understandable	Avoid & correct mistakes
Homepage	Inaccessible graphical link images (without description) Inaccessible Image (without alternative text)	Contents read with and without screen reader are different	A form control does not have a corresponding label	Inaccessible ‘Departure’ and ‘Return’ date links from keyboard; Inaccessible ‘Upgrade to CloudNine’ menu from keyboard	Unable to navigate for languages other than English. Eg. Arabic Some functionalities disappeared when language preference changed.	Meaning-less ‘0800 73 634’ link; ‘Departure’ and ‘Return’ date are not synchronized; Not present content in different modalities	Poor error communication
Searching a flight	Inaccessible graphical link images		No result after search text entered and ‘Search’ button clicked.	Inaccessible form web tab	Unable to navigate to UI components on the form that has a web tab.	Inaccessible “required field” text field	Poor or no “error” communication
Booking a flight	Inaccessible graphical link images	Inaccessible ‘Departure’ & ‘Return’ date	poor screen reading of required fields	Inaccessible ‘Book with Miles’ check box		No relationship between UI component and its purpose	No or poor “error” communication



Figure 1. Screenshot of ‘Departure Date Selection’ page of Ethiopian Airlines

5.2. Robustness Test

Two essential functionality pages of Ethiopian Airlines are automatically evaluated using the ‘W3C Markup Validator’ against WCAG 2.0. Robustness. The reported errors are manually counted and summarized in Table 4.

Table 4. Ethiopian Airlines website robustness evaluation result

Essential Functionality	WCAG 2.0: Robust				URL
	Total Errors Found	Error Category	Compatibility Issue	Possible consequence of errors	
Homepage	>=110 errors	Not allowed attribute in HTML element	Parsing	User agents like browsers and assistive technologies interpret, parse and display the same content differently and inaccurately.	https://www.ethiopianairlines.com/us
	133 errors	Duplicate ID			
Book a flight	>=27 errors	Not allowed attribute in HTML element	Parsing		https://www.ethiopianairlines.com/us/book/trip/flight
	2 errors	Duplicate ID			

5.3. WAI-ARIA

The Ethiopian Airlines website has used advanced UI components like web tab. The following results are found out after evaluating a given functionality based on WAI-ARIA. We have included the possible affected diversity groups since this part of the evaluation involved specific

UI components and summarized the result in Table 5 and a screenshot consists inaccessible ‘Book with Miles’ check box is presented in Figure 2.

Table 5. Ethiopian Airlines website booking page evaluation based on WAI-ARIA

Essential Functionality	ARIA 1.0				
	UI Element	Cause	Effect	User group affected	Erroneous Code Snippet
Book a flight	‘From’ and ‘To’ text fields	Content authors provide empty values and not used WAIARIA ‘ <i>ariarequired</i> ’ property.	<ul style="list-style-type: none"> No input suggestion for users Screen reader doesn’t read the semantics of asterisk (required) 	Ageing, cognitive, sensory	<pre><label for="mob-arrival-airport" class="control-label">To*</label> <input autocomplete="off" class="formcontrol rounded-0 widget-inputitem text-box single-line" id="mob-arrival-airport" name="ArrivalAirport" required="required" type="text" validationMessage="Please enter your destination and try again." value="" /></pre>
	‘One Way’, ‘Round Trip’, ‘Multi City’ web tabs	No proper semantics were provided for the custom widget (web tab)	<ul style="list-style-type: none"> inaccessibility for people with visual impairment Not operable from keyboard. 	Ageing, Sensory	<pre><div class="journey-type"> One Way Round Trip Multi City </div></pre>



Figure 2. Inaccessible ‘Book with Miles’ check box form keyboard.

5.4. South African Airlines Website Evaluation Result

The following test results depicted in Table 5 are discovered after a repetitive manual evaluation of South African Airlines website content based on WCAG 2.0 success criteria. Figure 3 depicts inaccessible language links.

Table 6. South African evaluation result

Essential Functionality	WCAG 2.0			Understandable Text readable & understandable
	Text alternative for non-text content	Content can be presented in d/t ways	Easier for users to see & hear content	
Homepage	Sliding images without image description	Contents read with and without screen reader are different	Alternative image found in the image is not well descriptive; Description for logo image is incorrect; Some 'Passenger Category' labels not accessible by screen readers	Language links are inaccessible since it is difficult to understand which language is selected using screen readers. Content is only accessible in English, French, Spanish, Italiano, and Portuguese. (Tested after the operating system language set to Arabic but accessibility issue persists)
Searching a flight	Inaccessible graphical link images (without description)		No result after search text entered. No communication in searching content.	Inaccessible passenger group or category by a screen reader. i.e. semantics of the category not extracted when a screen reader is used.
Booking a flight	Inaccessible graphical link images			Currency codes like NOK, DKK are not understandable when it read by the screen reader. i.e. screen readers read the letters rather than communicating their semantics. Inaccessible passenger group or category by a screen reader. i.e. semantics of the category not extracted when screen reader is used.

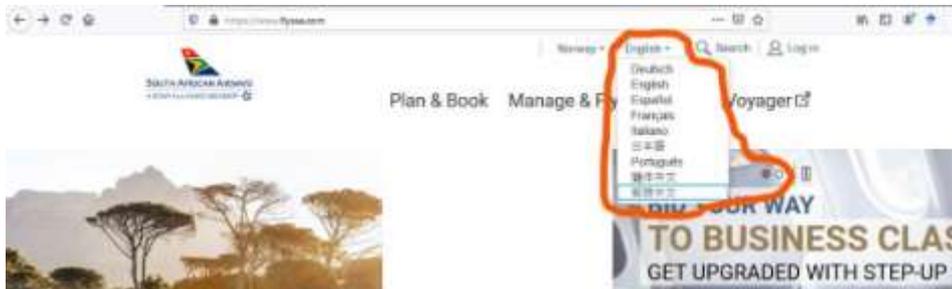


Figure 3. Inaccessible language links

5.5. Robustness Test

Two essential functionality pages are automatically evaluated using the ‘W3C Markup Validator’ against WCAG 2.0. Robustness. The reported errors are manually counted, classified and summarized in Table 7.

Table 7. South African Airlines robustness evaluation result

Essential Functionality	WCAG 2.0 Robust				
	Total Errors Found	Error Category	Compatibility Issue	A possible consequence of errors	URL
Homepage	2	Stray end tag	Parsing	User agents like browsers and assistive technologies interpret, parse and display the same content differently and inaccurately.	https://www.flysaa.com/
	1	Bad attribute value			
	12	CSS parse error			
Book a flight	1	Bad attribute value	Parsing		https://www.flysaa.com/plan-book/book
	14	Not allowed attribute in HTML element			
	4	CSS parse error			

5.6. WAI-ARIA

The South African airline's website has used advanced UI components like web panel. The following results depicted in Table 8 were found out after evaluating a given functionality based on WAI-ARIA. We have included the possible affected diversity groups since this part of the evaluation involved UI components. Figure 4 depicts the automatic evaluation result evaluated by PowerMapper.

Table 8. South African Airlines website booking page evaluation based on WAI-ARIA

WAI-ARIA 1.0					
Essential Functionality	UI Element	Cause	Effect	User group affected	Erroneous Code Snippet
Book a flight	‘Origin’ and ‘Destination’ text fields ‘One Way’, ‘Round Trip’, ‘Multi City’ web tabs	Content authors not used WAI- <i>arialabelledb</i> y attribute to associate instructions with form controls.	Not supported by some web browsers (older versions) and screen readers.	Sensory, Ageing, Sensory	<pre><div class="col-xs-12 col-sm-6"><div class="control-group"><label class="control-label" for="_bookingportlet_WAR_saaairw_aysportlet_origin"> Origin * </label><input class="field control-label field control-field" id="_bookingportlet_WAR_saaairw_aysportlet_origin" name="_bookingportlet_WAR_saaairw_aysportlet_origin" placeholder="Origin" type="text" value="" maxLength="90" ariainvalid="false" role="combobox" aria-required="true" /></div></pre>

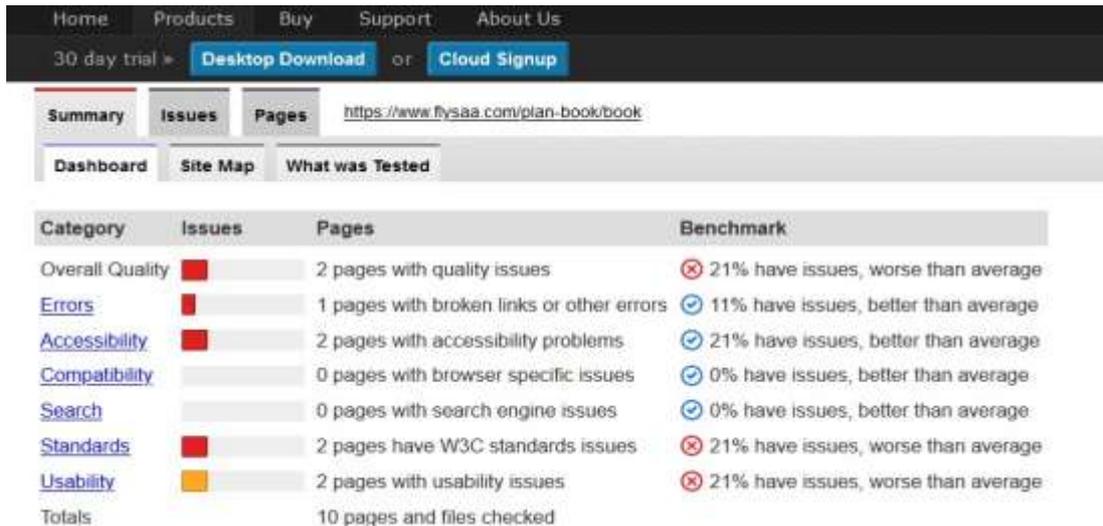


Figure 4. Automatic Evaluation result using PowerMapper.

5.7. Color Contrast Evaluation Result

The Ethiopian Airlines website flight booking page has failed the color contrast test as its ratio is 3.95:1 whereas the WCAG 2.1 standard is ratio 4.5:1. The evaluation didn't consider large texts, incident text or images, and logo types. The same functionality page by South African airlines website has passed the evaluation. The evaluation also includes placeholder texts for 'Origin' and 'Destination' text fields; but both passed the minimum contrast ratio which is not a usual case for placeholders.

5.8. Ethiopian and South African Airlines Booking Mobile Application Evaluation Results

According to the heuristics defined in Table 2., the following results are discovered and summarized in Table 9.

Table 9. Heuristics evaluation for mobile applications booking functionality

Heuristics	Problem Found	
	Ethiopian Airlines	South African Airlines
MEH001	No auditory image description in the mobile app for people with visual impairment	No auditory image description in the mobile app for people with visual impairment.
MEH002	UI components seen and read by Talkback is different.	Messy and complex UI with less important components are at the front.
MEH003	Passed	Important functionalities are accessed after scrolling down to book a flight
MEH004	Difficult to select the setting button on the home screen as it is near the border and tiny spacing between the 'Refresh' button.	Large, less attractive, and discouraging links that cover almost half of the screen.
MEH005	Not easy to enter 'Departure' and 'Return' dates	Passed
MEH006	'Adult', 'Child', 'Infant', 'Promo Code' labels and 'Use miles' radio button have poor contrast.	Passed (including placeholders)
MEH007	Difficult to understand UI group about 'Flight Category' (economy, business, both) preferences as they seem nonactionable/clickable/ UI component	less intuitive UI and components
MEH008	Poor Error communication when departure date is entered after return date.	Passed

5.9. Comparison based on Success Criteria and Conformance Levels

According to the result, we have tried to summarize content accessibility issues for both websites and summarized the comparison first using tabular representation and next with charts. The tabular representation is shown in Table 10.

Table 10. Comparison based on success criteria and conformance levels

Success Criteria	Ethiopian		South African		Conformance Levels
	Yes	No	Yes	No	
Provide a text equivalent for non-text element		✓		✓	A
The primary natural language of the web unit can be programmatically determined.		✓		✓	A
Organize documents so they may be read without style sheets. For example, when an HTML document is rendered without associated style sheets, it must still be possible to read the document.		✓		✓	A
Information that is conveyed by variations in presentation of text is also conveyed in text, or the variations in presentation of text can be programmatically determined.		✓		✓	AA
All functionality of the content operable from keyboard		✓		✓	A
Web units have titles		✓		✓	AA
Titles, headings, and labels are descriptive		✓		✓	AAA
If an input error is detected, the error is identified and described to the user in the text.		✓	✓		A
Context-sensitive help is available for text input		✓		✓	AAA
Ensure that foreground and background color combinations provide sufficient contrast when viewed by someone having color deficits or when viewed on a black and white screen.		✓	✓		AA
Use header elements to convey document structure and use them according to specification.	✓		✓		A
Use navigation mechanisms in a consistent manner.		✓	✓		A
Components that have the same functionality within a set of Web units are identified consistently.		✓		✓	AA
Web units or authored components can be parsed unambiguously, and the relationships in the resulting data structure are also unambiguous.		✓		✓	A

The chart representation is shown in Figure 5.

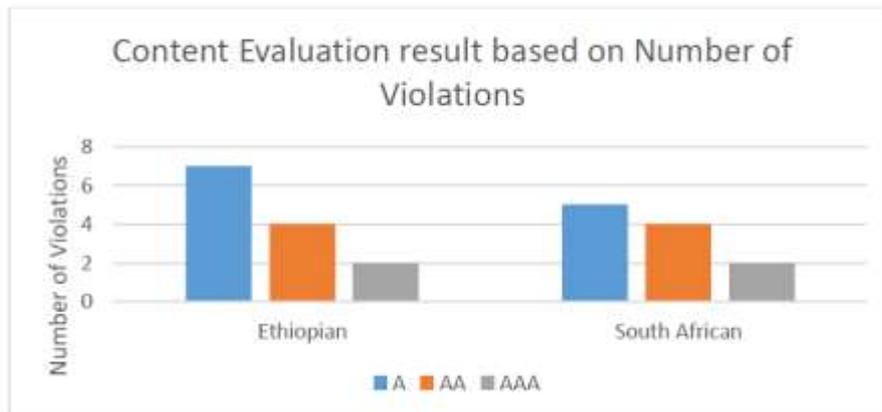


Figure 5. Comparison based on success criteria and conformance levels

5.10. Comparison Based on Automatic Evaluation

We have evaluated the website content accessibility using WAVE and FAE tools. We manually counted the results and summarize the finding using tables and charts. The tabular summarization is depicted in Table 11.

Table 11. Comparison based on automatic evaluation tools

	Tool	Accessibility Guideline Reference	URL	General Error	Contrast Error	Warning
Ethiopian	WAVE	WCAG 2.0	https://www.ethiopianairlines.com/no	69	0	59
		WCAG 2.0	https://www.ethiopianairlines.com/no/book/trip/flight	29	1	19
	FAE	WCAG 2.0, ARIA 1.0	https://www.ethiopianairlines.com/no	6	NA	3
		WCAG 2.0, ARIA 1.0	https://www.ethiopianairlines.com/no/book/trip/flight	7	NA	2
South African	WAVE	WCAG 2.0	https://www.flysaa.com/	6	18	29
		WCAG 2.0	https://www.flysaa.com/plan-book/book	5	17	10
	FAE	WCAG 2.0, ARIA 1.0	https://www.flysaa.com/	4	NA	3
		WCAG 2.0, ARIA 1.0	https://www.flysaa.com/plan-book/book	3	NA	2

The chart summarization is depicted in Figure 6.



Figure 6. Comparison based on success criteria and conformance levels

6. CONCLUSION

We are living in a much diversified world that is quite normal. This diversity can be expressed in terms of ability, disability, culture, language, religion, gender, age, and so on. Any organization with an interactive system that targets to create a better customer relationship globally must consider the notion of this diversity. Instead of testing the accessibility of a system at the end of

the development, it is very critical to consider it early and to recheck accessibility barriers iteratively.

According to our findings, South African Airlines is better than Ethiopian Airlines in terms of website accessibility whereas Ethiopian is better in mobile application accessibility. However, both airlines shall work hard to inclusively design their interactive systems. To do so, they need to consider the seven principles of UD when they enhance their interactive systems.

REFERENCES

- [1] Heinz, S., and O'Connell, J.F.: 'Air transport in Africa: toward sustainable business models for African airlines', *Journal of Transport Geography*, 2013, 31, pp. 72-83. <https://doi.org/10.1016/j.jtrangeo.2013.05.004>
- [2] Organization, W.T.: 'Tourism highlights 2018 Edition', in Editor (Ed.)^(Eds.): 'Book Tourism highlights 2018 Edition' (World Tourism Organization UNWTO, 2018, edn.), pp.
- [3] ICAO Uniting Aviation, A.U.S.A.: 'The World of Air Transport in 2017', 2017
- [4] Google: 'Think With Google', 2016
- [5] CRSs, G.D., Travel Agencies, and Online Reservations: 'History of Flight Booking', 2019
- [6] Awards, W.A.: 'Best Airlines by Region', 2019
- [7] africafacts.org: 'Africa Facts, Top 10 Best, Airlines', 2019
- [8] Meichsner, N.A., O'Connell, J.F., and Warnock-Smith, D.: 'The future for African air transport: Learning from Ethiopian Airlines', *Journal of Transport Geography*, 2018, 71, pp. 182-197. <https://doi.org/10.1016/j.jtrangeo.2018.06.020>
- [9] Airlines, E.: 'Ethiopian Airlines, History', 2019
- [10] Airways, S.A.: 'South African Airways: History', 2019
- [11] Mhlanga, O., and Steyn, J.: 'The aviation industry in South Africa: A historical overview', 2016. <http://hdl.handle.net/11189/5825>
- [12] Statistics, G.: 'Browser market share', 2019
- [13] Statistics, G.: 'Mobile Operating System Share', 2019
- [14] UN, D.o.E.a.S.A.: 'Disability, Article 9-Accessibility', 2019
- [15] Benyon, D.: 'Designing interactive systems: A comprehensive guide to HCI, UX and interaction design', 2014
- [16] Bias, R.G., and Mayhew, D.J.: 'Cost-justifying usability: An update for the Internet age' (Elsevier, 2005. 2005)
- [17] Hassan, S.T.: 'Online travel agencies: selling through opaque fares', *South Asian Journal of Marketing & Management Research*, 2013, 3, (3), pp. 56-58
- [18] Guritno, S., and Siringoringo, H.: 'Perceived usefulness, ease of use, and attitude towards online shopping usefulness towards online airlines ticket purchase', *Procedia-Social and Behavioral Sciences*, 2013, 81, pp. 212-216
- [19] Harteveldt, H.H.: 'The Future of Airline Distribution, 2016–2021', Atmosphere Research Group, 2016 <https://doi.org/10.1016/j.jairtraman.2005.11.005>,
- [20] ISO: 'Human-centred Design Processes for Interactive Systems', 1999
- [21] Nielsen, J.: 'Usability inspection methods', in Editor (Ed.)^(Eds.): 'Book Usability inspection methods' (1994, edn.), pp. 413-414
- [22] Orozco, A., Tabares, V., and Duque, N.: 'Methodology for heuristic evaluation of web accessibility oriented to types of disabilities', in Editor (Ed.)^(Eds.): 'Book Methodology for heuristic evaluation of web accessibility oriented to types of disabilities' (Springer, 2016, edn.), pp. 91-97

AUTHORS

Bisrat Betru is a Fullstack Software Developer with more than nine years of experience in the IT industry. He has MSc. degree in Computer Science from Addis Ababa University and another MSc. in Applied Computer and Information Technology from Oslo Metropolitan University. He was served as a System Administrator in the banking sector, as an IT Consultant for the World Bank Group, and a Software Developer for a private tech firm. He was also served as a Product Developer for a startup company in Oslo Science Park.

Uchenna Kelechi Ogbonna is a Frontend Developer with around seven years of experience in web development and UX design. He was served in private and public sectors at local and international levels. He is currently doing his masters at Oslo Metropolitan University in Universal Design of ICT. His research interest mainly focuses on web accessibility, inclusive design, and intelligent interface design.