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Addis Ababa University
College of Natural Science
School of Information Science

**Accessibility and Usability Evaluation of Ethiopian
Airlines Website**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa
University in Partial Fulfillment of the Requirements for the Degree of Master
of Science in Information System**

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Accessibility and Usability Evaluation of Website at Ethiopian Airlines

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Abstract

The development of user-friendly and accessible digital platforms is crucial for the airline's success. The airline's website, as its major digital platform, serves as a means for customers to access information, make bookings, and interact with the brand. It is critical for airlines to provide high-quality website usability and accessibility to meet customer expectations, create business development, and retain a competitive advantage in the market. The purpose of this study is to evaluate the usability and accessibility of the Ethiopian Airlines website, identifying areas for improvement and providing insights to enhance the user experience and address accessibility challenges. To achieve this objective, a mixed-method approach is used, the study integrates an online questionnaire, user-based testing utilizing Morae software, and automatic evaluation tools such as Accessibility Checker, WAVE, GTmetrix, and Google Lighthouse. The participant sample comprised 10 individuals which are members of sheba miles and who completed seven tasks using Morae, while an online questionnaire was administered to additional 32 Ethiopian Airlines customers who had utilized the website for flight bookings and were enrolled in the Sheba Miles frequent flier loyalty program. The findings of the study indicate there is the need for improvements in the website's usability and accessibility those are significant accessibility issues within the Ethiopian Airlines website, which hinder users with impairments to access the information and services provided. Additionally, the research uncovers various usability concerns, including difficulties in locating relevant information, slow page loading times, a lack of user friendliness, navigation challenges, and decreased user satisfaction.

Keywords:

Usability, Accessibility, WCAG, Website evaluation, User-centered design.

Table of Contents

Acknowledgements	iv
Abstract.....	v
List of Tables	viii
List of Figures.....	ix
List of Acronyms	x
CHAPTER ONE.....	1
INTRODUCTION	1
1.1 Background.....	1
1.2 Statement of the problem.....	4
1.3 Objective of the study	7
1.3.1 Main objective	7
1.3.2 Specific objective.....	7
1.4 Significance of the Study	7
1.5 Scope and limitation of the study	8
1.6 Organization of the research	9
CHAPTER TWO.....	10
LITREATURE REVIEW	10
2.1 Online Flight Reservation Systems Websites	10
2.3 Website and its key characteristics	10
2.4 The Concept of Usability and Accessibility	11
2.5 Components of Usability and accessibility	13
2.6 Usability and Accessibility Evaluation Methods	14
2.7.1 User-based Usability evaluation methods.....	15
2.7.2 Evaluator-based/Expert based Usability evaluation methods	16
2.7.3 Automatic website evaluation tools	17
2.7 Usability and Accessibility Evaluation models	19
2.7 Related Works	22
CHAPTER THREE	30
RESEARCH DESIGN AND METHODOLOGY	30
3.1 Research Approach	30
3.1.1 User Based Evaluation.....	31
3.1.2 Automated Evaluation Tools	32

3.2	Subjects of the study	Error! Bookmark not defined.
3.3	Sampling Technique.....	35
3.4	Data Collection Instrument	35
3.4.1	Questionnaire.....	35
3.4.2	Usability Evaluation Software	36
3.4.3	Document Analysis.....	37
3.5	Data Collection Procedure	37
CHAPTER FOUR		39
DATA ANALYSIS, DISCUSSION AND PRESENTATION		39
4.1	Findings of User Based Evaluation.....	39
4.1.1	Demographics Description of the Respondents	40
4.1.2	Analysis of Website Information Organization	41
4.1.3	Analysis of Difficulty of Reading Characters on Ethiopian airlines pages.....	42
4.1.4	Websites Functionality, Performance Capability and Reliability of Service	42
4.1.5	Users’ reaction to Ethiopian airlines website Main Usability issues	43
4.1.6	User perspective Evaluation Analysis Report Based on Nielson’s Quality Components of Usability ..	48
4.1.7	One Way ANOVA Test.....	51
4.1.8	Regression Analysis.....	52
4.2	Usability Test Using Morae Software	59
4.2.1	Time on Task and Task Success distribution.....	59
4.2.2	Average Mouse Clicks.....	62
4.2.3	Average Mouse Movement by Task	63
4.3	Automatic Evaluation tools.....	64
4.3.1	Usability Evaluation Using Online Tools	64
4.3.2	Accessibility Evaluation Using Online Tools	67
4.4	Summary of the findings.....	72
4.5	Discussion of the result.....	74
CHAPTER FIVE		78
CONCLUSIONS AND RECOMMENDATIONS		78
5.2	Recommendations	81
5.3	Research Limitations.....	82
5.4	Directions for Future Research	82
References		83
APPENDICES		91
Appendix A: Letter of Support Request		91

Appendix C: Morae Software Usability Test Cases	93
Appendix D: Screenshot of Usability Recording Morae Software	94
Appendix E: Screenshot of WAVE accessibility Results	95

List of Tables

Table 1: ASEF FRAMEWORK	21
Table 2: related works.....	26
Table 3: online usability testing tools	34
Table 4:participants of the study.....	35
Table 5:demographic description of respondents	40
Table 6: organization of website information.....	41
Table 7:Difficulty of Reading Characters.....	42
Table 8: Websites Functionality, Performance Capability and Reliability of Service	43
Table 9:website appearance	44
Table 10:website navigation	45
Table 11:website content	46
Table 12: Overall Capability.....	47
Table 13:user satisfaction	48
Table 14: learnability	49
Table 15:memorability.....	49
Table 16:efficiency	50
Table 17: error Prevention and recovery	50
Table 18: satisfaction	51
Table 19:one way anova test.....	52
Table 20: regression analysis	52
Table 21:KMO and Bartlett's Test	54
Table 22:Total Variance Explained	56
Table 23:Rotated Component Matrix	58
Table 24:Website Accessibility Evaluation Summary Results.....	73

List of Figures

Figure 1:age group of respondents.....	40
Figure 2: gender percentage of participants.....	41
Figure 3:Factor Analysis Screen Plot Graph	57
Figure 4:average time on task.....	60
Figure 5:task success distribution	61
Figure 6:average mouse clicks by task	62
Figure 7:average mouse movement by task.....	63
Figure 8:google lighthouse test result	65
Figure 9:gtmetrix test result	66
Figure 10:Home page (flight search)	69
Figure 11: Flight search popup	70
Figure 12:Accessibility Checker evaluation result	71
Figure 13:Accessibility Checker evaluation result details.....	71

List of Acronyms

ADA - American Disabilities Act

AHP - Analytical Hierarchy Process

ASEF - Airlines Site Evaluation Framework

ADOF - Accessibility Design Offer Fulfillment

CDN - Content Delivery Network

CRM - Customer Relationship Management

CSS - Cascading Stylesheet

CWUE - Comprehensive Website Usability Evaluation

EIII - European Internet Inclusion Initiative

GPS - Global Positioning System

HTML - Hyper Text Markup Language

ICT - Information Communication Technology

IATA - International Air Transport Association

IEEE - Institute of Electrical and Electronics Engineers

ISO - International Organization for Standardization

ITU - International telecommunication union

MCDM - Multi Criteria Decision Making

SPSS - Statistical Package for the Social Sciences

TAW - Web Accessibility Tester

UI - User Interface

UCD - User Centered Design

UEM - Usability Evaluation Method

WHO - World Health Organization

W3C - World Wide Web Consortium

WCAG - Web Content Accessibility Guidelines

WUAM - Websites Usability and Accessibility Model

CHAPTER ONE

INTRODUCTION

1.1 Background

Airlines are more and more using the Internet as a platform to develop new revenue sources. These include through digital marketing and sales of their key services (e.g., flight booking and check-in), as well as by the incorporating CRM systems into their business websites [1].

By offering low-cost flight tickets and enabling boarding operations such as e-ticketing and online check-in, airline websites are the most feasible methods for attracting more customers while increasing business values. Airlines can cut labor costs and, in certain circumstances, remove commissions entirely by expanding their usage of online booking, allowing them to increase profit margins [2].

In this paper accessibility and usability of Ethiopian airlines website is assessed. Based on the results improvement recommendations is suggested.

Ethiopian Airlines, serving as the flag carrier of Ethiopia, holds a prominent position as one of the largest and most rapidly expanding airlines across the African continent. It was founded in 1945 as Ethiopian Air Lines, and its first international flight was to Cairo, Egypt, in 1946. Since then, the airline has expanded its network to serve destinations across Africa, the Middle East, Europe, Asia, and the Americas.

Over the years, Ethiopian Airlines has built a reputation for operational excellence, innovation, and customer service. Throughout its 77-year history, it has established itself as a prominent carrier on the African continent. It serves over 125 destinations and uses the most modern and cutting-edge aircraft available.

Ethiopian Airlines has been at the forefront of digital innovation in the African aviation industry. The airline has embraced the use of technology to improve its services and enhance its customer experience. In the early 2000s, Ethiopian Airlines launched its first website, allowing customers to book flights and access information regarding the airline's services. The website was a significant step forward in the airline's digital strategy and helped to improve its visibility to potential customers.

In 2010, Ethiopian Airlines launched its mobile application, which allowed users to book flights, check-in, and access flight information on their mobile devices. The app was well received by customers and helped to streamline the booking and check-in process, making it more convenient for passengers.

In 2016, Ethiopian Airlines launched its Cloud-based Crew Management System, which uses advanced analytics and real-time data to optimize crew management and scheduling. The system has helped to improve crew productivity and reduce costs, making the airline more efficient and profitable. In 2018, Ethiopian Airlines launched its Online Visa Application System, which allows travelers to apply for visas online. The system has streamlined the visa application process, reduced wait times and making it easier for travelers to obtain visas to visit Ethiopia.

In the same year, Ethiopian Airlines also launched its Mobile Wallet payment system, which allows customers to pay for flights and other services using their mobile phones. The system has made it easier for customers to make payments and has helped to reduce the airline's reliance on cash payments.

In 2019, Ethiopian Airlines launched its In-flight Wi-Fi service, which allows passengers to access the internet while on board the aircraft. The service has been well received by customers and has helped to improve the airline's customer experience.

Airlines' fixed and operational expenses have decreased as electronic ticketing systems digitally show tickets to customers, saving on the costs of generating and distributing postal mail. Accounting procedures for online bookings are further simplified because payments for online booking are entirely automated. Organizations and brands that want to use marketing communication tools to stay well ahead of their competitors and safeguard and sustain their presence in the business see the internet as a chance to establish this differentiation[3]

The quality of a website is becoming increasingly important in catching clients' attention as the number of internet users and e-travelers rises. The advancement of the internet and e-commerce technologies, especially in the air transportation industry, necessitates the enhancement of airline websites to get a greater market share and compete with other firms in this sector.

Airlines' websites have become an essential aspect of business activity, and they are being used to improve the efficiency and effectiveness of the business and obtain an advantage in a highly competitive industry. It serves as the passenger's entrance point; these websites must accommodate the demands of abled people and disabled passengers in terms of easily accessing

the website. Unfortunately, a lot of those websites do not address usability and accessibility, and as a result are unable to turn website visitors into customers [4].

Several airlines have been able to improve their customer service and product and service qualities by utilizing web-based tools. The quality of the website is now regarded as a crucial aspect in attracting the customers' attention. Customers are more likely to visit and make purchases at websites that have high qualities [5]. The quality of an airline's website is critical since it acts as a vital point of contact between potential consumers and the airline. As a result, the quality of the airline's website undoubtedly impacts customers' perceptions of the airline [6].

As airlines become more dependent on websites for bookings, the use of travel agents is reduced, and the market grows; website design leads to customer satisfaction which becomes increasingly important in determining airline profitability [7]. The researcher also suggested in his research that ease of use, usefulness, and certain aesthetic features of airline sites are crucial to the customer and thus to the success or failure of the site which directly means the existence of the airline as a business.

Customers come back to buy flight tickets online mostly due to their satisfaction with the online booking processes and a good attitude towards using the online booking system [8]. Website quality is important in increasing traffic, keeping visitors, and eventually getting customers to buy online products. [9] developed a conceptual model that implies website quality (usability and functionality) has an impact on purchase intention through customer satisfaction.

In their research [10] reported that the visual appeal of a website's design, the availability of information, the level of interactivity, the establishment of trust, and the overall ease of use are key elements that significantly impact users' intentions and attitudes towards the website. Furthermore, these effects vary based on the users' prior experience with the site and the tangibility of the product. This suggests that prioritizing the enhancement of site usability, particularly in terms of information accessibility, ease-of-use, and interactive features, is crucial as these factors play a pivotal role in shaping consumers' attitudes and influencing their behavioral intentions.

Usability is the degree to which a website's features are easily and effectively used by users. As the website gets more usable it gets more utilized [11]. According to ISO 9241-11:2018 Usability is described as the degree that a system, service, or product can be accessed by specific users to accomplish specific objectives with effectiveness, efficiency, and satisfaction in a certain context of usage. Usability takes into account numerous elements including interface, the ease of

understanding the website structure and content, as well as the speed with which the users can find the items, they have been searching [12].

Web usability is a collection of user-oriented features such as ease of learning, efficient task completion, low user error rate, subjective user satisfaction, and long-term retention of users [13]. Usability is concerned with designing products that are effective, efficient, and enjoyable. It also includes user experience design.

Usability is commonly regarded as a software quality feature that aims to give solutions to several frustrating issues caused by the interaction between technology and people. It describes the quality of products and systems from the user's perspective. It is a relevant and necessary characteristic for the success and quality of web applications [14]. Whereas accessibility is defined as the degree to which services, products, systems, environments, or resources can be used by people with the widest range of capabilities to accomplish a particular task in a specific context of usage.

According to [15] Web accessibility refers to the concept of designing and developing websites, tools, and technologies in a manner that enables individuals with disabilities to navigate, perceive, understand, interact with, and contribute to the web without encountering any hindrances or barriers.

With the expansion of the internet, research on airlines' website usability and accessibility is increasing. There have been several studies that focused on "Evaluating Accessibility and Usability of Airline Websites" [16], Evaluation of Nigerian Airlines using An Analytical Approach to Accessibility and Usability [17] and there are other studies on the usability and accessibility of airline websites.

1.2 Statement of the problem

The international telecommunication union report claims that in October 2022 world internet users reached 5.07 billion which is 63.5% of the total world population [18]. This internet combustion also impacted airlines' way of doing business. It has provided opportunities for major travel suppliers to segment and target customers directly based on customer preferences [19]

The adoption of technology in airlines has made a great profit. Now every airline has a website that gives service and information 24/7. According to [20] 82% of all travel bookings in 2018 were completed online using a mobile app or website, with no human involvement.

The aviation sector connects the world in a way never before possible, bringing enormous value to the worldwide economy. It contributes USD 3.5 trillion in world economy which is 4.1% of global gross domestic product [21].

The rapid growth of digital technologies has transformed the airline industry, necessitating effective online interactions between airlines and customers. However, despite the increasing dependence on airline websites for information, ticket booking, and other services, persistent usability and accessibility issues indicate significant challenges for users, particularly those with disabilities and diverse needs [22]

Research by [23] found that difficulties in navigating websites, complex booking processes, and lack of alternative text for images were common issues that hindered users, particularly those with visual impairments. They also identified challenges related to form filling, error prevention, and inconsistent website structure as key obstacles impacting users' ability to complete tasks efficiently.

Moreover, studies conducted by [22] underscore the significance of accessibility and usability in the airline industry. They highlight how inaccessible websites and poor usability not only limit individuals with disabilities from accessing vital information and services but also result in reduced customer satisfaction and potential loss of business.

Maintaining core airline services (booking flight, check-in, flight status) and complementary services (car rental, hotel booking ...) is done via the internet. According to a recent research, mobile devices now account for more than one-third of all visitors to travel websites. It seems to reason that airline should aim to give their customers with the finest and most efficient mobile experience possible. Any airline that does not have a mobile solution is likely to be overtaken as competition rises to new levels.

As technology advances, more and more businesses are resorting to the internet market. According to Phocuswright report online booking made through airlines website is projected to reach 46%. The WHO report states that 15% of the world population has disabilities this will rise in number as the world population grows. This stresses the obvious relevance of website quality to market sustainability. So, while developing a website, usability and accessibility must be considered.

According to Amadeus surveys, in comparison to 16% of all passengers, one-third of frequent travelers and one-fourth of those aged 18-34 use smartphones to purchase tickets on regularly.

Airlines should develop mobile friendly applications and websites. Mobile apps assist airlines decrease costs through self-service alternatives, such as kiosks, that speed up the airport boarding process and help current staff concentrate on customer support[24].

Usability and accessibility are critical factors in website development. Ensuring the usability and accessibility of a website is essential for its success. By prioritizing these factors, a website can provide a seamless experience to users, resulting in increased customer satisfaction. This, in turn, has a positive impact on market sales and customer loyalty.

In today's digital age, websites have become indispensable for airline operations. Therefore, having an accessible and usable website is not only beneficial but also necessary for the smooth functioning and growth of an airline business [17].

Numerous research studies have investigated various aspects of usability and accessibility in the context of airline websites but there is only one research by [25] which focuses on Ethiopian airlines. In comparison to their study which focused on accessibility evaluation of Ethiopian and South African airlines' websites and mobile applications takes a distinct approach and focuses specifically on the usability and accessibility evaluation of the Ethiopian Airlines website. While both studies aim to assess the accessibility of airline websites, the target websites and scope of evaluation differ.

The researchers conducted a comparative analysis of Ethiopian and South African airlines' websites and mobile applications, assessing their accessibility features and compliance with accessibility standards. On the other hand, my research is solely dedicated to evaluating the usability and accessibility of the Ethiopian Airlines website, providing an in-depth examination of its interface, navigability, and compliance with international standards such as the Web Content Accessibility Guidelines (WCAG).

While [25] primarily focused on using online tools and questionnaires for their assessment, this research goes a step further by incorporating usability testing software to evaluate users' real time interaction with the website. The inclusion of usability testing software in my research methodology enhances the rigor and validity of the evaluation, as it goes beyond self-report measures and provides direct insights into users' real-time interactions with the website.

Generally, this research is distinct from the previous study by target platform, methodology and evaluation approach and also the focus.

Using its website <https://www.ethiopianairlines.com/> Ethiopian airlines serves its customers by providing services such as online booking tickets, check-in, loyalty programs (Sheba miles frequent flier program), marketing, promotion, and sales deals and offers.

The objective of this research is to evaluate the usability and accessibility of airlines website pages. Therefore, it aims to answer the following research questions.

- (i) What is the overall level of user satisfaction with the usability of the website?
- (ii) What best practices and guidelines for usability and accessibility should be considered when redesigning or improving the website?
- (iii) What is the accessibility status of the Ethiopian airline's website?

By building upon the existing body of research, this thesis seeks to contribute to the knowledge and understanding of accessibility and usability issues faced by users of Ethiopian Airlines' website. The findings of this study provide valuable insights and recommendations to enhance the website's accessibility and usability, fostering inclusivity and improving the overall user experience for all users.

1.3 Objective of the study

1.3.1 Main objective

The main objective of this study is to assess usability and accessibility of Ethiopian airlines website and recommend improvement ideas.

1.3.2 Specific objective

- To examine the accessibility of the website using various guidelines, standards, and tools.
- To identify learnability, efficiency, effectiveness, and memorability issues
- To explore how the usability and accessibility of the website
- To recommend improvements Ethiopian airlines user interface and layout design.

1.4 Significance of the Study

Both researchers and practitioners are believed to benefit from this study. For researchers, the study provides a valuable case study of the accessibility and usability of a major African airline's website. The study's findings can serve as a foundation for identifying potential areas of future research and exploration in the domains of web accessibility and usability.

For practitioners, the study offers practical insights into the specific challenges and opportunities facing an African airline in terms of website accessibility and usability. It can also be used to guide the development of more accessible and user-friendly digital products by airlines in the region and beyond. The study's findings can also be used to inform the development of best practices and guidelines for website accessibility and usability in the aviation industry.

Overall, the significance of this study lies in its potential to improve the user experience, ensure inclusivity, align with international standards, provide a competitive advantage, and address the research gap in the usability and accessibility evaluation of the Ethiopian Airlines website. The findings and recommendations derived from this research can inform the airline's efforts to create a more user-centric and accessible online platform, ultimately enhancing the satisfaction and engagement of its website users.

1.5 Scope and limitation of the study

This study focused on assessing the usability and accessibility of selected Ethiopian Airlines website and propose recommendations for improvement. Thus, the main goal of the study is to examine the Ethiopian airlines website, evaluate the usability and accessibility compliance based on two testing mechanisms namely user-based testing using online questionnaire and usability testing, and online tools which uses guidelines and frameworks and finally analyze the findings to forward recommendations for improvement.

The data used in the study includes qualitative data from an online questionnaire administered to Ethiopian Airlines customers of Sheba miles loyalty program, as well as quantitative data from usability testing conducted using Morae software and automatic evaluation tools such as Accessibility Checker, WAVE, GTmetrix, and Google Lighthouse. The data coverage focuses on user perceptions, experiences, task performance, and objective measures of accessibility and performance.

The limitation of this research is that due to time and resource constraint the study is conducted on selected pages of Ethiopian airlines website which is the pages used for booking a flight and giving information on flight booking. The study is also limited to evaluating from users and online tools perspective and it does not include expert view.

1.6 Organization of the research

The thesis consists of five chapters. The first chapter will introduce the research problem, objectives, questions, and significance of the study. Additionally, this chapter will give an overview of Ethiopian Airlines, its website.

The second chapter will present the literature review, discussing web and mobile accessibility and usability, airline websites. The chapter will also review the existing evaluation frameworks and guidelines for assessing the accessibility and usability of digital products.

The third chapter will describe the research methodology, including the research approach, data collection techniques, data analysis methods, and ethical concerns of the study. It also provides a description of the participants, data collection instruments, and data collection processes.

The fourth chapter presents the findings of the accessibility and usability evaluation of the Ethiopian Airlines website and present the results of the statistical analysis of the data collected. Finally, the fifth chapter provides a conclusion, recommendations, limitations of the study and research directions for the future.

CHAPTER TWO

LITREATURE REVIEW

The goal of this chapter is to give a general overview of airline websites and applications. Additionally, the chapter explores the various usability and accessibility issues faced by airline websites, drawing on findings from related studies that have taken different perspectives and approaches. By synthesizing these sources, this chapter aims to lay the foundation for the subsequent evaluation of Ethiopian Airlines' website usability and accessibility.

2.1 Online Flight Reservation Systems Websites

According to [26] worldwide online travel industry reached USD 354.2 billion in 2021. The growing use of mobile ticketing has improved user interface simplicity and increased customer satisfaction for the transportation system. Users can now order, buy, manage, and validate ticket pricing online. Mobile applications provide unique features that other internet platforms cannot, such as determining real-time user location, executing transactions at any time or location, customizing services for specific users, and facilitating rapid communication with customers via push notifications [27].

Airlines' use of websites and mobile applications allows them to reduce passenger service expenses while also offering opportunity to develop real-time, interactive interactions with customers. With the increasing number of Portable Electronic Devices that passengers carry in the terminal and on board the aircraft, there appears to be a real market opening to make airline website and apps more essential [28], [29].

2.3 Website and its key characteristics

A website is a collection of web pages and digital content that is accessible through a unique domain name on the Internet. It has evolved into an indispensable tool for providing people's information needs of all works of life. People visit the website for various reasons including information gathering, communication to online marketing of goods and services.

Visual appeal emerges as a critical factor in capturing users' attention and creating positive perceptions. Research by [30] indicates the role of aesthetics in website design, highlighting the

impact of well-organized layouts, appealing color schemes, and intuitive navigation on user satisfaction.

Usability, another crucial characteristic, [31] emphasizes the importance of user-centered design principles, such as simplicity, consistency, and user feedback, in enhancing website usability. Efficient navigation and clear information architecture are key factors both of which contribute to a positive user experience.

Content quality is another significant aspect of effective websites. Relevant, accurate, and up-to-date content helps establish trust and credibility with users. Research by highlights the importance of credibility in website design, emphasizing the need for well-structured and concise content tailored to the target audience.

Mobile responsiveness is increasingly important in today's mobile-driven world. According to [32]the need for responsive design and mobile optimization to ensure a seamless user experience across different devices and screen sizes.

2.4 The Concept of Usability and Accessibility

Nowadays, the quality of a company's website is critical to its success, especially if the company offers its services online. Usability is a quality attribute assessment of a product's user interface, such as websites and mobile applications, in addition to its value in allowing users to complete specific task. Users visit or return to a website if the information is useful, easy to navigate and access, and given in a well-organized layout. This implies that the acceptance of a website is primarily based on usability as it is one of the relevant factors of a quality website [33].

According to [34] one of the most significant quality aspects for websites is usability, it serves as acceptance criteria for interactive software applications. Due to users' various abilities, cultures, experiences, and physical and mental disabilities a website must be designed and developed to be user friendly and accessible to all users, including those with special needs [35]. According to [36] usability is the ease of use and acceptability of a product for a particular class of users doing tasks in a particular setting. Usability is the quality of a system in terms of simplicity of use, ease of learning and user satisfaction[37].

Usability refers to a software product's capacity to be understood, learnt, utilized, and appealing to the user when used under specific conditions [38]. It assesses the degree to which a product can

be utilized by designated users to successfully accomplish predetermined objectives, demonstrating efficiency, effectiveness, and satisfaction within a particular usage context. It encompasses the user's ability to easily learn, operate, input data into, and interpret the outputs of a system or component.

Usability can be defined as a fundamental component of quality that assesses the user-friendliness and ease of use of user interfaces for diverse individuals. It encompasses a set of practices aimed at enhancing the ease-of-use during the design process, ensuring that interfaces are intuitive and accessible to users of varying backgrounds and abilities. It is defined by 5 quality components efficiency, errors, learnability, satisfaction, and memorability.

Every design should follow universal design principles. Universal Design refers to the intentional and inclusive approach in designing and structuring an environment to ensure optimal accessibility, understanding, and usability for individuals of diverse backgrounds, regardless of their age, physical appearance, capabilities, or disabilities[39] It has Seven principles:

- **equitable use:** People with various abilities should be able to use the design.
- **flexibility in use:** It should be adaptable to a wide variety of users preferences and abilities.
- **simple and intuitive to use:** It should be simple to grasp regardless of the user's experience or understanding of the language, and it should avoid complexity.
- **perceptible information:** It successfully delivers necessary information regardless of the user's sensory capability.
- **tolerance for error:** It should minimize errors and provide warning and safe fail features
- **low physical effort:** It can be used with minimum effort and comfortably.
- **size and space for approach and use:** appropriate space and size should be provided

Web accessibility is the capacity to develop websites that can be used by various groups of people regardless of disabilities. It indicates that people with disability can simply observe, understand, navigate, and engage with websites and tools [15] .

Accessibility encompasses a broad spectrum of disabilities, encompassing visual impairments, hearing impairments, physical limitations, speech difficulties, cognitive challenges, language barriers, learning differences, and neurological conditions. According to [15] There are four pillars of web content accessibility guidelines

Perceivable: all information and functionality should be visible and accessible to all users. It discusses that all content must be able to be read and perceived by users regardless of their disability. So, a web or app must provide text alternatives, alternatives for time-based medias such as audio and video, create adaptable content that can be shown in various modes, make it easier for user to distinguish what they are perceiving such as audio control and color use.

Operable: A website should be functionally usable regardless of how it is accessed. It must support input mechanisms available, give users sufficient time to read and use the content, and provide easy to navigate and find content.

Understandable: The content should be understood by all users and shouldn't be complex and difficult to comprehend. Avoid jargon and unusual words, make the website operate in predictable ways, recognize, and notify or correct input errors.

Robust: The content should be usable across a platform and remain usable as technology changes. The content must be compatible with current and future devices and technologies

2.5 Components of Usability and accessibility

ISO defines usability as the degree to which a product can be used to accomplish specific goals with efficiency, effectiveness, and satisfaction in a particular setting. It specifies three factors to consider when assessing usability.

- **User:** The individual who engages with the product.
- **Goal:** Desired result.
- **Context of use:** Users, tasks, equipment as well as the physical and social contexts in which a product is used.

Nielsen Identified five quality components of usability:

- **Learnability:** How easily can a user accomplish basic tasks when encountering the design for the first time?
- **Efficiency:** How fast can users' complete activities or retrieve information once they have understood the design?
- **Memorability:** When users return to the design after a period of inactivity, how soon can they regain proficiency?

- **Errors:** How often do users make mistakes, how significant are these errors, and how readily can they be corrected?
- **Satisfaction:** How enjoyable is the experience of using the design?

2.6 Usability and Accessibility Evaluation Methods

Applying principles for the design of usable apps is insufficient to assure the final product's usability. Even if design methodologies may be utilized, it is still required to evaluate intermediate findings and test the final product to ensure that it has the intended functionality and fulfills the user requirements. The role of evaluation is to help in the verification of such issues [33].

An evaluation has three primary objectives: first, to evaluate the application's functionality; second, to assess the impact of the application's interface on the user; and third, to find problems with the application, such as features that show unanticipated effects when used within the intended context [40]. Usability evaluation is an extension of testing that use prototypes to validate the application design against usability requirements.

Usability evaluation is the process of identifying issues related with a user's interaction with a product [41]. In general, it refers to the various methods, for gathering and analyzing data about user interaction with a system, or how certain system features help to achieve a particular extent of usability and accessibility [42].

In answer to the problem of developing more accessible Web apps, several techniques, tactics, and technologies have been created. Even though there is a lot of expertise on how to construct acceptable Web apps, the majority of these applications fall short of most consumers' usability standards.

According to [43], usability evaluation method (UEM) is a method or technique for evaluating or testing the usability of an interaction design at any point of its development. A usability evaluation technique is a process that consists of a series of clearly defined actions for gathering use data linked to the user's interaction with a software product and/or how particular features of this software product help in reaching a particular level of usability.

Evaluation encompasses three primary objectives: first, to evaluate the scope and accessibility of the system's functionality, ensuring that the design meets user requirements and facilitates ease of task completion. Secondly, to gauge users' overall experience during interaction, encompassing

factors such as ease of learning, usability, and user satisfaction. Lastly, evaluation aims to identify any specific issues or challenges within the system, addressing and resolving unexpected outcomes, confusion, and areas of difficulty[40].

UEM is classified into five broad areas [44]: Testing (the assessor observes how a user performs a task), Inspection (the examiner follows a set of guidelines), Inquiry (Feedback on the interface is provided through user interviews, observations, etc.), Analytical modeling (using various models to forecast usability) and Simulation (using simulation technique to mimic and report the how users interact with the interface). Usability evaluation methods majorly categorized as Empirical methods which captures and analyze usage real time data from end user. Users assigned to perform a task and an expert, or a tool records the outcome. Inspection methods is performed by expert evaluators and the result is compared with set of guidelines

According to [45] usability evaluation can be classified into four groups: automatic, empirical, formal usage of models, and informal. Automatic evaluation involves software assessing usability, empirical evaluation involves testing with real users, formal evaluation uses models, and informal evaluation relies on rules of thumb and expert opinions. According to [46] usability evaluation methods categorized in to three major categories as Evaluator based, User based, and Tool based.

UEM is classified in to six major approaches which are User based, Evaluator based, Model based Soft Computing based, Tool based, and Multi criteria decision making based (MCDM) [47].

According to [48] three core constructs of usability measurement are efficiency, effectiveness, and satisfaction. Depending on the phase evaluation is performed it can be divided as formative evaluation which occurs during product design and summative evaluation which takes places after prototype or product is developed [49]. Websites can be measured manually or automatically using evaluation tools. According to [50] website evaluation methods can be categorized as:

2.7.1 User-based Usability evaluation methods

User-centered design (UCD) encompasses a set of methodologies that prioritize the inclusion of users throughout the entire product design and development cycle [51] This approach ensures that the design process is driven and informed by the users' behaviors, values, and expectations, from initial stages to the final product.

According to [52] UCD refers to a set of techniques that place users at the core of product design and development. It promotes including them on every stage of the design process, utilizing a variation of research and design approaches, to build very helpful and accessible products for end users.

This method evaluates users in real-time while performing a task, so it provides reliable evaluation. This enables assessors to overcome the lack of accuracy shown by predictive models when the application area is not accompanied by a robust and clear explanation [42]. This method also has a drawback. It is difficult to choose the right sample, it takes more time and resources specially if the features of web application are vast and sophisticated. Selecting improper sample and not well-trained users may lead to unrealistic conclusions rather than realistic outcomes [53].

2.7.2 Evaluator-based/Expert based Usability evaluation methods

The evaluator or expert inspects the interface and evaluates system usability using design standards, interface guidelines, user tasks, or their own knowledge, depending on the approach used to identify potential user problems [54] The evaluators can be designers, engineers, or usability specialists. Under this evaluation technique there are various methods such as guideline reviews, heuristic evaluation, standard inspection, and cognitive walkthrough [46].

- **Heuristic Evaluation:** is a form of expert-based usability evaluation approach in which the expert evaluates the user interface using heuristics or a set of guidelines and principles. Each evaluator passes through the system interface at least twice throughout the evaluation session. The first phase is to get a sense of the interaction's flow and the application's overall scope; the second is to concentrate on a specific item and its functionality, analyzing its design and execution against a set of standards and rules. A heuristic evaluation session produces a list of usability problems with references to the violated heuristics [49] .

Nielsen's ten heuristics which primarily address general website usability and Gerhardt-Powals' guidelines are some of the guidelines used in heuristic evaluation. Heuristic evaluation can be performed quickly, saving time, which is the major goal of such an evaluation [55]. [31] claims that heuristic evaluation can discover most usability issues. On the contrary, according to [41], heuristics evaluation is detachment from the user, which

increases risk of errors being missed in evaluation due to the impaired degree of exploration.

- **Cognitive Walkthrough:** A way of evaluating user cognitive activity, goals, and knowledge while learning to perform a specific task utilizing the system. The evaluator walks through the user interface steps necessary to perform a job and looks for any possible usability flaws during the walkthrough. It focuses on analyzing the usability concerns that system users may have while learning to perform tasks.
- **Pluralistic walkthrough:** is a usability evaluation approach that entails a collaborative design session in which representative users and system designers discuss and explore new ideas. This strategy develops active participation and interaction from diverse stakeholders during the design process, allowing for the exchange of important insights and perspectives. It is always led by a facilitator, who introduces the interface and starts discussions. Pluralistic walkthroughs are quite similar to cognitive walkthroughs, with the key distinction being the assessment team's comprehensiveness.
- **Feature inspection** examines feature sequences used to complete regular tasks, looking for lengthy sequences, difficult stages, steps that are not natural for users to undertake, and steps that need substantial knowledge/experience to evaluate a suggested feature set.
- **Consistency inspection** involved designers from many projects inspecting an interface to check if it performs the same functions as their own designs. The goal is to provide uniformity across a set of previously tested items.
- **Standards inspection** an interface expert conducts a thorough examination of the interface to ensure compliance with established standards.
- **Formal usability inspection** includes individual and group inspections in a six-step approach with clearly defined responsibilities, integrating components of heuristic evaluation and a simplified version of cognitive walkthroughs.

2.7.3 Automatic website evaluation tools

Automated usability assessment approaches, like heuristic evaluations, adhere to a set of predetermined guidelines developed by specialists. The primary distinction between automated and heuristic evaluation is that in the case of automatic evaluation, a software system evaluates the interface against the standards rather than human users. It is a software that automates the

collection of interface usage data (automated capture) or the detection of possible problems (automated analysis) and the resolution (automated critique) of potential problems [56].

It emphasizes on developing techniques and tools to rapid evaluation tools for larger numbers of subjects that reach a broader range audience of users for usability testing, as well as solutions with built-in automated remote analysis features [57]. It requires less time and effort to use as the configuration of the tool for automatic usability evaluation can be done once and, afterwards, evaluation can be performed several times without any preliminary configurations and human involvement.

According to [58] Automated evaluation tools pass through three processes data capture which includes gathering usability data, such as subjective ratings, errors, task completion duration, and guideline violations, Analysis it is the phase where usability data are interpreted to identify usability and accessibility problems in the web site and Critique which consists of suggesting solutions or improvements to mitigate the previously identified problems.

The Most Common Automated Website Usability and Accessibility Tools are:

- **WAVE accessibility evaluation tool** is a tool that assesses the websites accessibility according to the W3C WCAG 2.0 standards online. Its purpose is to evaluate the accessibility extent in the design and web pages development, ensuring inclusivity for all individuals, regardless of their unique features.
- **Page Speed Insight:** is googles free performance evaluating tool which analyzes the content of given webpage and provides suggestion on what to improve.
- **FAE – Functional Accessibility Evaluator:** evaluates a web page for its accessibility by referencing the Web Accessibility Standards such as WCAG and the results of the evaluation are broken into 5 categories: Navigation and Orientation, Text Equivalents, Scripting, Styling and HTML Standards
- **Web Accessibility Tester (TAW)** is an online application for analyzing the accessibility of websites using guidelines. Its purpose is to examine the extent of accessibility in web page development and design to provide access for everyone, despite their individual features.

2.7 Usability and Accessibility Evaluation models

Traditionally, service quality for products and services of non-internet-based customer experience and interaction is measured using a well-known model: SERVQUAL, which focuses the difference between customer expectations and perceptions on five dimensions, namely, tangibles, responsiveness, reliability, assurance, and empathy [59]. Based on similarity to the five dimensions of SERVQUAL model, [60] proposed seven criteria (E-QUAL): accessibility, content navigation, design/presentation, responsiveness/ feedback, background information, and personalization/customization.

In the research [61] proposed a quantitative model centered website quality evaluation method called WEBQEM that has four major technical phases and they extracted four criteria as functionality, usability, efficiency, and reliability. [62] developed WEBQUAL a website quality measurement technique based on the perception of end users with twelve dimensions such as informational fit-to-task, response time, ease of understanding, tailored information, trust, intuitive operations, visual appeal, innovativeness, emotional appeal, consistent image, on-line completeness, relative advantage.

A model developed by [63] to measure quality of airlines website. The proposed is approved by customers, airline staffs and ticket agencies the model comprises three major factors which contains various metrics to be considered the three major factors are ease of use, quality information and security and privacy.

To measure the success of website [64] developed ADOF model which includes

- Accessibility: the visibility and simplicity of finding a website.
- Design: the degree to which the contents of a website are organized, accessible and the users may easily discover the information they want.
- Offer: to persuade clients to buy online, items and services should be presented at cheaper prices than in the real world, or the website should create greater perceived quality levels.
- Fulfillment: the extent to which the company's commitments to consumers are met (for example, delivery delays, returns, and complaint processing).

Nielsen's heuristic approach states there are 10 general principles for interactive design

- (i) Aesthetic and minimalist design.
- (ii) Error prevention.
- (iii) Visibility of system status.
- (iv) Flexibility and efficiency of use.
- (v) Match between system and the real world.
- (vi) User control and freedom.
- (vii) Recognition rather than recall.
- (viii) Help users recognize, diagnose, and recover from errors.
- (ix) Consistency and standards.
- (x) Help and documentation.

Similarly, [65] developed a principle for designing efficient and effective interface called Schneiderman's Eight Golden Rules which includes:

- i. Strive for consistency: This rule emphasizes the importance of using consistent terminology, layout, and design elements throughout the website.
- ii. Enable frequent users to use shortcuts: This rule suggests providing shortcuts, such as keyboard shortcuts, to allow frequent users to complete tasks more quickly.
- iii. Provide feedback: This rule emphasizes the importance of providing users with feedback, such as confirmation messages or error messages, to ensure that they understand the consequences of their actions.
- iv. Provide error prevention and simple error handling: This rule suggests designing the website in a way that prevents errors from occurring and provides simple and clear error messages when errors do occur.
- v. Permit easy reversal of actions: This rule suggests allowing users to undo their actions, such as using an "undo" button.
- vi. Support internal locus of control: This rule emphasizes the importance of giving users a sense of control over their interactions with the website, such as using clear and visible navigation menus.

- vii. Reduce short-term memory load: This rule suggests designing the website in a way that minimizes the amount of information that users need to remember at any given time, such as using clear and concise instructions.
- viii. Provide perceptible information: This rule suggests designing the website in a way that makes important information perceptible, such as using clear and prominent headings.

WCAG 2.1 categorizes four web accessibility principles in four categories

- **Perceivable:** Website’s user interface and all information in that website must be visible to all type of user so that they can be aware of all things listed there.
- **Operable:** Websites should be operable for all type of users using their own way of operation.
- **Understandable:** All information should be understandable to all users.
- **Robust:** Content of website should be accessible even technology gets enhanced.

By assessing 30 airlines around the world [66] developed airlines site evaluation framework (ASEF). It is focused on analyzing airline websites from the perspective of a customer. It contains six categories Finding, Navigation, Interface, Reliability, Content, and technical aspects. Each category consists of several subcategories and subcategories contain several criteria. The framework is shown in the table below.

This airline site evaluation framework provides a collection of criteria to assess the effectiveness and usability of airline websites. It covers multiple aspects, including site finding, interface and presentation, navigation, content, functionality, and usability. It emphasizes the importance of intuitive organization and structure, easy-to-use search functionality, mobile-responsive design, and accessibility features to accommodate users with disabilities. The framework also highlights the significance of high-quality and engaging content, as well as responsive and secure functionality.

The table below shows summary of the framework

TABLE 1: ASEF FRAMEWORK

ASEF Framework Categories, subcategories, and criteria's

Site finding	Interface	Navigation	Content	Reliability	Technical aspects
URLs are simple to memorize and type.	Visually attractive site	Structure	Services information	Registration (Ease of registration)	Loading speed
Easy to discover site using search engines	Flexibility (Multilingual content...)	Internet Booking engine	Special offers and FFP	Transaction procedure	Security
	Multimedia	Search Engine (internal search)	Company Information	E-ticketing (alternative mode of payment)	Browser compatibility
	Text (Consistent and easy to read fonts)	Navigational necessities (No broken link...)	Advertisement	Paper ticket	
Services for Website Users			Privacy policy		
Competency of helped (FAQ)					

2.7 Related Works

Due to the growing importance of usability and accessibility several research have been conducted on both websites and mobile applications.

According to [17] which examined the accessibility and usability of Ten selected Nigerian airline websites using an analytical approach. In this study, the researchers have used automated tools and additionally to test the usability heuristic method is used. Based on the results of various analyses most of the websites have shown high failure and problem in conforming the guidelines. In terms of usability most of the websites do not have the required usability standard for airlines additionally none of the websites comply with WCAG 2.0 accessibility standard. According to the study's findings, the majority of the airline's websites need to be significantly enhanced to increase usability and accessibility.

In research conducted by [16] the focus was on evaluating the quality of websites belonging to selected airlines in India. The primary objective of the study was to assess the accessibility, usability, and readability of these websites. The evaluation process involved using automated online tools as well as manual expert evaluation. The usability is tested based on various parameters such as pages load speed, broken links, mobile friendliness, page size and the accessibility are tested against website accessibility guideline WCAG 2.0 the readability is evaluated using Flesch Kincaid Reading Ease (FKRE) algorithm.

The finding of the study indicates that no Indian airline websites fulfil WCAG 2.0 accessibility guideline, so this means the websites are less accessible and when it comes to usability the websites have a major usability issue and in terms of readability the result indicates majority of the websites have easily understandable text. The findings indicate that designers and developers must be aware of usability and accessibility standards and principles while addressing universally accessible websites. For the future study the researchers intended to evaluate websites based on WCAG 2.1 guideline which is built based on WCAG 2.0 and to enhance web accessibility, seventeen additional success criteria have been developed.

According to [3] study which focuses on comparing usability of websites in selected airlines the websites are assessed based on various dimensions of usability and accessibility. This study used quantitative approach and content analysis, the methodology of the research is based on scoring system of Gibson which focuses on two main factors functionality(usability) and delivery(accessibility). The researcher adjusted some of scoring system features to match with the airline industry. The results of the study indicate that even though there are certain changes in both dimensions such changes haven't transferred to a major extent of website usability and accessibility. The limitation of the study is the research only focused on Airlines in Turkey and the findings of the study is not tested against user expectation. Further comparative analysis with worldwide airlines is recommended to get a better result. The researcher suggests it is more beneficial if future study focus on semiology.

Researchers [25] evaluated accessibility of Ethiopian airlines and South African airline website and mobile application (android version only) using both manual and automated accessibility techniques. The scope of the evaluation limited to selected pages. Finding of the research stated

both airlines have accessibility problem and should consider inclusive design and seven principles of Universal Design when designing a new or enhancing their interactive systems, in comparison South African airlines is better in terms of website accessibility whereas, Ethiopian airlines is better in mobile application accessibility.

Studies conducted by [4] research quality assessment based on usability and accessibility on seven Indian airline websites using multi criteria decision making approach the methods used to evaluate the usability and accessibility of airlines website include TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), AHP (Analytical Hierarchy Process), Fuzzy AHP. The usability metrics were website size, loading time, time to response, missing links, and contrast issues, and the TAW tool was implemented to assess the websites' accessibility compliance with WCAG 2.0. to compare the results of various MCDM techniques Friedman's test is applied and indicates no significance difference between the ranking methods selected. The result indicates tested websites have many usability issue and none of them adheres WCAG 2.0 accessibility guidelines. The research suggests airlines website developers must adopt the guidelines.

In their research [67] made a performance evaluation on quality of Asian airlines websites using AHP approach and online diagnostic tools the testing parameters. The findings indicated that the websites disregard quality and performance requirements. The researcher recommended for the future study to add dimensions and perspectives to further evaluate website quality.

The researchers [68] examined the usability of the Emirate airline website using summative usability testing methodology using end-users. End users assess the website's performance based on five user's task assessed on three usability measurements those are duration to complete the task, overall error made and error time. While the design of a device interface can be tested in terms of user interaction, the findings show that usability on its own is insufficient to establish a website's efficiency and effectiveness. For further work, the system security and integrity should be evaluated to ensure that any web-based/mobile-based apps meet the needs of the users and the system.

On evaluating performance of airline websites [69] proposed the website performance framework using hybrid multi-criteria decision-making methods and analyzed the performance of 11 airlines in Turkey on seven criteria using online testing tools. According to the findings of this study,

airline websites disregard performance and quality criteria. It shows that, most websites have three key usability issues: broken links, absence of a help menu, and inconsistency.

A study by [70] is performed on usability assessment of the Latam airline website on three airline website functionalities those are buying flight ticket, airline package purchasing, and check-in service by applying heuristic evaluation and usability test with users.

In the study of measuring quality and performance of Four leading airlines in Malaysia [71] measured quality attributes of airlines websites using various automatic evaluation tools. The Analytical Hierarchy Process (AHP) and Fuzzy Analytical Hierarchy Process (FAHP) methodologies are used to assess, measure, and compare the quality of websites.

In their research [72] used fuzzy and non-fuzzy MCDM approaches to assess the quality of e-government websites in five Asian nations. As web quality metrics, websites have been analyzed using online tools to collect data on markup validation, load speed, broken links, page size, page rank, and traffic. To rate the website, the authors also presented a hybrid multi-criteria decision-making model technique. According to the findings, four Asian airline websites did not meet website quality requirements and needed to be updated.

On their research of usability study [73] in which they rated the usability of 64 e-commerce websites, including airline websites, using a 12-cultural centered heuristic evaluation methodology. According to the data, the culturally oriented heuristic indicated more usability concerns than the standard Nielsen's usability heuristics.

Research conducted on Malaysia E-government websites usability and accessibility by [74]. The primary goal of the study is to investigate at the usability and accessibility of e-government websites to achieve this Nielsen usability guideline is used to measure usability and WCAG 1.0 is used to measure accessibility. The federal and state government websites were used to select samples of 155 Malaysia e-government websites. Several automatic evaluation tools were used to achieve the goal. The result of the study shows there is a high number of usability and accessibility issues specially on regional websites compared to federal websites this alerts developers and other stakeholders should set a higher priority on usability and accessibility.

In their study [75] conducted research on Usability of Travel mobile apps the study is conducted Rankey.com's top three mobile travel applications with distinct UIs. Mode Tour, Hana Tour and Interpark Tour. To assess usability, the heuristic technique was used. According to the findings of this study, there are now differences between various travel applications in menus and what they want to deliver, and distinct UI designs can be identified and used by users as a new design.

In his research [76] conducted with the objective of investigating Ethiopian e-government websites and proposing Ethiopia e-Government WUAM in this study the researcher used mixed method of research. Four perspectives used in evaluation namely Managers, end-users, expert based, and automated evaluation The study's findings reveal that the websites have several accessibility and usability gaps. In general, it does not meet most Heuristics principles for usability and does not comply to W3C, WCAG 2.1. The study developed a framework with five elements to improve website usability and accessibility.

The study conducted by [77] aims to investigate usability, accessibility, and mobile readiness of 164 Indian government websites. Usability evaluation is done on various quality parameters using automatic online tools and WCAG 2.0 Compliance of Accessibility evaluation of is done using online tool TAW and mobile readiness is also conducted using online tool. According to the study's findings, many government websites have low usability and do not adhere to WCAG 2.0 accessibility guidelines, and all of them are unusable or completely inaccessible on mobile.

TABLE 2: RELATED WORKS

Author and Year	Objective/Purpose	Approaches/ Methodologies	Key Findings
I. O. Oyefolahan, A. Musa Onuja, and H. Abubakar Zubairu (2018)	The study aimed to identify the accessibility and usability issues in Nigerian airlines websites and provide recommendations for improvement.	Analytical approach is used to evaluate website of 8 Nigerian airlines using assistive technologies.	The websites have key accessibility and usability issues & none of the websites adhere WCAG 2.0 guidelines.
G. Agrawal, D. Kumar, M.	Evaluating the accessibility and	Mixed approach including survey and	The websites had major accessibility & issues.

Singh, and D. Dani(2019)	usability of airlines websites in context of Indian travelers. It aims to identify the key factors and propose a solution.	usability test is used on 6 major airlines	According to the survey results, Indian travelers prioritize website features such as ease of navigation, clarity of information, and mobile compatibility. The study provides some insights to solve the issues
E. Babacan Aktas and Ö. Mutlu (2015)	The objective of the study is to evaluate website usability of airlines companies in Turkey from a marketing communication perspective and determine its relationship with customer satisfaction.	Quantitative approach is used 500 participants data is collected using questionnaire	The study found that website design is the most important factor affecting website usability and customer satisfaction it implies that there is a positive relationship between them.
B. Betru and U. K. Ogbonna (2022)	The objective of the study is to evaluate accessibility of Ethiopian & South African airlines website and mobile app.	Mixed method approach, including survey and automated evaluation tools is used to check WCAG 2.0 compatibility	The result shows evaluated airlines website and app had major accessibility issues on both survey and automated test result. The study proposed both design and compatibility enhancement.
G. Agrawal, A. Dumka, and M. Singh (2022)	The objective of the study was to evaluate the usability and accessibility of Indian airline websites, to identify the key factors that affect the quality of airline websites and propose a framework for evaluating the quality using MCDM techniques.	500 travelers in India are surveyed, and factor analysis is used to identify key dimensions.	The study identified six key dimensions of website usability and accessibility. It also found that there was a positive relationship between website usability and website accessibility.

N. F. M. EL-firjani, E. K. Elberkawi, and A. M. Maatuk (2017)	The objective of the study was to compare different methods of website usability evaluation and propose a new method for evaluating website usability that considers both user satisfaction and task performance.	Comparative analysis approach, which compares four different methods of website usability evaluation is used. The study also used a sample of 60 participants to evaluate the effectiveness of the proposed method.	The study proposed a new method called the Comprehensive Website Usability Evaluation (CWUE) method, which combines the advantages of the four existing methods.
B. Murillo, S. Vargas, A. Moquillaza, L. Fernández, and F. Paz (2017)	The objective of the study is to investigate the effectiveness of combining heuristic evaluation and usability testing in evaluating the usability of websites	To achieve the objective the study employed case study approach. The study used a sample of 20 participants to evaluate usability. System usability scale is used to measure task performance.	The key findings of the study showed that combining heuristic evaluation and usability testing methods provides more comprehensive and accurate results than each method used alone
H. Khan and P. D. D. Dominic (2017)	The objective of the study was to investigate the performance of airline websites in Malaysia in terms of their acceptance by customers and their impact on customer satisfaction.	The study used a survey research design to collect a sample of 384 respondent data who had used airline websites in Malaysia for flight booking or other related services.	the usability and functionality of airline websites significantly influence customer satisfaction and acceptance also perceived usefulness and ease of use are critical factors in determining satisfaction of users and acceptance of airline websites.
H. Khan and P. D. D. Dominic (2013)	The objective is to measure the quality of Asian airline websites using Analytical Hierarchy Process (AHP) and explore the relationship between website quality and customer satisfaction.	300 passengers who used the websites of Malaysian, Singaporean, and Thai airlines. AHP was used to evaluate the quality of the websites based on four dimensions.	The result of the study indicates design was the most important factor affecting customer satisfaction, followed by content, navigation, and responsiveness.
W. A. Rahim, W. Mohd, I. Muhammad, R.	The objective of the study is to assess the usability and	They employed various tools such as WAVE, TAW3 and Usability	The key findings of the study revealed that the Malaysia e-government

Suhami, and S. S. Semsudin (2011)	accessibility of the Malaysia e-government website by evaluating the compliance with guidelines.	Test, which included a survey to collect data from the 40 participants.	website was not fully accessible and had several usability issues. It also showed that participants encountered several problems when including difficulties in finding information and navigating the site.
Y. Kim and H. Kim (2020)	The objective of the study was to evaluate the usability of mobile travel apps and propose improvements to enhance the user experience.	The researchers used mixed-method approach, including heuristic evaluation, user testing, and surveys from 153 participants, to assess the usability of three popular mobile travel apps	The key findings of the study showed that the evaluated mobile travel apps had significant usability issues, including unclear navigation, complex search processes, and inconsistent interfaces. The study also revealed that users' satisfaction with the apps was affected by usability issues.

This study aims to fill the research gap by conducting a comprehensive evaluation of the usability and accessibility of the Ethiopian Airlines website. By focusing specifically on this airline's website, It aims to provide valuable insights into the specific challenges and limitations users encounter when accessing information, booking flights, and utilizing online services. Through a combination of user feedback, usability testing, and compliance assessments with international standards such as the Web Content Accessibility Guidelines (WCAG), this research aims to provide actionable recommendations for enhancing the website's usability and accessibility.

By addressing this research gap, the study contributes to the existing body of knowledge by providing specific insights and recommendations tailored to the Ethiopian Airlines website context. The findings are valuable not only for Ethiopian Airlines but also for other airlines and organizations seeking to improve the usability and accessibility of their websites. Ultimately, this research aims to enhance the overall user experience, inclusivity, and customer satisfaction when interacting with the Ethiopian Airlines website.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

This chapter covers the approach used to achieve the goal of the study. First, generic study approaches are presented, followed by three types of assessment and data collection processes from various perspectives. Finally, the research subjects, population, sampling process, data collecting tool, and data collection procedures are addressed.

3.1 Research Approach

To achieve the goal of the study, the researcher used a multi-perspective evaluation technique to collect the most apparent usability and accessibility issues and to offer a solution. End users' data collected, and automatic usability and accessibility tools used.

In this study, applied research is used to identify fundamental usability and accessibility issues with Ethiopian Airlines' website to acquire information to help resolve usability and accessibility problems. According to [78], the goal of applied research is to find practical solutions for pressing problems or to arrive at effective solutions for specific challenges.

The researcher used mixed research method which is systematic combination of both quantitative and qualitative data within a study. The overall goal of the mixed-methods research approach is to give deeper understanding, by providing an in-depth overview that can enhance understanding and description of the scenario [79].

The mixed method is used to reflect participants perspectives in detail, to address some of the inherent constraints of using only one of the methods and to ensure more holistic findings could be acquired and as well as to get a fuller grasp of research problems.

In this research major issues of Ethiopian airlines website usability and accessibility is investigated using various guidelines and tools. Using qualitative research, analyze the various factors or issues that led users to behave in a particular manner or which make people prefer or despise a specific website standard. Additionally, quantitative research methods are used to create statistical analysis, when working to discover usability and accessibility problems.

The study conducted an evaluation of Ethiopian Airlines websites in a three-stage study. This section provides a detailed explanation of the research operations, including the behavior observed and the instruments used.

3.1.1 User Based Evaluation

End-users' feedbacks and experience are identified through online questionnaire and usability testing software. According to [80], it is critical to investigate the condition of current websites from the perspective of end users before developing a model or suggesting any solution to improve usability. Through online questionnaire, the study collect feedback from users on their experiences using the website. It is used in this study aimed to gather feedback from end-users on their perceptions of the Ethiopian Airlines website's ease of use, content, functionality, performance capability, and reliability of the service. It also included questions related to the website's appearance, navigation, overall capabilities, and user satisfaction.

In this study, the online questionnaire used to evaluate the Ethiopian Airlines website's usability was adopted from [76] research with some modifications to match the airline website. The modifications included analyzing user perspective data using categories of the website's primary functional features and components listed in the ASEF framework.

The ASEF framework is a model used to categorize the questionnaire to evaluate the usability of websites. It includes five primary functional features, which are: content, navigation, interaction, presentation, and transaction. Each of these features is further divided into several components, such as clarity of information, ease of use, ease of navigation, consistency, and security.

By adopting and modifying the questionnaire to match the Ethiopian Airlines website, this study was able to gather feedback from users on specific aspects of the website's usability. The questionnaire was designed to address the primary functional features and components of the website to ensure a comprehensive evaluation of the website's usability.

In addition, usability testing software is used. Usability testing software is a type of software application that is used to evaluate the usability of digital products, such as websites, mobile applications, and software interfaces. For this study Morae TechSmith version 3.3.3 is used. Morae software is a tool used for conducting usability tests and user experience research. It provides a range of features such as recording user sessions, tagging, and marking important moments in the recordings, and generating reports and visualizations of the data[81].This software enabled the

study to collect data on users' behavior, including their navigation patterns and the time taken to complete tasks. This data helps to identify any usability issues and areas that needed improvement.

The Morae software is employed in this study to carry out a usability test and user experience research for Ethiopian Airlines website. This tool has various features such as recording user sessions, tagging, and marking significant moments in the recordings, and generating reports and visualizations of the data. The software captures user interactions in real-time, including mouse clicks, keyboard inputs, and page navigation, providing valuable insights into the user experience. By utilizing this software, the study aimed to identify areas of improvement and increase user satisfaction and usability of the website. According to [82] usability testing with Morae software can lead to significant improvements in product usability and user satisfaction.

For this study 10 participants were selected from Ethiopian airlines frequent flier loyalty program customers called Shebamiles. The tasks of booking a one-way or round-trip flight, finding flight schedules, checking flight status, finding baggage information, finding contact information, and checking payment options were selected for the usability evaluation. These tasks were chosen based on their high traffic which is taken from the airlines analytics data and representation of typical user actions on an airline's website. The tasks are attached in appendix section.

According to [83] selecting representative tasks is crucial for gathering accurate and meaningful data on user behavior and experiences. In addition, the selected tasks must be realistic and relevant to the website being tested to ensure that the results obtained are applicable and useful for improving website usability [84].

3.1.2 Automated Evaluation Tools

Web accessibility evaluation tools refer to software applications or online services that assist in assessing the adherence of web content to accessibility standards. These tools aid in determining whether a website meets the requirements for accessibility. [85] .

There are various tools to evaluate usability and accessibility. In this study to enhance reliability and reduce user bias 2 automated tools are used for usability and 2 automated tools are used for accessibility evaluation. The tools evaluate the website against set of standards and guidelines. The following tools are selected based on [86] research on automated website evaluation tools and website accessibility tool.

WAVE, Accessibility Checker, GTmetrix, and Google Lighthouse are among the most widely used tools for evaluating the usability and accessibility of websites. These tools are preferred because of their effectiveness, reliability, and accuracy in identifying issues related to website usability and accessibility.

WAVE and Accessibility Checker are both web accessibility evaluation tools that check web pages for compliance with accessibility standards, such as WCAG. They are considered as reliable tools for identifying accessibility issues and providing recommendations for improving website accessibility.

GTmetrix and Google Lighthouse, on the other hand, are website performance analysis tools that provide insights on how to enhance the loading speed, performance, and user experience of websites. These tools are preferred because they provide a comprehensive analysis of website performance, including loading speed, page size, request count, and other metrics that impact website usability and user experience.

WAVE: is an online application for analyzing web site accessibility based on the WCAG 2.0. Its purpose is to test the extent of accessibility in the development and design of websites so that everyone can access, regardless of their specific traits.

ACCESSIBILITY checker: an online tool which checks websites against ADA (American Disabilities Act) & WCAG guidelines and gives instruction to fix issues.

GTMetrix: audits a website with more than 50 parameters such as performance, load time etc. and recommends improvements.

Google's Page Speed Insight: is a Google's website performance testing tool. Which evaluates performance, accessibility and best practices of webpages and provide insight to improve quality.

The table below shows the features, metrics and focus of the tools

TABLE 3: ONLINE USABILITY TESTING TOOLS

Evaluation tool	Focus of the tool	Key Features	Metrics Measured
Google Lighthouse	Recommends ways to enhance the user experience	The website is analyzed based on Google’s ranking algorithm and report is generated.	The performance, adherence to accessibility guidelines, best practices, and SEO
GTMetrix	in-depth audit and provide recommendations	Performance test, competitive analysis, web page analysis,	Latency, weight, speed, number of issues
WAVE accessibility evaluation tool	accessibility analysis of web sites.	Accessibility conformance of websites based on WCAG 2.0 guidelines	Contrast, structural elements, features, and structure
Accessibility checker	accessibility analysis of web sites.	Accessibility conformance of websites based on W3C WCAG 2.0 guidelines and ADA	color contrast, keyboard accessibility, text alternatives for non-text content, and use of headings and lists.

3.2 Subjects of the study

The population of this study is the customers of Ethiopian Airlines who have booked their flight tickets using its website, and members of the airline's Sheba Miles loyalty program. The frequent fliers were selected as the respondents of the survey because they have a higher level of experience with the Ethiopian Airlines website and are more familiar with its functionalities and potential issues. Limiting the study to Sheba Miles allows for a more focused and targeted analysis of a specific user group that frequently interacts with the Ethiopian Airlines website. By narrowing the scope to loyalty program members, who are more likely to utilize the website's features and services extensively, the research can gain a deeper understanding of their unique needs, challenges, and preferences.

Moreover, their email addresses are already registered with the airline, making it easier to contact them for the survey. This approach allowed for a more targeted and informed evaluation of the website's usability and accessibility from the perspective of its regular users.

According to [84] a sample size of five participants is often sufficient to uncover a significant portion of usability issues. Nielsen also emphasizes that while five participants can provide valuable insights up to 85%, increasing the number of participants is likely to identify additional issues. [87] suggests that testing with 15 participants can uncover most usability issues. [88] states

the sample size to 15 participants allow for the discovery of approximately 95% of usability problems.

For this study to address rare usability cases the researcher aims to address 30 users from various tiers of Sheba miles program namely Welcoming, Blue, Silver, Gold, and Platinum by including 6 participants from each tier to get more than 85% of usability issue, the study aimed to ensure representativeness and capture a diverse range of perspectives. To achieve this the questionnaire is sent for 50 participants expecting to get a response from 30 users. Out of the 50 questionnaires that were sent out, with an expectation of receiving 30 responses, a total of 32 responses were received.

3.3 Sampling Technique

The research involves users of the website. Purposive sampling is used to select website users for the qualitative study since they are the study's target audiences based on their interaction with the systems and are thought to be ideal key informants for the research. The table below shows participants of the study

TABLE 4: PARTICIPANTS OF THE STUDY

Users' perspective	Usability Testing Software	Automatic Evaluation tools
32 are users selected	10 Sheba miles members are selected	4 automatic usability and accessibility tools are used based on Automated Website Usability Evaluation tools [86]

To get clear view about usability issues of Ethiopian airlines website from the perspective of the service users, end user evaluation method is used. The sample number of participants for usability testing software were ten. Which are experienced users in booking and using a website.

3.4 Data Collection Instrument

A questionnaire, usability testing tools, and an analytics tool were utilized to collect the necessary data. The data collection methods are described below:

3.4.1 Questionnaire

The data collecting instrument was mostly designed by a review of literatures related to the study's objectives. To collect data from customers of Ethiopian Airlines, a 5-point Likert scale questionnaire was used. The questionnaire consisted of scales ranging from 1, representing

"strongly disagree," to 5, representing "strongly agree". Respondents were asked to show their extent of agreement or disagreement with the given statements using these scale points.

To measure the identified research problems, a questionnaire for usability evaluation was adopted from the model [89] as well as relevant literature on the subject. This approach integrated the best practices and guidelines from both sources to ensure a comprehensive and effective evaluation of usability. By incorporating established models and drawing from relevant literature, the questionnaire was designed to address the specific research problems and provide valuable insights into the usability of airlines' websites. Some parts of the adopted questionnaires were reviewed, and a few adjustments were made to match the Ethiopian Airlines context.

The adopted survey helps to explore the features of the questionnaire that evaluate user satisfaction and usability problems from the user's point of view, as well as provide management and scoring direction for the surveys. Usability experts may easily utilize these questions to assess user satisfaction with the website. The survey is carried out independently by the participant, who answers the questions on their own. Furthermore, via sending surveys /online questionnaires/ using Google form, as given below link, using my Gmail account (berhanwhy@gmail.com) were prepared and sent to research participants:

https://docs.google.com/forms/d/e/1FAIpQLSdWppe46gV6FFocuyd1r4o3IURn9QabKfSVbO8GV5zohSx5Xg/viewform?usp=sf_link

The link is mailed to the selected users. Questionnaires are the most often utilized means of gathering additional data and information in various economic and business-related surveys. [78]

The Cronbach's Alpha reliability test result indicates a coefficient of 0.92 based on the reliability study. The Cronbach's Alpha coefficient ranges from 0 to 1, where 0 represents no reliability and 1 represents complete reliability. In general, a reliability range of 0.7 and above is considered acceptable.

3.4.2 Usability Evaluation Software

The data collection process for the usability evaluation software Morae TechSmith collected by recording user interacting with the website. This is done using various tools provided by the software, such as screen recording, webcam recording, and audio recording.

To conduct a usability and accessibility test using Morae software, the test scenarios, and tasks that users perform on the website are prepared based on the traffic they have on website and the way they represent airlines website activities.

The analysis of the collected data from usability testing software is passed through various steps, the first step is to transcribe the users' interaction videos into text format. This allows for a more manageable and accessible form of data. Then qualitative analysis of the transcribed data is conducted. This involves examining the textual data to identify patterns, themes, and insights related to the usability of the website. Next, the transcribed data is quantified through the process of coding. Coding involves assigning descriptive codes to each unit of data, such as words, phrases, or sentences, to categorize and organize the data based on its content and meaning.

The coded data is quantified by assigning numeric values to the codes. These numeric values serve as identifiers or labels to represent the occurrence or frequency of specific codes within the data. By quantifying the data, it becomes possible to apply numerical analysis techniques and summarize the qualitative findings in a more structured manner.

It is important to note that quantifying the data in this manner does not diminish the qualitative nature of the analysis. The numeric values assigned to the codes serve as labels or identifiers rather than true quantitative measurements. The essence of the analysis lies in the interpretation and understanding of the underlying meanings and contexts within the data [90].

3.4.3 Document Analysis

By referring to Ethiopian Airlines' website analytics tool, document analysis is used as an additional data source for analysis. Some of the document analyzed include device type used, session duration, bounce rate and others.

3.5 Data Collection Procedure

The data collection methods used in this study include an online questionnaire, usability testing software, and automatic evaluation tools.

To collect user feedback on Ethiopian Airlines website's usability and accessibility, an online questionnaire was developed using Google Forms. The questionnaire was distributed via email to a sample of 50 Ethiopian Airlines customers who had booked a flight on the website and were also members of the Sheba Miles frequent flier loyalty program. This technique was chosen due to its

ease of access to participants and their experience in using the website. It consisted of questions related to the website's usability and accessibility, as well as the overall user experience. It is designed to be easy to understand and complete, and participants were given clear instructions on how to fill it out. The questionnaire is designed to be completed within 10-15 minutes, to ensure that participants did not lose interest or become fatigued.

Usability testing software was used to evaluate the website's usability. For this purpose, participants who had used the website before were selected using purposive sampling. The participants were selected based on their availability and willingness to participate in the testing session. During the usability testing sessions, the researcher provided a brief tutorial to each participant to familiarize them with the software, including how to start and stop tasks and how to use the software to provide feedback on their experience.

Participants were given a series of tasks to complete on the Ethiopian Airlines website, and their interactions with the website were recorded using Morae. The researcher observed the participants and took notes on their interactions, including any difficulties they encountered or feedback they provided.

Finally, automatic evaluation tools such as Accessibility Checker, WAVE, GTmetrix, and Google Lighthouse were used to evaluate the website's accessibility and performance. These tools were used to assess the scan the website and identify any accessibility issues, performance bottlenecks, and other technical problems and website's compliance with WCAG guidelines and other accessibility standards.

By using a combination of different sampling techniques, this study was able to gather a comprehensive evaluation of the Ethiopian Airlines website's usability and accessibility from various perspectives. The users' perspective provided valuable insights into their experience and satisfaction with the website, while usability testing and automatic evaluation tools provided objective measures of the website's usability and accessibility.

CHAPTER FOUR

DATA ANALYSIS, DISCUSSION AND PRESENTATION

This chapter presents the results of the data analysis, discussion, and presentation of the Ethiopian Airlines website usability and accessibility evaluation. In this chapter, the researcher analyzes and interprets the data collected during the usability testing and accessibility evaluation of the Ethiopian Airlines website. The chapter provides a detailed overview of the findings and discuss the implications of the results.

Following the presentation of the results, the chapter provides a detailed discussion of the findings. This includes an interpretation of the results and an assessment of their significance. The researcher also discusses the implications of the results for Ethiopian Airlines, as well as for the broader field of website usability and accessibility.

Finally, the chapter concludes with a presentation of the key recommendations for enhancing the usability and accessibility of the Ethiopian Airlines website. These recommendations is based on the results of the research and aimed at improving the overall user experience of the website.

4.1 Findings of User Based Evaluation

One of the most crucial considerations for Ethiopian Airlines' website usability was the assessment of end-user perspectives. As a result, in assessing the status of usability of Ethiopian airlines website, this section of the study aimed to investigate the usability of the website from the viewpoint of the end-users by addressing three main research questions.

To answer the research question evaluated the overall level of user satisfaction with the usability of the website. This was assessed through surveys and feedback gathered from users during the evaluation.

By focusing on the end-user perspective, the study was able to provide insights into the usability of the Ethiopian Airlines website, identifying areas for improvement to enhance user experiences and increase user satisfaction.

4.1.1 Demographics Description of the Respondents

The collected data includes information on the distribution of respondents based on gender and age for demographic analysis, as well as their level of basic computer skills.

As shown in the table below among the total participants of the study, 68.8% were male users, while 31.3% were female users. Furthermore, most participants (84.4%) fell within the age range of 18 to 30 years.

TABLE 5:DEMOGRAPHIC DESCRIPTION OF RESPONDENTS

Characteristics		Frequency	Percentage
Gender	Male	22	31.3
	Female	10	68.8
Age	18-30	27	84.4
	31-40	5	15.6

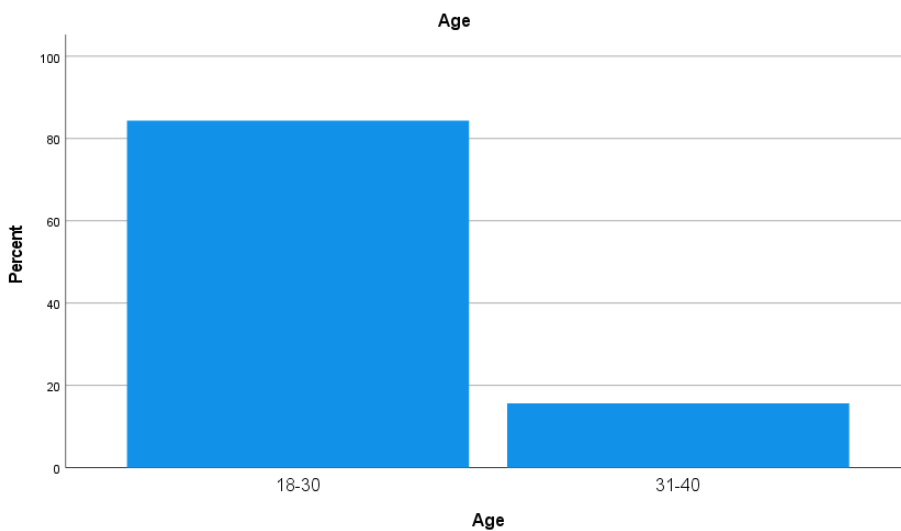


FIGURE 1:AGE GROUP OF RESPONDENTS

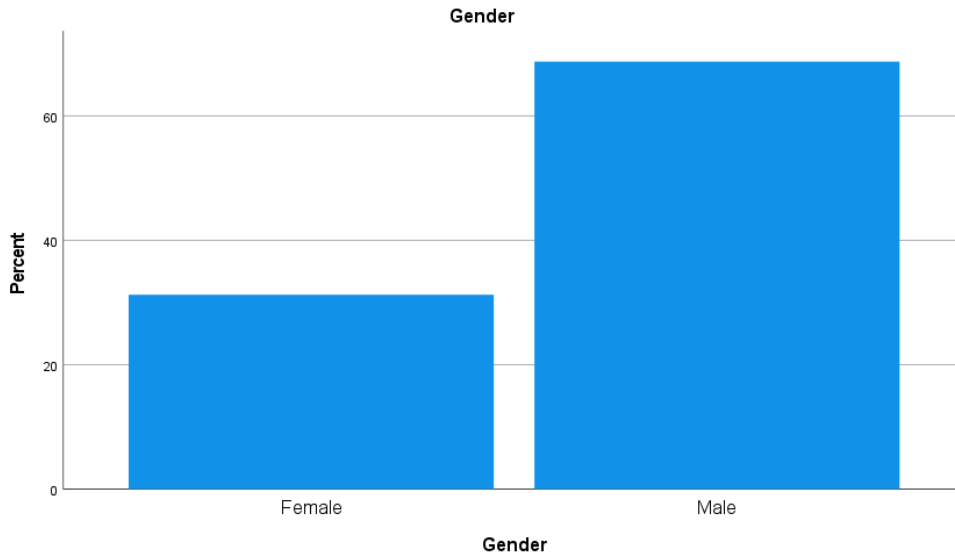


FIGURE 2: GENDER PERCENTAGE OF PARTICIPANTS

4.1.2 Analysis of Website Information Organization

The usability assessment questionnaire for Ethiopian airlines website from End users perspective indicated in the shows that, 3.1% of respondents rated Organization of the website information is “Very poor”, there are 9.4% which said it is neither good nor poor it is “Neutral “and 77.5% respondents rated the organization of the website information “Good and very good”. Based on the survey results, Ethiopian Airlines' website is generally well-organized and easy to use from the end users' perspective. However, the organization of website information needs improvement to ensure a better user experience for those who rated it as "Very poor" and "Neutral."

TABLE 6: ORGANIZATION OF WEBSITE INFORMATION

Characteristics	Quantity	Very poor	Poor	Neutral	Good	Very good	Mean	Std. Dev
Organization of website information	Frequency	1	-	3	21	7	4.03	0.78
	Percent	3.1	-	9.4	65.6	21.9		
Provision of all required features and capabilities, such as flight search and booking?	Frequency	1	-	3	19	9	4.09	0.82
	Percent	3.1		9.4	59.4	28.1		

4.1.3 Analysis of Difficulty of Reading Characters on Ethiopian airlines pages

Participants were asked to evaluate readability of text fonts in terms of size and type. As seen in table 7, the percentage distribution of participants for the survey question shows 81.3% respondents were “Agree and Strongly agree”, 12.5% of respondents said they feel “Neutral”, and 6.3% respondents indicated that they “Disagree”.

TABLE 7:DIFFICULTY OF READING CHARACTERS

Characteristics	Quantity	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std. Dev
The text (font) size and type are easy to read	Frequency	-	2	4	22	4	3.88	0.707
	Percent	-	6.3%	12.5%	68.8%	12.5%		

4.1.4 Websites Functionality, Performance Capability and Reliability of Service

The Ethiopian Airlines website offers a wide range of functionalities to its users, including flight booking, flight status, online check-in, baggage information, special services, customer support, and many others. Based on a survey of participants, as depicted in table 8, the website's functionality and performance received positive ratings. Specifically, 65.6% of the respondents rated it as "Good," 21.9% as "Very good," 9.4% felt "Neutral," and only 3.1% rated it as "Poor."

Despite the positive functionality and performance ratings of Ethiopian Airlines, the survey results also suggest that there is room for improvement. While most users rated the website as "Good" or "Very good," there were still a significant number of respondents who felt "Neutral" or rated it as "Poor." This indicates that there are areas where the airline can further improve its online experience to better meet the needs and expectations of its customers.

In case of reliability features the respondent's rate 87.5%. This indicates Ethiopian airlines website services level of trustworthy(reliability) is in good condition. Which means the website doesn't ask or gather personal information without a legitimate reason, it has secure booking process, it gives accurate flight information, has clear pricing without any hidden fee.

TABLE 8: WEBSITES FUNCTIONALITY, PERFORMANCE CAPABILITY AND RELIABILITY OF SERVICE

Characteristics	Quantity	Very poor	Poor	Neutral	Good	Very good	Mean	Std. Dev
Functionality and capability performance	Frequency	1	0	3	19	9	3.53	.707
	Percent	3.1%	0	9.4%	59.4%	28.1%		
Reliability level (Trustworthiness of the website)	Frequency	1	0	3	21	7	4.13	.842
	Percent	3.1	0	9.4	65.6	21.9		

4.1.5 Users’ reaction to Ethiopian airlines website Main Usability issues

Key website usability issues with end-users’ feedback to Ethiopian airlines website were assessed and categorized with five areas: websites appearance, navigation, content, overall capabilities, and users’ satisfactions. The assessment analysis results were presented as follows:

4.1.5.1 Websites appearance

The appearance of a website is an essential aspect that can significantly impact users’ ability to communicate effectively and decision making. Websites that are visually appealing, well-organized, and easy to navigate tend to have a higher chance of engaging users and ultimately influencing how users perceive the validity, trustworthiness, and overall quality of a website.

In this website appearance analysis result as shown on table 9 the “quality of website appearance” examined using several variables, including visual attractiveness, consistency, meaningful icons and links, and font size characteristics that are easy to read. The analysis also focused on highlighting the most important content and determining whether decorative elements were being used appropriately.

The aggregated mean (mean of mean) result for Ethiopian airlines website appearance attribute construct was 3.82 or 61.88% This value is obtained based on end user perspective of Ethiopian airlines website overall the appearance rated is categorized as being the state of “Agreement”.

Compared to other attributes of the appearance variable, the variable "The website is visually appealing" has the highest mean value of 3.91 in the questionnaire and is “agreed” upon by most of the respondents.

TABLE 9:WEBSITE APPEARANCE

No.	Appearance of the website	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Dev.
1	The website is visually appealing	-	6.3	18.8	53.1	21.9	3.91	0.818
2	The website's links and buttons are clear, self-descriptive, and easy to use	-	6.3	18.8	65.6	9.4	3.78	0.706
3	The layout of the website clear and easy to navigate	-	9.4	12.5	65.6	12.5	3.81	0.78
4	The website is responsive to actions (e.g. scrolling, clicking, etc.)	6.3	9.4	9.4	56.3	18.8	3.72	1.085
5	The text (font) size and type easy to read	-	6.3	12.5	68.8	12.5	3.88	0.707
Aggregated Percentage / Mean, Std. Dev		1.26%	11.32%	14.4%	61.88%	15.02%	3.82	0.8192

4.1.5.2 Websites Navigation

According to [91] website navigation is an essential component of creating a user-friendly website. It is the process of designing and implementing menus, links, and other tools that allow users to easily navigate the site and find the information they need. A well-designed navigation system can improve user engagement and help visitors easily and quickly find what they are looking for. Factors that contribute to effective website navigation include clear and concise labeling, logical grouping of pages, and intuitive placement of links and menus. It is important to test and improve navigation system to ensure that it provides a positive user experience [87].

To evaluate Ethiopian airlines website usability issues regards to navigation, participants were surveyed on their perceptions of the navigation scheme and features, as shown in table 10. The finding indicated a high level of “agreement” among respondents, with an overall mean value of 3.54 representing 62.5% of those participants.

Out of all the participants analyzed in this study, it was found that most respondents agree with the “Easy finding specific pages or sections of the website related to the booking process”. Specifically, 56.5% of respondents agreed with the statement that the navigation menu is " It is easy to navigate between different pages and sections of the website ", 59.3% agreed with the booking process is easy to find, and 59.4% feel neutral and disagreed that there is no broken link.

Based on the study results, most respondents agreed that the navigation system of Ethiopian Airlines' website was easy to use and allowed for effortless movement between pages to access the desired web content. This indicates that the navigation system was well-designed and user-friendly. However, it's important to note that there is always room for improvement, and even a

well-designed navigation system can be further enhanced for a better user experience. Regular updates and improvements to the navigation system can help ensure that the website meets the changing expectations and needs of its users.

TABLE 10: WEBSITE NAVIGATION

No.	Appearance of the website	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Dev.
1	The layout of the website is clear and easy to navigate	-	9.4	12.5	65.6	12.5	3.81	0.78
2	Easy finding specific pages or sections of the website related to the booking process	3.1	15.6	21.9	53.1	6.3	3.44	0.95
3	The website's booking process is easy to remember	3.1	3.1	15.6	59.4	18.8	3.88	0.87
4	It is easy to navigate between different pages and sections of the website	3.1	6.3	34.4	46.9	9.4	3.53	0.88
5	No broken link (no blank or not working link)	9.4	21.9	28.1	37.5	3.1	3.03	1.06
Aggregated Percentage		3.74	11.26	22.5	52.5	10.02	3.54	0.91

4.1.5.3 Websites Content

Website content is one of the most important parts of the website outweighing navigation, visual layout, functionality, and interaction. The website has little or no value if the content does not give the necessary information that people are looking for, regardless of how user-friendly the site is.

In this regard, a survey was conducted to evaluate the content of Ethiopian Airlines' website. The results of the survey indicate that the website's content is highly rated, with an aggregate mean of 3.6, which is rated in the “Agree” category. Over 62% of the respondents agreed that the content on the website provides the information needed by users.

As [91] point out, content is the most critical element of any website, and it is essential to provide users with comprehensive information about services, destinations, schedules, and travel policies. Engaging and informative content such as travel recommendations, destination information, and customer stories can also be added to inspire and educate users.

The website's content has been evaluated to be of high quality, providing users with the information they need to plan their travel and make informed decisions.

According to [13] research, there are certain fundamental reasons why users tend to revisit certain websites while ignoring others. These reasons, commonly referred to as "HOME" elements, which primarily includes four critical components that users typically demand from a website: **H**igh quality content, **O**ften updates, **M**inimal download time, and **E**ase of use. These elements have been identified as key determinants of a website's success in retaining users and increasing their engagement.

Therefore, to ensure websites are user-friendly and effective it's important to focus and prioritize the HOME elements, by making these elements a priority, designers can create websites that provide a positive user experience, encourage users to engage with the site, and build user loyalty. Ultimately, by focusing on user needs and preferences, organizations can create websites that meet their objectives and deliver an effective online presence.

According to the survey Ethiopian airlines website content is meeting the needs of its users. They have responded that the website is easy to use and provides clear information about flight schedules, prices, and other important details. Overall, the content of the website has been positively received by users.

TABLE 11:WEBSITE CONTENT

No.	Appearance of the website	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Dev.
1	The content presented in a clear and concise manner, with easy-to-understand language and instructions	3.1	12.5	21.9	53.1	9.4	3.53	0.95
2	Information is Up to date	3.1	6.3	28.1	50	12.5	3.63	0.91
3	The content of the website meets my expectations	-	9.4	21.9	59.4	9.4	3.69	0.78
Aggregated Percentage		2.06	9.4	23.97	54.2	10.4	3.62	0.88

4.1.5.4 Overall Capability of Ethiopian airlines website

According to [92] technical capabilities, including system response time, reliability, and ease of use, significantly impacted user satisfaction and utilization. This implies that a website that is easy to navigate and provides relevant and up-to-date information can improve the user experience, leading to increased utilization of the site's services and features.

The survey participants were asked to assess the overall capabilities of Ethiopian Airlines' websites, and the results are displayed in Table 12. On average, the overall capabilities of the website were rated as 50.7%, indicating that the respondents agreed about its capabilities. Out of all the capabilities-related variables covered in the survey, The website load quickly and consistently, with no delays or downtime was rated the lowest with a mean score of 3.03, whereas the website is responsive to actions such as scrolling and clicking was rated the highest with a mean score of 3.72. Almost half of the respondents were feel neutral and disagreed with the websites overall capability. Based on these findings, it is recommended that Ethiopian Airlines' website should improve its overall capability.

TABLE 12: OVERALL CAPABILITY

No.	Appearance of the website	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Dev.
1	The website load quickly and consistently, with no delays or downtime	9.4	18.8	37.5	28.1	6.3	3.03	1.06
2	The website is responsive to actions (e.g. scrolling, clicking, etc.)	6.3	9.4	9.4	56.3	18.8	3.72	1.09
3	Technical assistance is required to use the website.	9.4	25	28.1	25	12.5	3.06	1.19
4	Website have mistake correcting system	6.3	12.5	40.6	34.4	6.3	3.22	0.96
5	The website is designed for all level of users	3.1	9.4	21.9	62.5	3.1	3.53	0.84
Aggregated Percentage		6.9	15	27.5	41.3	9.4	3.31	1.03

4.1.5.5 User Satisfaction

In their study,[93] found that well-designed websites with high-quality visual appearance, usability, and content had a substantial positive impact on user satisfaction. Additionally, the research revealed that user satisfaction significantly influences the intention to revisit a website in a positive manner. These findings suggest that a website's design quality plays a crucial role in generating user satisfaction and encouraging repeat visits.

According to [94]study, which examined the appearance, functionality, usability, and their impact on user satisfaction of airline websites, website design plays a vital role in shaping user perception and satisfaction. The research findings highlight that a visually appealing and functional website

design, combined with ease of use and intuitive navigation, are key factors that contribute to user satisfaction with airline websites.

As shown on table 13 below, the aggregated mean of the respondents that are very satisfied with the survey question “visual design of our website, including colors, typography and imagery?” is 3.81, for “The mobile version of the website for booking and managing flight?” is 3.72 which are in agree category.

TABLE 13:USER SATISFACTION

No.	User Satisfaction	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied	Mean	Std.Dev.
1	The mobile version of the website for booking and managing flight?	-	3.1	28.1	62.5	6.3	3.72	0.63
2	the visual design of the website, including colors, typography and imagery?	-	3.1	21.9	65.6	9.4	3.81	0.64
3	the design and layout of the website?	-	3.1	9.4	78.1	9.4	3.91	0.69
4	the overall experience you had on the website	-	3.1	12.5	81.3	3.1	3.84	0.52
	Aggregated Percentage	-	3.1%	17.98%	71.88%	7.05%	3.84%	0.62

4.1.6 User perspective Evaluation Analysis Report Based on Nielson’s Quality Components of Usability

The usability of the Ethiopian Airlines website was evaluated from the end-user's perspective, using Nielsen's Five Quality Components of Usability. These components are widely accepted guidelines for evaluating the usability of websites and can provide valuable insights into areas that may require improvement. The following analysis report presents the findings based on Nielsen's Five Quality Components of Usability.

4.1.6.1 Learnability

The evaluation included questions that assessed how to use the website and the ease of learning. Users were asked to rate the clarity and intuitiveness of the website's navigation, the availability of help and documentation, and the overall ease of understanding how to perform tasks such as searching for flights, booking tickets, and managing reservations. The responses were categorized and analyzed to determine the extent to which the website was easy to learn for users.

Participants were asked to rate the learnability of Ethiopian Airlines' website, as shown in Table 14. The variable "The website is responsive to actions such as scrolling and clicking" received the highest mean score of 3.78, indicating that users found it easy to interact with the website.

However, "Technical assistance is required to use the website" received the lowest mean score of 3.06, indicating that some users felt that the website required additional help to navigate. On average the website learnability got overall mean score of 3.49 which indicates that users generally found the website easy to learn.

TABLE 14: LEARNABILITY

No.	Characteristics	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Dev.
1	The website's booking process is easy to learn	3.1	6.3	21.9	59.4	9.4	3.66	0.87
2	Technical assistance is required to use the website.	9.4	25	28.1	25	12.5	3.06	1.19
3	The website's links and buttons are clear, self-descriptive, and easy to use	-	6.3	18.8	65.6	9.4	3.78	0.71
4	The content presented in a clear and concise manner, with easy-to-understand language and instructions	3.1	12.5	21.9	53.1	9.4	3.53	0.95
5	Easy finding specific pages or sections of the website related to the booking process	3.1	15.6	21.9	53.1	6.3	3.44	0.95
Aggregated Percentage		3.74	13.14	22.5	51.24	9.4	3.49	0.93

4.1.6.2 Memorability

The evaluation included questions that assessed the ease of remembering how to use the website. Users were asked to rate the ease of remembering how to perform tasks after initial use, the availability of cues or reminders, and the overall memorability of the website's features and functions. The responses were categorized and analyzed to determine the extent to which the website was memorable for users.

TABLE 15: MEMORABILITY

No.	Characteristics	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Dev.
1	The website address(url) is memorable	3.1	3.1	18.8	43.8	31.3	3.97	0.97
2	The website's booking process is easy to remember	3.1	3.1	15.6	59.4	18.8	3.88	0.87
Aggregated Percentage		3.1	3.1	17.2	51.6	25.05	3.92	0.92

4.1.6.3 Efficiency

The evaluation included questions that assessed the efficiency of using the website to complete tasks. Users were asked to rate the speed and effectiveness of the website's features and functions, such as the speed of loading pages, the responsiveness of buttons and links, and the overall efficiency of the booking process. The responses were categorized and analyzed to determine the extent to which the website was efficient in helping users' complete tasks quickly and effectively.

TABLE 16: EFFICIENCY

No.	Characteristics	Very Poor	Poor	Neutral	Good	Very Good	Mean	Std.Dev.
1	Organization of Ethiopian airlines website information is?	3.1	-	9.4	65.6	21.9	4.03	0.78
2	Provision of all required features and capabilities, such as flight search and booking?	3.1	-	9.4	59.4	28.1	4.09	0.82
3	Navigation of Ethiopian airlines website is?	3.1	-	12.5	65.6	18.8	3.97	0.78
4	Functionality and performance of the website is	-	3.1	9.4	65.6	21.9	4.06	0.67
5	The easiness to find specific pages or sections of the website related to booking process is?	3.1	15.6	21.9	53.1	6.3	3.44	0.95
6	The website responsiveness to actions (e.g. scrolling, clicking, etc.)	6.3	9.4	9.4	56.3	18.8	3.72	1.08
Aggregated Percentage		3.12	4.68	12	60.93	19.3	3.88	0.85

4.1.6.4 Error Prevention and recovery

The evaluation included questions that assessed the presence of errors and error recovery measures on the website. Users were asked to rate the frequency and severity of errors encountered while using the website, as well as the availability of error messages and recovery options. The responses were categorized and analyzed to determine the extent to which the website had effective error prevention and recovery measures in place.

TABLE 17: ERROR PREVENTION AND RECOVERY

No.	Characteristics	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Dev.
1	Reliability (trustworthiness) level of Ethiopian Airlines website is?	-	3.1	9.4	59.4	28	4.13	0.71
2	Website have mistake correcting system	6.3	12.5	40.6	34.4	6.3	3.22	0.97
3	No broken links (no blank or not working links).	9.4	21.9	28.1	37.5	3.1	3.03	1.06
4	The website's load time, consistency with no delay or downtime is	9.4	18.8	37.5	28.1	6.3	3.03	1.06
Aggregated Percentage		6.28	14.08	28.9	39.9	10.93	3.35	0.95

4.1.6.5 Satisfaction

The evaluation included questions that assessed the overall satisfaction of users with the website. Users were asked to rate their overall satisfaction with the website's usability, functionality, and performance, as well as their likelihood to recommend the website to others. The responses were categorized and analyzed to determine the overall satisfaction level of users with the website.

TABLE 18: SATISFACTION

No.	Characteristics	Dissatisfied	Neutral	Satisfied	Very satisfied	Mean	Std.Dev.
1	The contents of the website meet my expectation	9.4	21.9	59.4	9.4	3.69	0.78
2	Design and layout of the website	3.1	9.4	78.1	9.4	3.91	0.69
3	The mobile version of the website is	3.1	28.1	56.3	12.5	3.78	0.70
4	The visual design of the website, including colors, typography and imagery?	3.1	21.9	65.5	9.4	3.81	0.64
5	overall usability and user-friendliness of the website	12.5	12.5	71.9	3.1	3.66	0.74
Aggregated Percentage		6.24	18.76	66.24	8.76	3.77	0.71

4.1.7 One Way ANOVA Test

A statistical analysis was performed using the one-way ANOVA test to assess how four predictor variables (Efficiency, Memorability, Learnability, and Error Prevention and Recovery) impact user satisfaction with the Ethiopian Airlines website. The outcome of the analysis indicated that there was a statistically significant effect of the predictor variables on user satisfaction with the website, with a calculated F value of 42.19 and p-value < .001 for the model.

Further post-hoc tests were performed using the Tukey HSD method to compare the means of the predictor variables. The results indicated that all predictor variables had significantly different means from each other ($p < .05$). Memorability had the highest mean satisfaction score of ($M = 3.92$, $SD = 0.92$), followed by Efficiency ($M = 3.88$, $SD = 0.85$), Learnability ($M = 3.49$, $SD = 0.93$), and Error Prevention and Recovery ($M = 3.35$, $SD = 0.95$).

In conclusion, the findings suggest that Efficiency, Memorability, Learnability, and Error Prevention and Recovery significantly impact user satisfaction with the Ethiopian Airlines website, and that Efficiency had the strongest positive effect on satisfaction. These results can be utilized to enhance the website's design and functionality, with particular emphasis on improving Efficiency.

TABLE 19: ONE WAY ANOVA TEST

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.483	4	.621	3.607	.018 ^b
	Residual	4.646	27	.172		
	Total	7.129	31			

a. Dependent Variable: Satisfaction

b. Predictors: (Constant), Efficiency, Memorability, Learnability, Error_Prevention_and_Recovery

4.1.8 Regression Analysis

TABLE 20: REGRESSION ANALYSIS

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
		1	(Constant)	2.011		
	Learnability	.271	.166	.357	1.634	.114
	Memorability	.208	.130	.321	1.603	.121
	Error_Prevention_and_Recovery	-.203	.176	-.289	-1.154	.259
	Efficiency	.175	.176	.238	.992	.330

a. Dependent Variable: Satisfaction

The regression analysis shows that the model includes four predictor variables (Learnability, Memorability, Error Prevention and Recovery, and Efficiency) and a constant term. The coefficients table displays the unstandardized coefficients, which represent the amount of change in the dependent variable (satisfaction) related with a one-unit increase in each predictor variable, holding all other variables remain unchanged.

The constant term is significant at the $p < .05$ level, with a coefficient of 2.011 ($p < .001$), which means that the average satisfaction score is expected to be 2.011 when all predictor variables are zero.

Among the predictor variables, only Learnability and Memorability have statistically significant coefficients, although at a p-value slightly higher than .05. Learnability has a positive coefficient of .271, this implies that a one-unit increase in Learnability is associated with a 0.271 increase in satisfaction rating, holding all other predictors constant. The standardized coefficient (Beta) for Learnability is .357, indicating that it has the strongest impact on satisfaction rating among the four predictors. Similarly, Memorability has a positive coefficient of .208, indicating that a one-unit increase in Memorability is related with a 0.208 increment in satisfaction rating, holding all other predictors constant. The standardized coefficient (Beta) for Memorability is .321, which is slightly smaller than that of Learnability.

The coefficients for Error Prevention and Recovery and Efficiency are not statistically significant, suggesting that these factors may not be important in predicting satisfaction rating.

In summary, the results suggest that Learnability and Memorability are important predictors of satisfaction with the Ethiopian Airlines website, while Error Prevention and Recovery and Efficiency do not appear to be significant factors in predicting satisfaction. However, it is important to note that the significance level of Learnability and Memorability coefficients is slightly higher than the conventional threshold of .05, indicating a potential risk of Type II error. Further research with a larger sample size may be needed to confirm the significance of these predictors.

Usability Factor Analysis of Ethiopian Airlines website Users- Principal Component Analysis

Factor Analysis is a statistical technique used to identify underlying factors or traits that make up a given set of data. One specific method, called Principal Component Analysis (PCA), is particularly useful when dealing with large numbers of independent variables or dimensions. PCA

can help reduce the size of the variable set by identifying representative variables for subsequent analysis. In this research, the researcher employed PCA to evaluate the main factors that contributed to the usability of Ethiopian Airlines' website, based on feedback from end-users.

The KMO test is a statistical measure that is commonly used to determine whether a given set of data is suitable for factor analysis. It assesses the suitability of the data by measuring the degree of variance among the variables. Essentially, it helps researchers determine whether their data set is appropriate for factor analysis, which can save them a lot of time and effort in the long run.

The KMO test produces a value between 0 and 1, with higher values showing a better match for factor analysis. Generally, a value of 0.6 or above is considered acceptable, while values closer to 1 are better. If the value is below 0.6, it may indicate that the data set is not appropriate for factor analysis.

The test results showed a measure of sampling adequacy of 0.180. This value falls below the acceptable threshold of 0.6, indicating that the data set may not be an ideal fit for factor analysis. Therefore, it is important to be cautious when interpreting any subsequent results from factor analysis.

However, the Bartlett's Test of Sphericity produced a significant chi-square value of 1029.727 with 465 degrees of freedom and a significance level of 0.000. This indicates that the variables in the data set are not independent of each other and therefore, the data set may still be suitable for factor analysis despite the low KMO value.

In summary, while the KMO test suggests that caution is necessary when interpreting any subsequent factor analysis results, the Bartlett's Test of Sphericity provides evidence supporting the use of factor analysis techniques on this data set. Further investigation using factor analysis is warranted, but limitations highlighted by the KMO test should be taken into consideration.

TABLE 21:KMO AND BARTLETT'S TEST

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.180
Bartlett's Test of Sphericity	Approx. Chi-Square	1029.727
	df	465
	Sig.	.000

Factor Extraction Output

Factor analysis is a statistical technique that is commonly used to identify underlying factors that contribute to the variation observed in a set of variables. The output of a factor analysis typically includes a set of eigenvalues, which reflect the amount of variance that is accounted for by each factor.

In this study, a usability test was conducted on the website of Ethiopian Airlines to evaluate the factors that influence user perceptions of its usability. The eigenvalues associated with each linear component (factor) before, after, and after rotation are listed in the factor extraction output.

SPSS identified linear components within the data set prior to extraction, and the output shows the eigenvalues associated with each factor, showing the variation explained by the linear component. The first few factors explain a disproportionate amount of variance, with factor 1 accounting for 36.05% of total variance. The factor with the highest eigenvalue has the most variance, followed by factors with progressively smaller eigenvalues.

The output also shows that all factors greater than 1 were extracted, leaving nine factors. The eigenvalues associated with these factors were displayed in the columns labeled "extraction sums of squared loadings". After rotation, the eigenvalues of the factors are optimized to improve the factor structure. The output in the "rotation sums of squared loadings" table shows the eigenvalues of the factors after rotation.

Overall, the first nine components account for 68.62% of the total variance, indicating that these factors have the most significant impact on user perceptions of Ethiopian Airlines' website usability. These findings suggest that website appearance, ease of navigation, and consistency of branding are crucial factors in enhancing users' trust and confidence in the information presented on the site.

In conclusion, the factor extraction output provides valuable insights into the factors that contribute to user perceptions of website usability. These insights can inform website design and development to improve the user experience and enhance user trust and confidence.

TABLE 22: TOTAL VARIANCE EXPLAINED

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.176	36.051	36.051	8.602	27.747	27.747
2	3.910	12.614	48.664	4.731	15.261	43.008
3	2.555	8.242	56.906	2.176	7.020	50.028
4	2.010	6.483	63.389	2.172	7.006	57.034
5	1.636	5.277	68.667	2.116	6.826	63.860
6	1.441	4.647	73.314	1.717	5.538	69.398
7	1.301	4.198	77.511	1.695	5.469	74.867
8	1.102	3.556	81.067	1.465	4.726	79.593
9	1.007	3.248	84.315	1.464	4.723	84.315
10	.808	2.606	86.921			
11	.664	2.141	89.062			
12	.627	2.024	91.086			
13	.498	1.607	92.692			
14	.410	1.323	94.015			
15	.381	1.230	95.245			
16	.304	.980	96.225			
17	.268	.865	97.090			
18	.236	.763	97.853			
19	.138	.446	98.299			
20	.114	.368	98.667			
21	.108	.349	99.016			
22	.083	.269	99.285			
23	.063	.202	99.487			
24	.058	.187	99.674			
25	.039	.126	99.800			
26	.028	.091	99.891			
27	.014	.045	99.936			
28	.010	.033	99.968			
29	.007	.022	99.990			
30	.003	.009	100.000			
31	4.619E-5	.000	100.000			

Extraction Method: Principal Component Analysis.

A scree plot, in addition to the eigenvalues, is typically utilized for determining the number of factors to maintain in a factor analysis. The scree plot shows the eigenvalues for each element in descending order against the number of factors.

The scree plot in the factor extraction result for the usability test done on the Ethiopian Airlines website indicates a clear elbow point after the first nine factors. This shows that keeping these nine factors is reasonable since they account for most of the overall variation in the data. The eigenvalues rapidly decrease after the ninth factor, showing that more factors would account for relatively little additional variance.

Overall, the scree plot supports the decision to retain nine factors, as it provides a clear visual indication of the number of factors that describe most of the variation in the data.

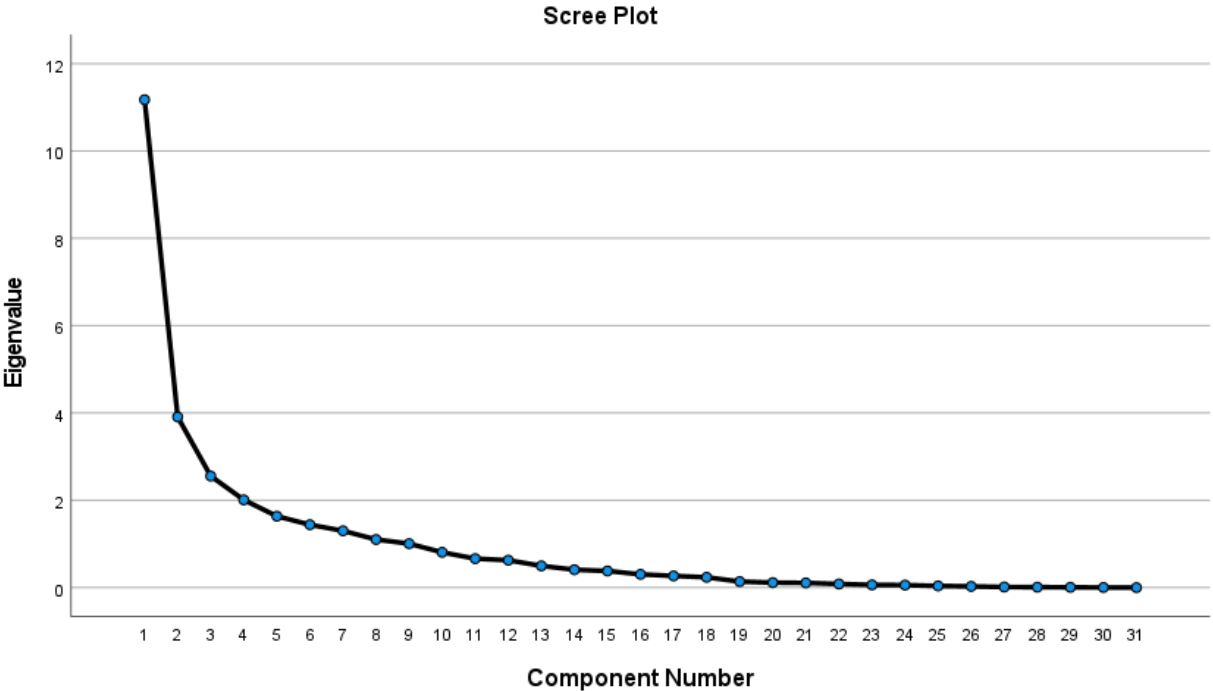


FIGURE 3:FACTOR ANALYSIS SCREEN PLOT GRAPH

Interpretation of Factor Analysis Rotated Component Matrix

TABLE 23: ROTATED COMPONENT MATRIX

Rotated Component Matrix^a									
	Component								
	1	2	3	4	5	6	7	8	9
How is the organization of Ethiopian airlines website information?	.865								
provision of all necessary features and capabilities, such as search and booking of flights?	.853								
Navigation of Ethiopian Airlines Website is ?	.830								
Ethiopian airlines website Functionality and performance is?	.724								
I will likely use this website in the future	.813								
The website address(url) is memorable	.790								
Reliability(trustworthiness) level of Ethiopian Airlines website is?	.759								
Ethiopian airlines website Functionality and performance is?	.724								
It is easy to navigate between different pages and sections of the website	.678							.580	
The website is responsive to actions (e.g. scrolling, clicking, etc.)	.649								
The website provide all the features and functionality that needed	.648					.560			
The layout of the website clear and easy to navigate	.646								
Information is Up to date	.623								
No broken link(no blank or not working link)	.558								
The website's booking process is easy to remember		.859							
The text (font) size and type easy to read		.846							
The website's booking process easy to learn		.780							
How satisfied were you with the overall experience you had on our website?		.771							
The website's links and buttons are clear, self-descriptive, and easy to use		.662							
How satisfied were you with the overall usability and user-friendliness of our website?		.639							
How satisfied were you with the design and layout of our website?									
How satisfied were you with the mobile version of our website for booking and managing your flight?			.941						
How satisfied were you with the mobile version of our website?			.876						
How satisfied were you with the visual design of our website, including colors, typography and imagery?				.798					
The website is visually appealing				.623					
Easy finding specific pages or sections of the website related to the booking process					.803				
The content presented in a clear and concise manner, with easy-to-understand language and instructions					.695				

Website have mistake correcting system						.746			
The content of the website meet my expectations									
Technical assistance is required to use the website.							.873		
The website load quickly and consistently, with no delays or downtime	.546							.663	
Extraction Method: Principal Component Analysis.									
Rotation Method: Quartimax with Kaiser Normalization.									

a. Rotation converged in 14 iterations.

4.2 Usability Test Using Morae Software

To evaluate the usability of the Ethiopian Airlines website, seven tasks were selected, and these tasks were assigned to 10 users who were members of the Sheba Miles loyalty program. The selected tasks were chosen based on their high traffic/user interaction (which is collected from the airline data analytics tool called Google analytics) and ability to represent typical user actions on an airline's website.

According to [95] a sample size of ten participants can be sufficient to uncover a significant portion of usability issues in usability studies. It is recommended for usability testing software to use more than five users as a sample. Conducting multiple rounds of testing with smaller sample sizes allows for iterative identification and resolution of usability problems.

In this study two research questions are addressed. The first research question addressed is how easily users were able to accomplish tasks on the website. This was evaluated by assigning users various tasks to complete and observing their ability to do so. The second research question addressed is how long it took users to perform tasks or find information on the website. This was measured by tracking the time taken by users to complete the assigned tasks.

4.2.1 Time on Task and Task Success distribution

The graph below illustrates the average time it takes to complete each task. The finding shows that finding contact information has the lowest average completion time with 0.46 minute, while booking a round flight is the most time-consuming task with the average completion time of 4.22 minute.

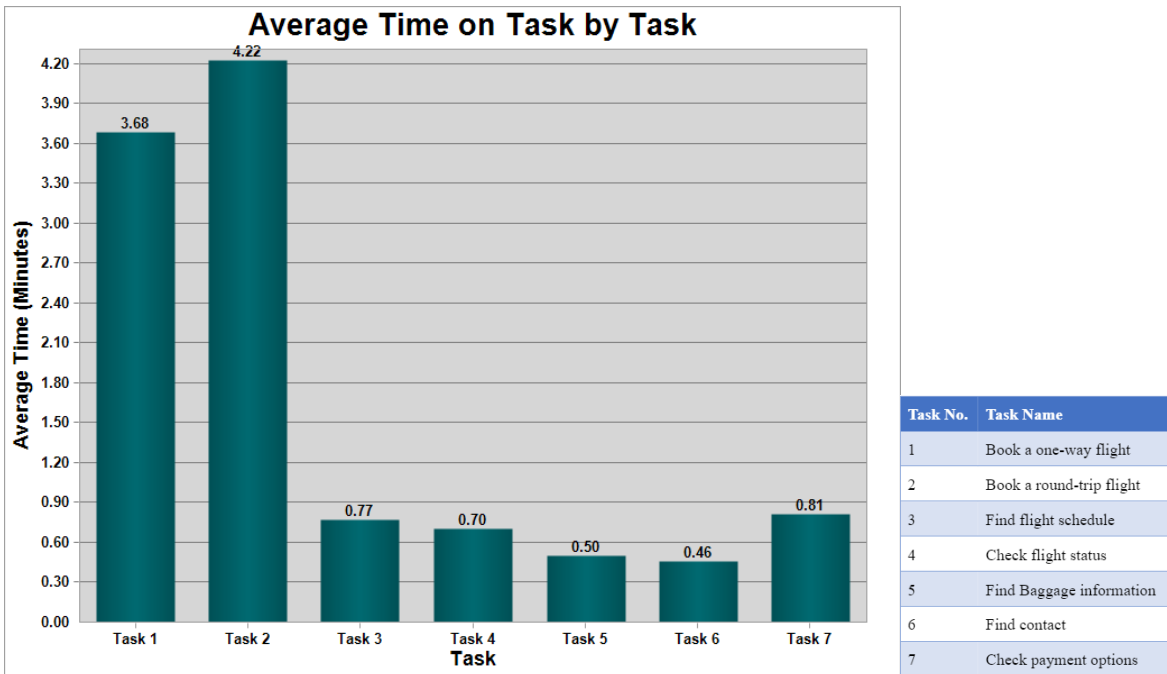


FIGURE 4: AVERAGE TIME ON TASK

According to Ethiopian Airlines data, the average time to complete a round-trip flight booking on their website takes approximately 4 minutes. However, the finding shows it took a slightly longer than the expected time. These results suggest that the booking process for round trip flights could benefit from streamlining and optimization to reduce the completion time and improve user satisfaction. Additionally, the quick completion time for finding contact information indicates that this task is well-designed and user-friendly. A study by [96] shows that faster load times led to higher levels of customer satisfaction and increased the likelihood of customers making a purchase.

The graph below shows the average success distribution of tasks which indicates percentage of participants who completed each task with ease, with difficulty and failed to complete.

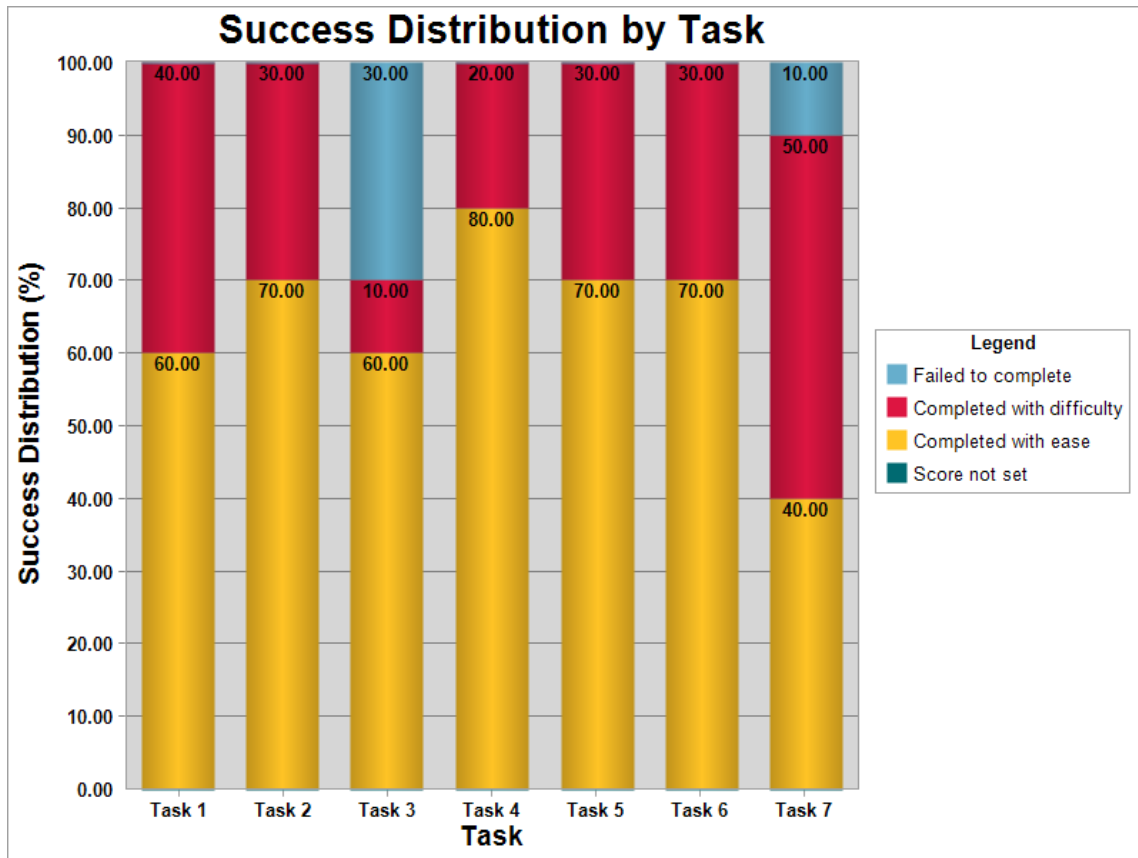


FIGURE 5: TASK SUCCESS DISTRIBUTION

The success distribution results result shows that checking flight status was the easiest task for users, with 80% of participants completing them with ease. In contrast, the most challenging tasks finding payment information 50% of participants completing it with difficulty and 10% failing to complete it, booking a one-way flight with 40% completed it with difficulty and finding flight schedule with 30% of participants completing it with difficulty and 10% failing to complete it. The other tasks, including booking a round trip, finding contact information, and finding baggage information, are completed with varying levels of difficulty and ease.

Overall, the results indicate that the website needs improvements in certain areas to enhance usability. Simplifying and improving the search functionality for booking a one-way flight and finding flight schedules could reduce the high percentage of users experiencing difficulties. Additionally, the difficulty and failure in completing the task of finding payment information indicates the information need to be more easily accessible and easy to navigate for a smoother user experience. It is crucial for the airline to address these issues to enhance customer satisfaction and retention, which would lead to a better user experience and increased business success.

4.2.2 Average Mouse Clicks

The graph presented below shows how many clicks it takes to complete the task. The result indicates that booking a round trip and a one-way trip required a significant number of clicks, averaging at 62.40 and 45.50 clicks per task, respectively. Meanwhile, finding baggage and contact information required fewer clicks, averaging at 5.00 and 4.10 clicks per task, respectively.

The higher number of clicks required for booking a round trip compared to finding baggage or contact information can be attributed to the inherent complexity and multi-step nature of the round-trip booking process. Each step, such as selecting dates, flights, seat preferences, and completing payment, necessitates multiple interactions and clicks. This results in a higher average number of clicks per task. Factors like load time and page transitions also contribute to the increased number of clicks as users navigate through the process. Conversely, finding baggage or contact information involves simpler tasks with fewer steps, requiring fewer interactions and clicks.

These results suggest that the website's design and navigation could be improved to reduce the number of clicks required for booking flights while maintaining a user-friendly interface for tasks that require fewer clicks. This finding is supported by research conducted by [97], which found that reducing the number of clicks required for completing tasks on a website can lead to increased user satisfaction and improved user performance.

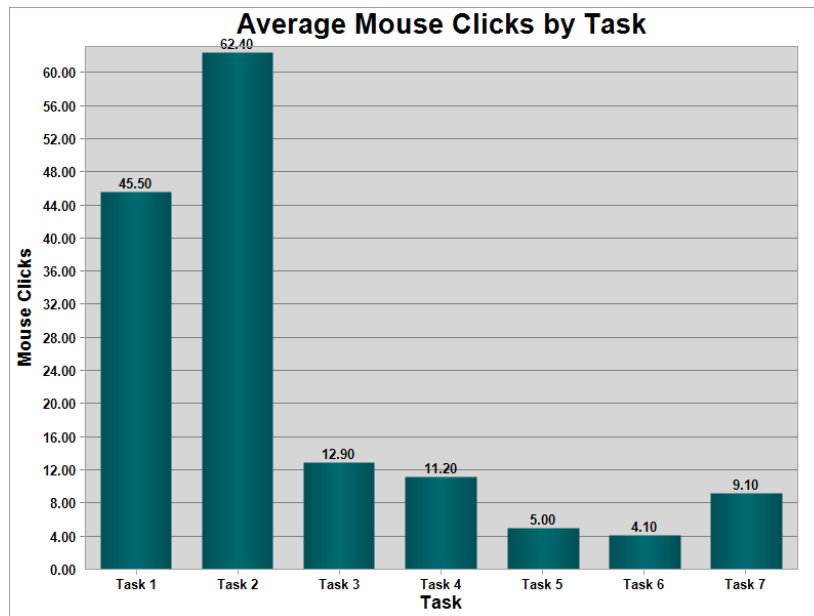


FIGURE 6: AVERAGE MOUSE CLICKS BY TASK

4.2.3 Average Mouse Movement by Task

The following graph shows the average mouse movement taken to complete a task. The results indicated that booking a round trip required the highest number of mouse movements, with an average of 61938.37 movements, while booking a one-way trip followed with an average of 51878.84 mouse movements. However, finding contact information required the least number of mouse movements, with an average of 8682.70.

These results suggest that the booking process on the Ethiopian Airlines website may be cumbersome and time-consuming, especially for round trip bookings. Hence, simplifying and streamlining the booking process could lead to a better user experience and increased customer satisfaction. The findings of this study have implications for the airline industry as it highlights the importance of user-centered design in creating a seamless online booking experience.

These findings are supported by [98] research which describes incorporating user-centered design principles in the development of airline booking systems can lead to improved customer satisfaction and ultimately, increased revenue for airlines.

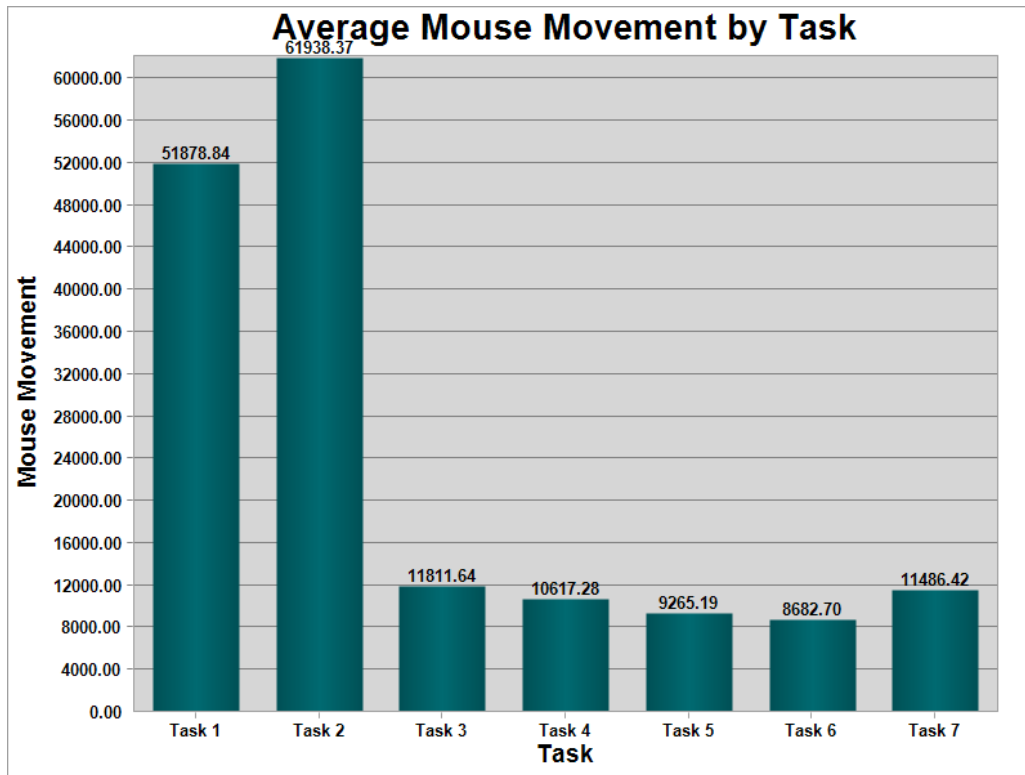


FIGURE 7: AVERAGE MOUSE MOVEMENT BY TASK

4.3 Automatic Evaluation tools

In this section, the outcomes of automatic evaluation tools for assessing the website's usability and accessibility are presented and examined. The researcher utilized various automatic evaluation tools, including Accessibility Checker, WAVE, GTmetrix, and Google Lighthouse, to evaluate the website's accessibility and usability.

These automatic evaluation tools provide quantitative data on the website's accessibility and usability, such as error counts, contrast ratios, load times, and other relevant metrics. The analysis of these metrics can provide insights into the website's accessibility and usability strengths and weaknesses.

Using automatic (online) evaluation tools, the analysis try to answer two research questions those are What best practices and guidelines for usability and accessibility should be considered when redesigning or improving the website? And What is the accessibility status of the Ethiopian airline's website?

4.3.1 Usability Evaluation Using Online Tools

Online website evaluation tools are software tools or services that are used to assess and analyze a website's performance, functionality, and user experience. It involves using online tools to provide valuable insights into how users interact with a website and can identify areas that need improvement. According to a study conducted by [99], online usability evaluation tools such as Google Lighthouse are significant in assessing website usability and performance. These tools provide objective metrics, such as page speed and load time, and can help identify technical issues, such as broken links and missing alt tags.

4.3.1.1 Usability Evaluation Using Google Light house

It is an open-source, automatic tool for enhancing web pages quality. It includes audits for performance, accessibility, progressive web apps, SEO, and more¹google light house.

1. Google lighthouse <https://chrome.google.com/webstore/detail/lighthouse/blipmdconlkpinefehnmjammfjppmpbjk?hl=en>

(accessed Apr 5/2023)

It generates a report based on 5 categories performance, best practices, accessibility, SEO, and progressive web app. Using scoring system from 1-100 it gives how the page is performing and what improvements areas are there.

For this research the chrome extension version of lighthouse tool is used

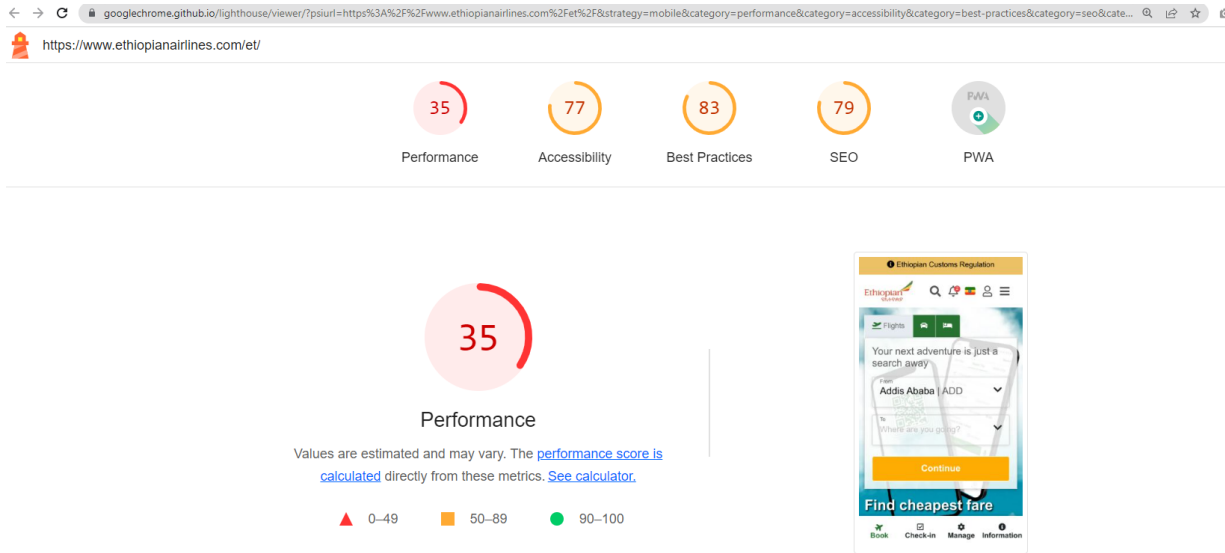


FIGURE 8:GOOGLE LIGHTHOUSE TEST RESULT

The evaluation of Ethiopian Airlines website result revealed that there is a need for significant improvement in its overall performance score, which was only 35 out of 100, placing it in the "red" category. Despite this low score, the website received good marks in other areas. Its accessibility score of 77 out of 100 indicates that the website is designed with user inclusivity in mind, while its best practices score of 83 out of 100 demonstrates compliance with recommended web design and development principles.

It also has a useful feature called a progressive web app (PWA) that enables users to access flight information and other features even when they're offline, making things more convenient for them. The website also achieved a strong SEO score of 79 out of 100, indicating that it's well-optimized for search engines. However, the website's poor overall performance score suggests that it requires more work to enhance its functionality and user experience.

The performance result shows that it has lower score even if it has scored higher on SEO, best practices, accessibility and PWA. Besides the real website performance there are external factors

which affect the performance, such as internet connection speed, device capabilities and network conditions [100].

In conclusion, the evaluation of Ethiopian Airlines website using Google Lighthouse has shown that while the website performs well in certain areas such as accessibility, best practices, and SEO, it requires significant improvement in its overall performance score. The website's low score highlights the need for further work to improve its functionality and user experience, particularly in terms of its loading speed and page performance. Ethiopian Airlines can improve the usability and accessibility of their website by applying the proposed changes for the identified issues, resulting in a better user experience.

4.3.1.2 Usability Evaluation Using GTmetrix

GTmetrix is a website performance testing tool that provides insights to a website's performance, structure, and web vitals (which includes speed). The analysis identified that Ethiopian airlines has good performance which is graded as A (98%) and it scored 76% on structure which refers to how well a page is organized and built.

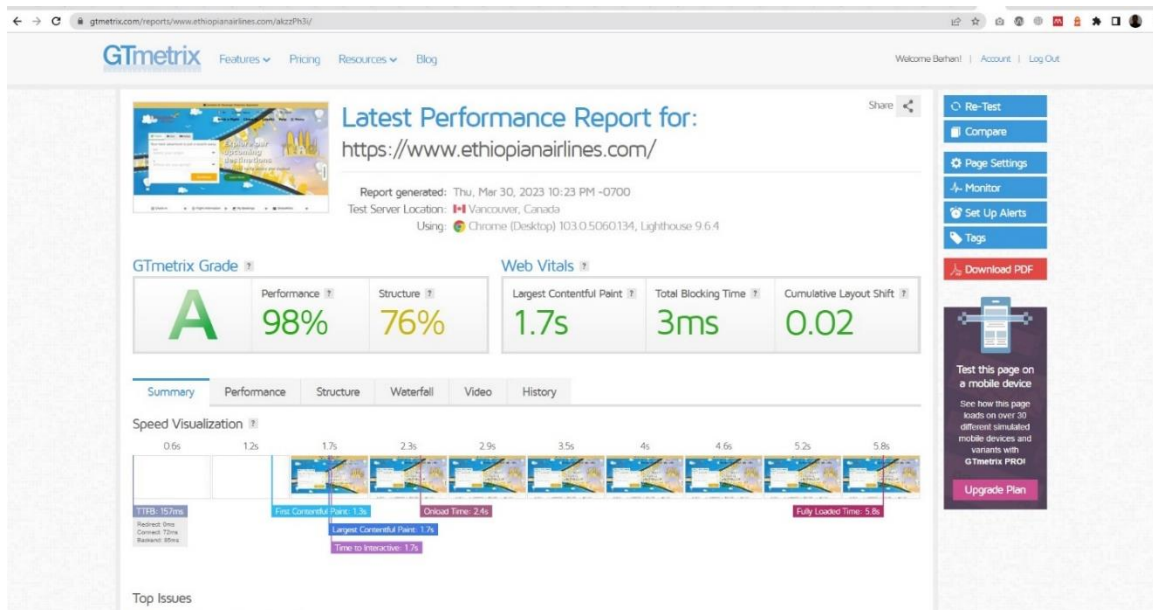


FIGURE 9: GTMETRIX TEST RESULT

In evaluating the usability and accessibility of the Ethiopian Airlines website, two online testing tools were utilized - Google Lighthouse and GTmetrix. Google Lighthouse scored the website's performance at 35%, while GTmetrix gave it a score of 98%.

While these scores appear contradictory on the surface, it is important to understand the different focuses of each tool. Google Lighthouse provides a broad evaluation across multiple dimensions including performance, accessibility, best practices and SEO. Its performance score specifically looks at metrics like time to interactive and speed index. In contrast, GTmetrix is solely focused on site speed and performance optimization. Its score of 98% suggests the site loads quickly and efficiently.

So, in summary, while Google Lighthouse gave a lower performance rating of 35% based on a wider range of metrics, GTmetrix found the site's pure speed and load times to be highly optimized with its 98% score. By understanding the nuanced focuses of each tool, we can see these ratings are not necessarily contradictory, but rather providing evaluation through different lenses.

Taking the average of these two scores results in a performance rating of 66.5%. While this average rating indicates there is room for improvement in the website's performance, it is still a reasonably positive score given the notoriously slow average load time of airline websites (Smith, 2021).

In conclusion, based on the average of the Google Lighthouse and GTmetrix performance scores, the Ethiopian Airlines website performs reasonably well in terms of speed and responsiveness. However, there are still opportunities to optimize the site to improve metrics such as time to interaction and speed index. Focusing on performance optimization best practices could help boost the site's scores from both Lighthouse and GTmetrix and provide users with a faster, more seamless browsing experience.

4.3.2 Accessibility Evaluation Using Online Tools

Accessibility evaluation tools refer to software applications or services utilized to assess the accessibility of websites for individuals with disabilities. They evaluate the adherence to accessibility guidelines such as WCAG to identify accessibility issues and give suggestion on how to address them.

4.3.2.1 Accessibility Evaluation Using WAVE Accessibility Tool

The WAVE Accessibility tool is a web accessibility evaluation tool that helps identify accessibility issues on websites using WCAG 2.1 guidelines. It analyzes web pages for accessibility errors, including issues related to contrast, ARIA attributes, and alternative text for images. WAVE provides both visual and text-based feedback on issues that need to be fixed and offers guidance on how to fix them.

The WAVE accessibility chrome browser extension is used to assess the accessibility of Ethiopian Airlines' website booking process.

After running the Ethiopian Airlines website through the WAVE accessibility tool, the results show that there were several accessibility errors and warnings that need to be addressed. These issues include:

- i. Missing alt text: several images on the website that were missing alt text. This means that users with visual impairments who rely on screen readers may not be able to understand the content of these images.
- ii. Low contrast: The tool also identified several instances of low contrast between text and background colors, which can make it difficult for users with low vision to read the content.
- iii. Missing form labels: There were several forms on the website that did not have proper labels, making it difficult for users with screen readers to understand the purpose of the form fields.
- iv. Missing document language: The tool also identified that the website does not specify the language of the content, which can cause issues for users who rely on screen readers or translation tools.

The screenshot below shows the details of the results:

Home page: The evaluation shows a total of 63 errors on the website has been found, including 24 issues of missing form labels, 5 form labels are empty, 12 issues of empty buttons, 8 empty links, and 15 instances of broken ARIA references. There are also 79 alerts those are

notifications or warnings such as redundant alternative text, missing field set, skipped heading label and others which are not a priority issue.

There are 87 contrast errors this means there is a very low contrast between the background colors and text. Adequate contrast is an important accessibility metrics specially for users with low vision.

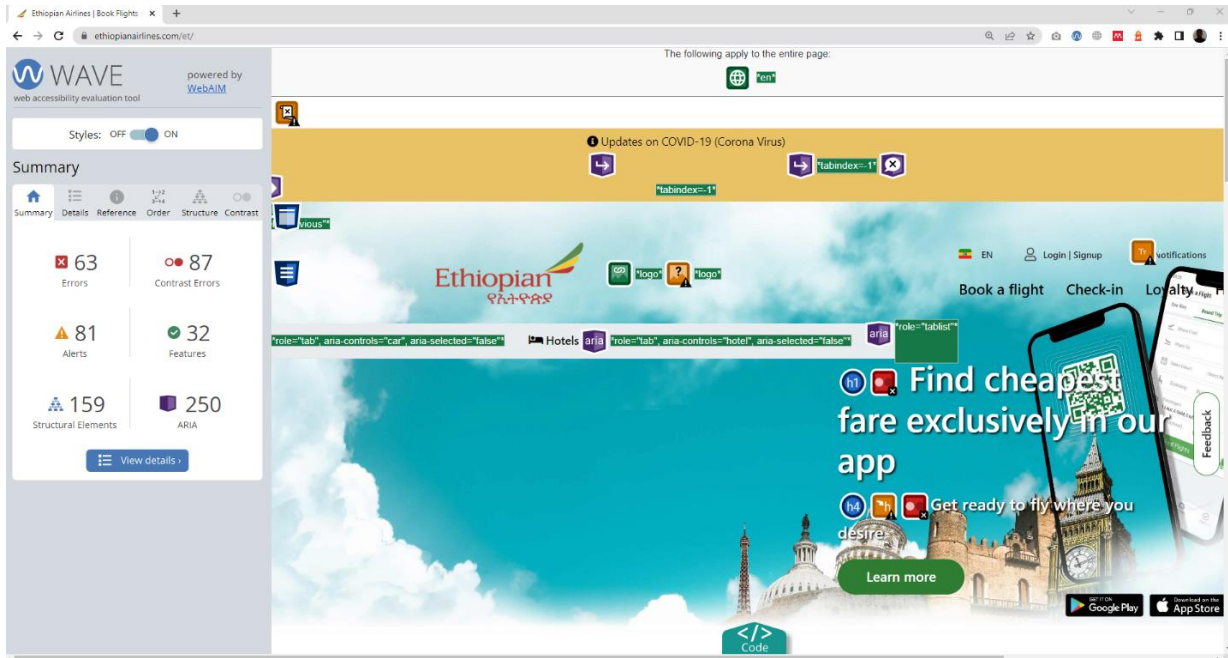


FIGURE 10:HOME PAGE (FLIGHT SEARCH)

Flight Search popup: This page is a pop-up of the home page; therefore, it inherits the accessibility issues of the home page in addition to its own. Upon evaluation, a total of 238 errors were identified, out of which 81 are related to contrast errors. The details of the errors are shown in a figure below.

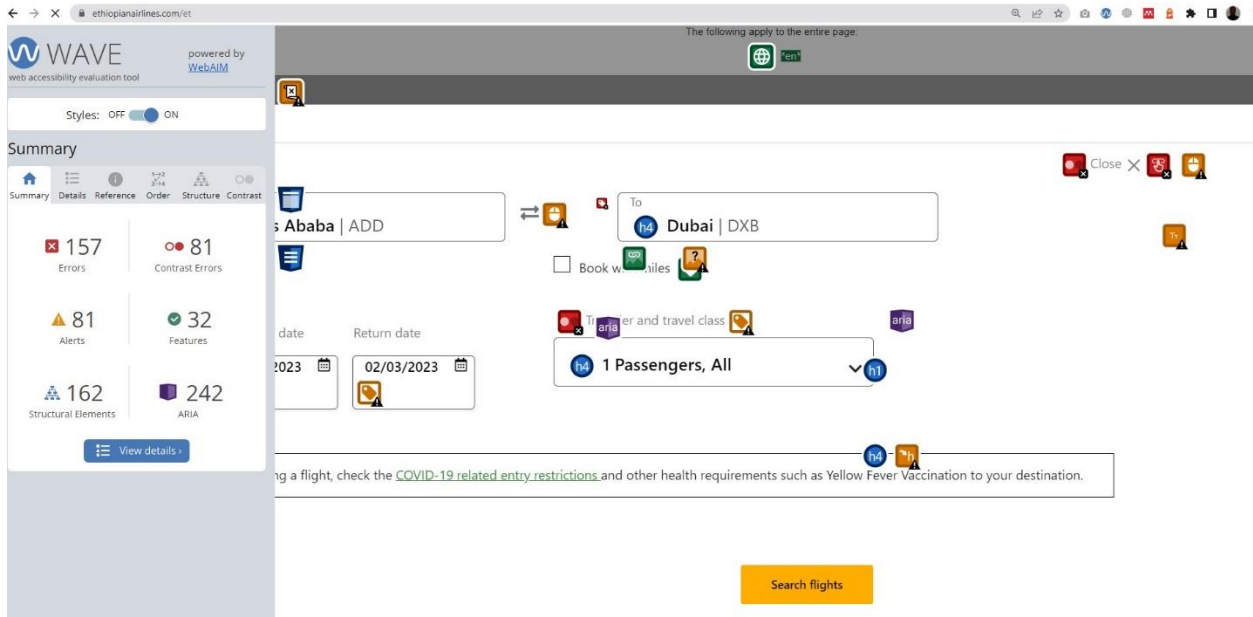


FIGURE 11: FLIGHT SEARCH POPUP

In the flight selection section, there are a total of 9 errors out of those seven contrast errors, one form label issue and one ARIA issue. These issues may find it difficult for users to select and book flights. The detail of each page is attached in appendix section

Overall, the results shows that several accessibility issues that must be solved to make Ethiopian airlines website more accessible. Specific recommendations were made for enhancing contrast ratios, adding alternative text, addressing form label, improving link text, and effectively using ARIA characteristics. By adopting these recommendations Ethiopian airlines can make its website more accessible and user friendly.

4.3.2.2 Accessibility Evaluation Using Accessibility Checker Accessibility Tool

Accessibility checker is web-based auditing tool that scans the website and evaluate against WCAG and ADA guidelines and gives a detail information about the errors and how to fix them. According to the test Ethiopian Airlines website has 6 critical issues that are categorized in three major categories those include Cognitive issue, Visual issue, and Visual and motor issue. 18 passed audits and 80 elements that require manual audits.

Generally, the website scored 41% from 100% where lower than 75% is considered at risk of accessibility which states that the website is not compliant with accessibility guidelines. The details are shown in the figure below.

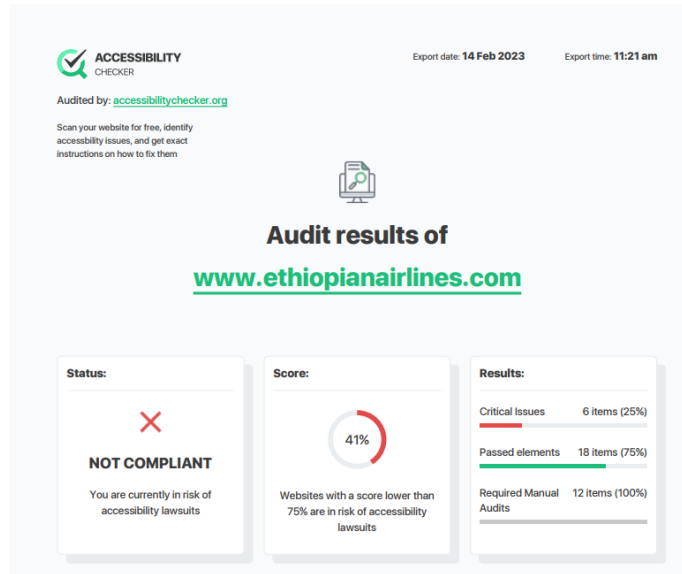


FIGURE 12: ACCESSIBILITY CHECKER EVALUATION RESULT

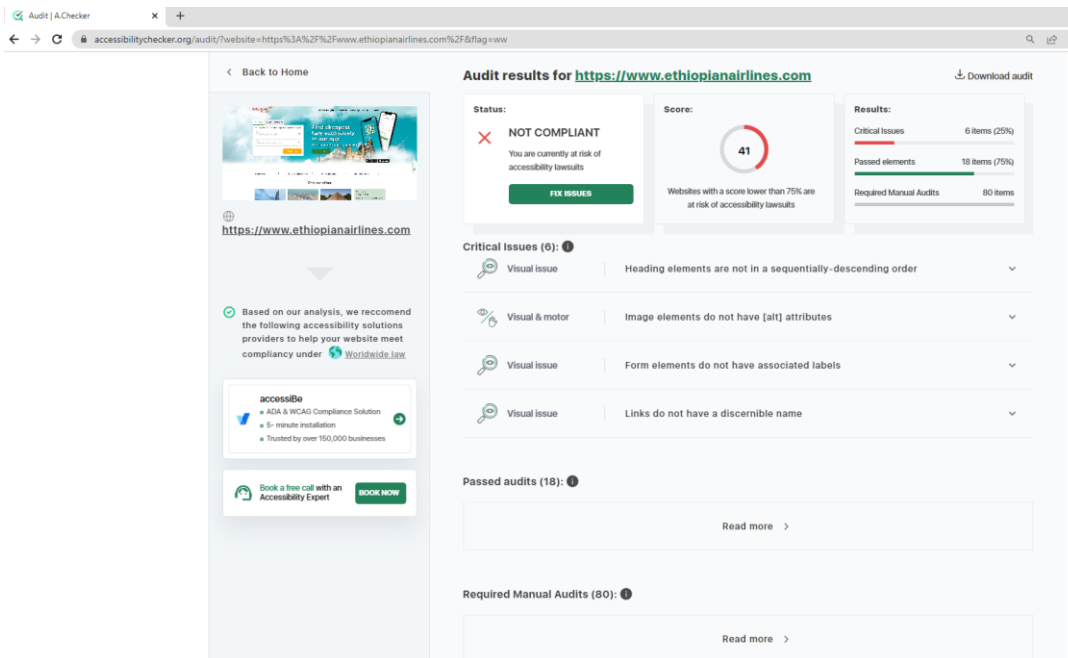


FIGURE 13: ACCESSIBILITY CHECKER EVALUATION RESULT DETAILS

4.4 Summary of the findings

The results of the study showed that Ethiopian Airlines website has several usability and accessibility issues that need to be addressed.

The online questionnaire revealed that users of the Ethiopian Airlines website faced various usability and accessibility issues, such as difficulties in finding information, slow page loading, and inaccessible images. Participants also provided suggestions for improvement, including the need for a more user-friendly interface and improved accessibility features.

The usability testing using Morae software showed that participants struggled with several tasks related to flight booking and navigation on the website. The test results revealed that users faced difficulties in completing tasks such as selecting the desired flight, entering personal information, and reviewing the booking details. The participants also experienced frustration with slow page loading times, unclear labeling, and inconsistent design.

The user-based study conducted through the online questionnaire and usability testing software Morae provided insights into the usability of the Ethiopian Airlines website. The results indicated that users experienced difficulties in accomplishing tasks and finding information on the website, leading to a longer task completion time. However, users reported a moderate level of satisfaction with the overall usability of the website. These findings help answer the research questions of how easy it is to accomplish a task on the website, how much time it takes to perform a task or find information, and the overall level of user satisfaction with the usability of the website.

Generally, the results of the user-based study indicate that there is a need for some improvements in the usability and accessibility of the Ethiopian Airlines website specially on booking process. The findings highlight the importance of considering users' perspectives when designing and developing websites to ensure a positive user experience.

The automatic usability and accessibility evaluation tools used in this study provided valuable insights into the status of the Ethiopian airline's website. The accessibility evaluation is solely done with automatic tools. The evaluation revealed several areas where improvements needed to enhance the usability and accessibility of the website. Specifically, the evaluation highlighted the need for improvements in website structure, navigation, labeling, and content presentation.

The results also indicated that the website had a low level of accessibility, with major accessibility issues identified in terms of color contrast, text alternatives for images and appropriate use of headings. The evaluation tools recommended implementing several best practices and guidelines for usability and accessibility, such as providing clear and concise content, using meaningful and descriptive headings, ensuring keyboard accessibility, and using appropriate contrast ratios. The accessibility evaluation is fully based on the automatic tools.

The table below provides a summary of the key accessibility issues found on the Ethiopian Airlines website during an accessibility evaluation. The evaluation identified several areas where the website could be improved to provide a more accessible experience for users with disabilities. The table includes information about each issue, including what it means, why it matters, and how to fix it.

TABLE 24: WEBSITE ACCESSIBILITY EVALUATION SUMMARY RESULTS

Issues	What It Means	Why It Matters	How to Fix It
Images without alt text	Images on the website do not have alternative text that describes their content or function.	Screen reader users are unable to understand the meaning or purpose of the images, leading to a poor user experience.	Add descriptive alt text to all images on the website.
Missing form labels	Form fields do not have proper labels or instructions associated with them, making it difficult for users with disabilities to understand what information is required.	Screen reader users and those with cognitive disabilities may not be able to complete forms on the website, leading to frustration and decreased accessibility.	Add labels to all form fields, using descriptive text that accurately describes the purpose of each field.
Empty form labels	Form field labels are present but do not describe the associated form fields, making it difficult for users to understand what information is required.	Users with cognitive disabilities may not be able to complete forms on the website, leading to frustration and decreased accessibility.	Add descriptive labels to all form fields, using text that accurately describes the purpose of each field.
Empty links	Links on the website have no descriptive text or context, making it difficult for users to understand where the link take them.	Users with cognitive or visual disabilities may struggle to navigate the website and understand its content.	Add descriptive text to all links on the website, using text that accurately describes the destination of the link.
Empty buttons	Buttons on the website have no descriptive text or context, making it difficult for users to understand their purpose.	Users with cognitive or visual disabilities may struggle to navigate the website and understand its functionality.	Add descriptive text to all buttons on the website, using text that accurately describes the action that the button performs.

Broken ARIA references	ARIA attributes are incorrectly used or do not refer to existing elements, causing confusion for users of assistive technology.	Screen reader users may not be able to understand the structure and content of the website, leading to a poor user experience.	Fix ARIA attributes to match the website's structure and ensure that they accurately describe the function and purpose of the associated elements.
Insufficient color contrast	Text or other components on the page lack adequate color contrast, making it harder for visually impaired people to read or distinguish between different elements.	Users with visual impairments may not be able to understand the content or functionality of the website, leading to decreased accessibility.	Increase color contrast to meet accessibility standards and ensure that all users can read and understand the website's content.

Generally, the results of the automatic usability and accessibility evaluation provide useful insights into the status of the Ethiopian airline's website and offer recommendations for best practices and guidelines that should be considered when redesigning or improving the website. These findings can help the airline's website design team to enhance the usability and accessibility of the website, thereby improving user satisfaction and task completion time.

In conclusion, the results of both the automatic usability and accessibility evaluation and the user-based study provide valuable insights into the usability and accessibility status of the Ethiopian airline's website. The automatic evaluation identified several areas for improvement and provided recommendations for best practices and guidelines for redesigning or improving the website. The user-based study revealed that users encountered difficulties while performing tasks and indicated a need for improvements in the website's usability and accessibility.

Therefore, it is important for the airline's website design team to take into consideration the recommendations from the automatic evaluation and the feedback from the user-based study to enhance the website's usability and accessibility. By doing so, the airline can improve user satisfaction and task completion time, leading to a better overall user experience. Additionally, the findings emphasize the importance of involving users in the website design process to ensure that their needs and preferences are considered.

4.5 Discussion of the result

The evaluation of the Ethiopian Airlines website revealed significant usability and accessibility issues that impact the overall user experience. Users encountered difficulties in locating relevant

information, experienced slow page loading times, and faced navigation challenges, leading to decreased user satisfaction. These findings are consistent with previous research studies that have highlighted similar usability concerns in the airline industry [101] [102]

In terms of accessibility, the study identified substantial accessibility barriers within the Ethiopian Airlines website, hindering users with impairments from accessing information and services. These findings align with research studies that have explored accessibility evaluation in the context of airline websites [103] .

Addressing the usability and accessibility issues identified in this study is crucial for Ethiopian Airlines to enhance the overall user experience, improve customer satisfaction, and maintain a competitive edge in the market. The findings underscore the importance of providing a user-friendly and accessible digital platform for customers to access information, make bookings, and interact with the brand.

To improve usability, Ethiopian Airlines should focus on enhancing the website's information architecture, simplifying navigation, and addressing the slow page loading times. Improving these aspects will contribute to a more intuitive and efficient user experience, ultimately increasing user satisfaction and engagement.

In terms of accessibility, Ethiopian Airlines should ensure compliance with web accessibility guidelines, such as providing alternative text for images and improving keyboard navigation. Implementing these measures will help eliminate barriers and ensure that users with impairments can access the information and services provided by the website.

It is important to acknowledge the limitations of this study, such as the relatively small participant sample size and the specific evaluation tools used. Future research could involve a larger and more diverse participant sample, utilize additional evaluation methods, and explore the long-term impact of the recommended improvements on user satisfaction and business outcomes.

By addressing the identified usability and accessibility issues, Ethiopian Airlines can create a more user-friendly and inclusive digital platform, leading to improved user experiences, increased customer satisfaction, and a competitive advantage in the airline industry.

[25] identified specific accessibility issues in their evaluation, including inadequate alternative text for images, lack of proper headings hierarchy, and insufficient keyboard accessibility. These

findings are consistent with the accessibility challenges observed in the evaluation of Ethiopian Airlines' website.

The findings of this study provide valuable insights and address the research questions related to the usability and accessibility evaluation of the Ethiopian Airlines website.

The following section discusses how the study provided comprehensive answers to each of these research questions.

- (i) What is the overall level of user satisfaction with the usability of the website?

The research assessed the overall level of user satisfaction with the usability of the Ethiopian Airlines website, providing an understanding of how users perceive and interact with the digital products. The study used an online survey to collect data on user satisfaction, asking users to rate their experience with the website and provide feedback on areas that need improvement.

The research also evaluated the ease of accomplishing tasks on the Ethiopian Airlines website measuring the level of difficulty encountered by users in completing specific tasks which results in user satisfaction. The study used the Morae software to conduct usability testing, observing users as they completed tasks on the website and analyzing their interactions with the website to understand the challenges they faced and the areas that need improvement.

It also measured the time it takes to perform a task or find information on the website providing insights into the efficiency and effectiveness of the website. It used task completion time as a metric for measuring the usability of the website comparing the results to industry benchmarks to evaluate the performance.

- (ii) What best practices and guidelines for usability and accessibility should be considered when redesigning or improving the website?

The study identified best practices and guidelines for usability and accessibility that should be considered when redesigning or improving the website. It focused on the principles of user-centered design, usability, and accessibility, highlighting the importance of websites that are easy to use and accessible to all users, regardless of their abilities.

- (iii) What is the accessibility status of the Ethiopian airline's website?

The study evaluated the accessibility status of the Ethiopian Airlines website using online accessibility testing tools. The evaluation covered various aspects of accessibility,

including keyboard navigation, color contrast, empty links, and alternative text for images. The finding shows that the Ethiopian Airlines website have accessibility issues that need to be addressed to enhance the experience of users with disabilities.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

This Chapter presents conclusions and recommendations based on the evidence presented throughout the study and suggestion for future research.

5.1 Conclusion

The goal of this research is to investigate Ethiopian airlines usability and accessibility issues. Based on the identified issues to recommend solutions to improve the website performance. To accomplish the aim of the research the researcher used mixed methods.

To get various perspective and clear possible usability and accessibility issues three different data are collected using online questionnaire, online usability and accessibility evaluation tools and usability testing software. The sampling technique for the questionnaire and usability testing software is purposive sampling.

In this study, two website performance evaluation tools, namely Google Lighthouse and GTMetrix, were utilized to assess the usability and performance of the Ethiopian Airlines website. These tools enabled the analysis of various aspects of website performance, including loading speed, accessibility, and user experience, providing comprehensive insights into the website's technical performance.

To assess the usability of the Ethiopian Airlines website, Morae software was used. In this study, seven tasks were selected to evaluate the website's usability, and these tasks were assigned to a group of 10 users. The tasks were designed to simulate real-world scenarios that users might encounter while interacting with the website. By observing how users interacted with the website and how they completed the assigned tasks, valuable insights were gained into the website's usability, identifying any potential usability issues that could impact user experience.

On the final stage, automatic web accessibility assessments were conducted to determine the website's accessibility level based on standard web accessibility guidelines. In this study, two evaluation tools were employed: the WAVE Accessibility Tool and Accessibility Checker. These tools are based on WCAG 2.1 and American Disability Association (ADA) guidelines, which are widely recognized as the standard for web accessibility.

The tools were used to evaluate the accessibility of the Ethiopian Airlines website, providing valuable insights into the accessibility of the website for individuals with disabilities or impairments.

Based on user-based website evaluation result, Ethiopian airlines website end-users of the research participants main identified issues are:

- Difficulty in finding relevant information due to confusing information organization
- Inconsistency while navigating the website, especially during the booking process.
- Slow loading times, causing frustration and impatience while navigating the website

Furthermore, Online usability evaluation tools such as Google Lighthouse have provided valuable insights into the performance of the Ethiopian Airlines website. The results of these evaluations have shown that the website has several areas for improvement to enhance its usability and overall user experience. Specifically, the website was found to have issues related to loading speed, accessibility, and user experience, which can significantly impact the website's effectiveness in serving its users.

The evaluation of the Ethiopian Airlines website using online WAVE accessibility tools and accessibility checker revealed that the website has a multitude of accessibility errors and does not comply to international standards for the design of WCAG and American Disability Association guidelines. The assessment highlighted several accessibility issues, including missing alt text, low contrast between text and background, missing form labels, missing document language, broken ARIA references, and empty links. These issues make it difficult for disabled persons to access and use the website's functionality features. Therefore, the results of this study confirm that Ethiopian Airlines websites violate WCAG 2.0 standards and ADA guidelines.

Finally, the goal of the research is achieved by conducting survey, by using online evaluation tools and by using usability testing software. Based on the findings of these evaluations actionable solutions are suggested to improve usability and accessibility of Ethiopian airlines website.

In summary, the study aimed to answer several key research questions, including the current standards for usability and accessibility in web design, the ease of accomplishing tasks on the website, the time it takes to perform a task or find information, the overall level of user satisfaction with the usability of the website, the best practices and guidelines for usability and accessibility

that should be considered when redesigning or improving the website, and the accessibility status of the Ethiopian airline's website.

Based on the three research questions, the findings of the study revealed that the Ethiopian Airlines website has major issues related to usability, accessibility, and user satisfaction.

Research Question 1: What is the overall level of user satisfaction with the usability of the website?

- Online surveys found somewhat good user satisfaction, while usability testing using Morae software identified difficulties accomplishing tasks, indicating the need to improve user experience.

Research Question 2: What best practices and guidelines for usability and accessibility should be considered when redesigning or improving the website?

- The study recommended implementing user-centered design, usability, and accessibility best practices when redesigning the website to enhance ease of use.

Research Question 3: What is the accessibility status of the Ethiopian airline's website?

- Accessibility evaluations using online tools uncovered issues with keyboard navigation, color contrast, empty links, and lack of alt text, showing accessibility problems needing remediation.

5.2 Recommendations

Based on the findings of the study, there is a potential for improving overall user experience of Ethiopian airlines website. Therefore, to have a quality website service and to solve website's usability and accessibility issues the following recommendations were made:

Ethiopian Airlines should involve users throughout the development and implementation of its website services. It is essential to pay attention to end-users' feedback, requirements, and involvement to ensure a user-friendly and accessible experience. Conducting regular surveys after launching the website can help to identify pain points and accessibility issues and gather feedback on the usability and accessibility of the website. By prioritizing user involvement and feedback, Ethiopian Airlines can ensure that its website is usable, accessible, and convenient for its users.

Improve website navigation and information architecture, particularly by focusing on providing clear and easily accessible information on payment options, baggage regulations, flight status, and flight schedules. Improvements in these areas can greatly improve the website's user experience, making it easier for users to find and access the information they need.

Provide a consistent user interface design and page organization, particularly in the booking process. This means presenting the identical options in the same way across the entire site. Consistency in layout design and visual interface includes using a consistent header and footer as well as maintaining consistency in the size and spacing of characters, fonts and backgrounds, locations of labels and colors used for labels the, text, and pictures elements within and across the pages.

Enhance loading speed and overall page performance. This can be achieved by optimizing images and videos, reducing the number of HTTP requests, and minifying HTML, CSS, and JavaScript files. Additionally, implementing a Content Delivery Network (CDN) can help to reduce the website's loading time by serving content from a server closer to the user's location. Website caching can also be used to store commonly used files locally, reducing the need for repeated downloads. By improving the website's speed and performance, Ethiopian Airlines can provide a better user experience for their customers and ensure that their website remains competitive in the online travel industry.

Ethiopian Airlines website should prioritize improving the accessibility of its website by addressing the identified issues to comply with accessibility guidelines such as Web Content

Accessibility Guidelines (WCAG). The website should address the issues of missing alt text, low contrast, missing form labels, and missing document language to ensure that all users and additionally, adding voice support can further enhance the website's accessibility for those who have difficulty reading or navigating the content, including those with disabilities, can access and use the website's content easily.

Ethiopian Airlines should adopt consistent usability and accessibility assessments and investigations on their website using various evaluation methods. This helps identify and address any potential usability and accessibility issues and ensure that the website is continuously improving its user experience. Conducting regular evaluations using methods such as heuristic evaluations, user testing, and accessibility audits can provide valuable insights into user behavior and needs and highlight any areas of the website that require improvement.

5.3 Research Limitations

Due to limited resource the research is limited to use free online website usability and accessibility evaluation tools. Moreover, the study is limited to user evaluation and online assessment, thus excluding expert evaluation from its scope.

5.4 Directions for Future Research

Future research can explore additional evaluation methods to further assess the accessibility and usability of Ethiopian Airlines' website. For instance, conducting heuristic evaluations and expert reviews can provide a deeper analysis of the website's design and functionality. Another area for future research is to investigate the impact of implementing accessibility and usability improvements on user satisfaction and engagement on the website.

Investigate the impact language factors on the usability and accessibility of the Ethiopian Airlines website, for users from different regions of the world.

Expand the scope of the study to cover all pages and features of the Ethiopian Airlines website and mobile app, rather than just focusing on the booking process and booking information.

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APPENDICES

Appendix A: Letter of Support Request

አዲስ አበባ ዩኒቨርሲቲ
የተፈጥሮ ሳይንስ ኮሌጅ
የኢንፎርሜሽን ሳይንስ ት/ቤት



Addis Ababa University
College of Natural Science
School of Information Science

Date: November 2, 2022
Ref No. SIS/78/2022/15

To: - Ethiopian Airlines
Addis Ababa

Subject:- Student Berhan Deribew

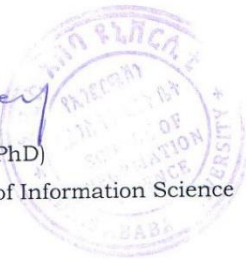
Dear Sir /Madam,

Student Berhan Deribew (ID.No GSE/0194/13) is a graduate student at the School of Information Science, Addis Ababa University. He is currently conducting M.Sc. Thesis research under the title “The Effects of UI/UX on Digital Marketing Performance: The Case of Ethiopian Airlines .”

I would like to thank you in advance for all the assistance that you would provide to the student.

With Regards

Dereje Teferi (PhD)
Head, School of Information Science



☒: 1176 Email: information_cci_cns@aau.edu.et ☎: +251-(11)-122-91-91

Appendix B: Screenshot of online questionnaire for user perspective

Survey to Asses Usability and Accessibility of Ethiopian Airlines Online Booking


Dear Respondents,
I am Berhan Deribew a postgraduate student. Currently, I am attending Master of Science in Information System at Addis Ababa University, Ethiopia.


This questionnaire aims to investigate the level of usability of current Ethiopian airlines websites and mobile app from end-users and customers perspectives. It is a part of a comprehensive study to find out how to improve the Ethiopian airlines websites and mobile app for better utilisation.

Therefore, your assistance is highly appreciated by providing your valuable information using the following questionnaire and the information you provide will be confidential and will only be used for this research purpose.

If you require any assistance or clarification, please don't hesitate to contact me through, Email: berhanwhy@gmail.com

Thank you For your Willingness to participate in the study

berhanwhy@gmail.com [Switch account](#) 

 Not shared

*** Indicates required question**

A) Participants Information

Please select one item for your response

1. Gender *

Male

Female

2. Age *

18-30

31-40

41-50

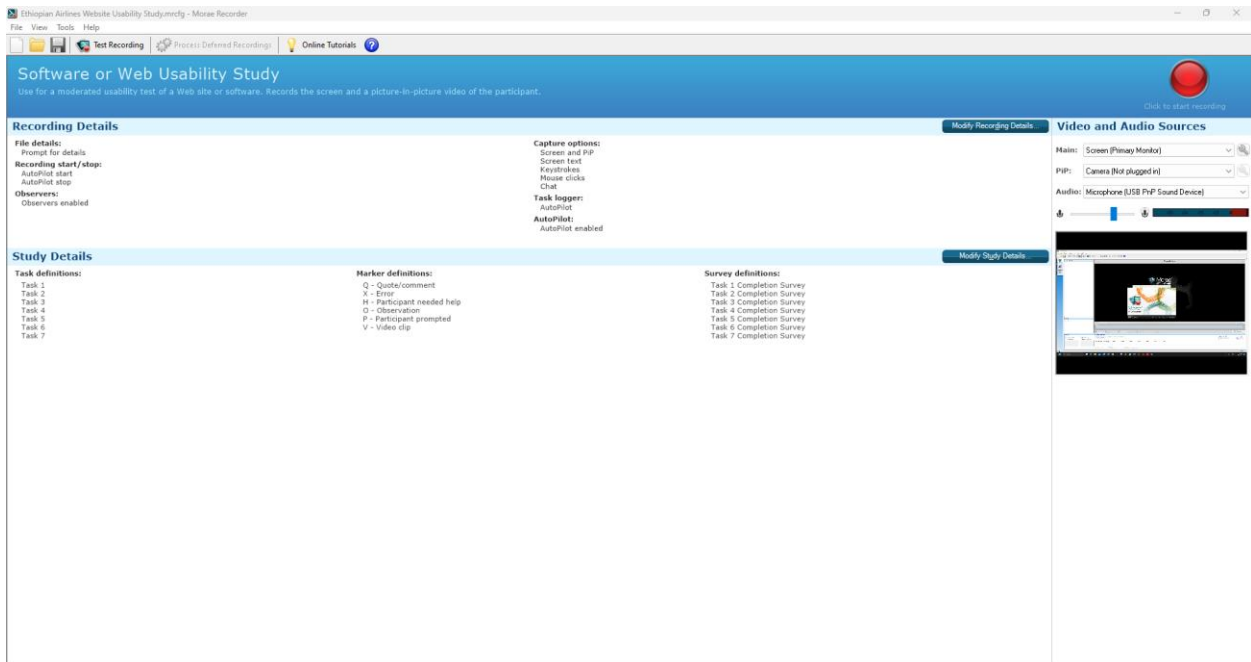
51-65

Over 65

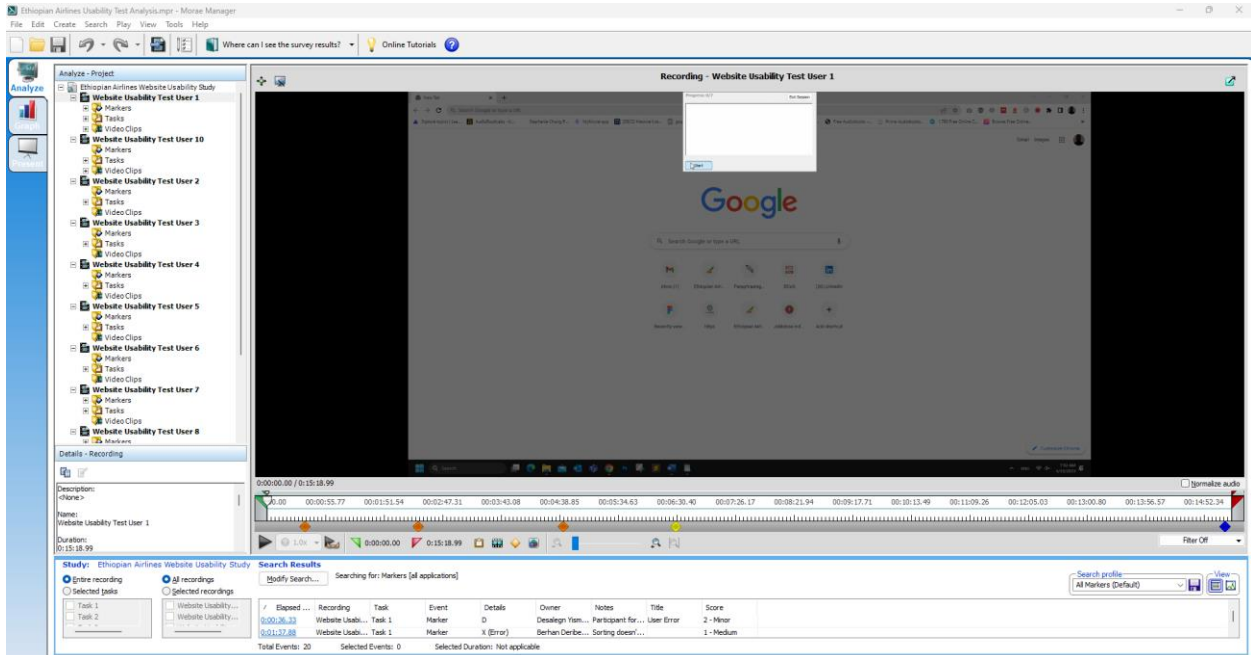
Appendix C: Morae Software Usability Test Cases

Task No	Task Name	Task description	Test requirement	Test instruction
1	Book a one-way flight	Search for flights from Addis Ababa to Bahirdar on March 31 and sort the flights by price. Task Performance: Common Measurement Attributes: <ul style="list-style-type: none"> • Successful completion of the task • Time taken to complete the task 	The test requires: <ul style="list-style-type: none"> • Access to a device with an internet connection • Knowledge of travel details such as travel dates and destination • It should be completed within 4minute 	Book a one-way flight Sort list of flights by price
2	Book a round-trip flight	Book a round-trip flight for one adult and one child from Addis Ababa to New York City, departing on June 1, 2023, and returning on June 10, 2023. Task Performance: Seldom Measurement Attributes: <ul style="list-style-type: none"> • Successful completion of the task • Time taken to complete the task 	The test requires: <ul style="list-style-type: none"> • Access to a device with an internet connection • Knowledge of travel details such as travel dates and destination It should be completed within 4minute	Book a departure and return flight
3	Find flight schedule	Find Flight Schedule for Ethiopian Airlines from Addis Ababa to Dubai on May 10, 2023 Task Performance: Seldom Measurement Attributes: <ul style="list-style-type: none"> • Successful completion of the task • Time taken to complete the task 	The test requires: <ul style="list-style-type: none"> • Access to a device with an internet connection • Knowledge of accessing airlines website It should be completed within 1 minute	Find information on flight schedule for the selected destination
4	Check flight status	Check Flight Status for a Flight from Addis Ababa to Bahir Dar on March 22 Task Performance: Seldom Measurement Attributes: <ul style="list-style-type: none"> • Successful completion of the task • Time taken to complete the task 	The test requires: <ul style="list-style-type: none"> • Access to a device with an internet connection • Knowledge of accessing airlines website It should be completed within 1 minute	Find information on flight status for the selected destination
5	Find Baggage information	Find information on baggage allowances for flights on Ethiopian Airlines Task Performance: Seldom Measurement Attributes: <ul style="list-style-type: none"> • Successful completion of the task • Time taken to complete the task 	The test requires: <ul style="list-style-type: none"> • Access to a device with an internet connection • Knowledge of navigating a website It should be completed within 1 minute	Find baggage information
6	Find contact	Locate the global contact center phone number or email address for Ethiopian Airlines Task Performance: Seldom Measurement Attributes: <ul style="list-style-type: none"> • Successful completion of the task • Time taken to complete the task 	The test requires: <ul style="list-style-type: none"> • Access to a device with an internet connection • Knowledge of navigating a website It should be completed within 1 minute	Find Ethiopian airlines contact center
7	Check payment options	Check what payment options are available for booking Ethiopian airlines flight Task Performance: Seldom Measurement Attributes: <ul style="list-style-type: none"> • Successful completion of the task • Time taken to complete the task 	The test requires: <ul style="list-style-type: none"> • Access to a device with an internet connection • Knowledge of navigating a website It should be completed within 1 minute	Find and check what payment options are available

Appendix D: Screenshot of Usability Recording Morae Software



Morae recorder



Morae Manager

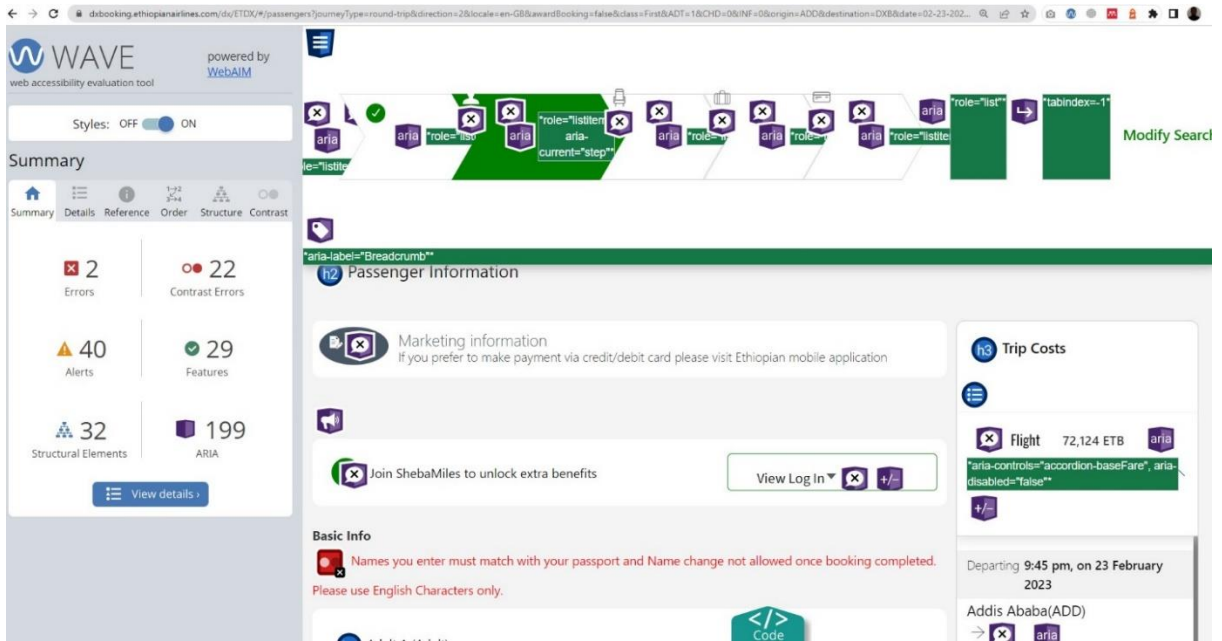
Appendix E: Screenshot of WAVE accessibility Results

The screenshot displays the WAVE accessibility evaluation tool interface. On the left, the 'Summary' panel shows the following metrics: 2 Errors (red X), 33 Alerts (yellow triangle), 21 Structural Elements (blue triangle), 7 Contrast Errors (red circle), 12 Features (green checkmark), and 120 ARIA elements (purple square). The main content area shows the 'Flight Selection' page with a calendar view for February 20-24, 2023. Thursday, 23 Feb is selected with a price of 17,223 ETB. A chat window titled 'Flight Assistance' is open on the right side of the page.

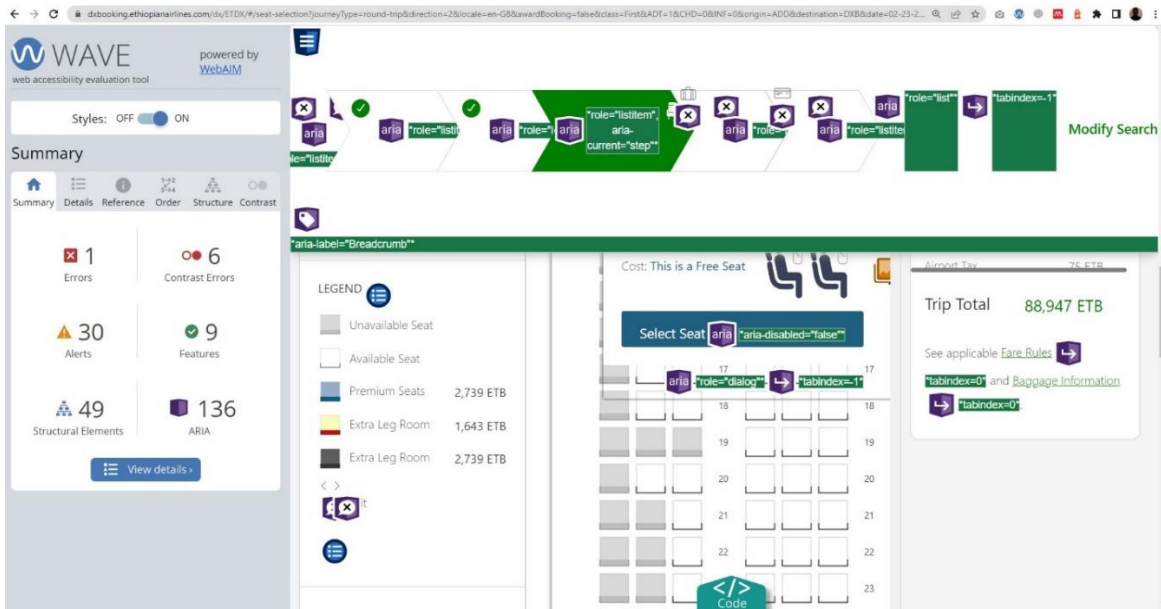
Flight Selection

The screenshot displays the WAVE accessibility evaluation tool interface for the 'Select Flight Summary' page. The 'Summary' panel on the left shows: 1 Error (red X), 30 Alerts (yellow triangle), 23 Structural Elements (blue triangle), 8 Contrast Errors (red circle), 11 Features (green checkmark), and 101 ARIA elements (purple square). The main content area shows a flight summary with a 'Modify Search' button and various accessibility annotations.

Select Flight Summary



Passenger Information



Seat Selection

WAVE powered by WebAIM web accessibility evaluation tool

Styles: OFF ON

Summary

- 2 Errors
- 31 Alerts
- 31 Structural Elements
- 6 Contrast Errors
- 9 Features
- 112 ARIA

View details

Departing 9:45 pm, on 23 February 2023

Addis Ababa(ADD) → Dubai(DXB)

Duration: 4 hrs 10 mins / Non-stop

Etihad

Seats

Let us transport your bags for you.

Bags

Starting From 12,322 ETB per bag / per passenger

Some bag allowance included per passenger.

Enjoy internet access on your flight

Wi-Fi

Starting From 274 ETB per person, per flight

Extra services

WAVE powered by WebAIM web accessibility evaluation tool

Styles: OFF ON

Summary

- 9 Errors
- 31 Alerts
- 30 Structural Elements
- 6 Contrast Errors
- 15 Features
- 169 ARIA

View details

Departure Flights

Addis Ababa(ADD), Ethiopia → Dubai (DXB), UAE

bags, and their respective weight, that you will be carrying.

Up to 23 kgs/50 lbs	Up to 32 kgs/70 lbs
12,322 ETB	17,799 ETB

Number of bags: 0 0 ETB are free

Return Flight

Extra baggage selected

WAVE web accessibility evaluation tool

Styles: OFF ON

Summary

- 2 Errors
- 29 Alerts
- 38 Structural Elements
- 6 Contrast Errors
- 18 Features
- 129 ARIA

Almost done! Time for payment.

Marketing information
If you prefer to make payment via credit/debit card please visit Ethiopian mobile application

Trip Summary

Trip Costs

- Flight 72,124 ETB

Payment page

WAVE web accessibility evaluation tool

Styles: OFF ON

Summary

- 1 Errors
- 28 Alerts
- 38 Structural Elements
- 9 Contrast Errors
- 14 Features
- 140 ARIA

Your trip to Dubai (DXB), UAE is booked. Your confirmation code (PNR) is IWXPED. A summary of your trip information is below.

Your Reservation is on Hold and will expire in 11 hours and 59 minutes.

Addis Ababa (ADD), Ethiopia ⇌ Dubai (DXB), UAE

Confirmation Code
IWXPED On Hold Addis Ababa (ADD), Ethiopia ⇌ Dubai (DXB), UAE

Your Trip Details

Addis Ababa → Dubai Confirmed

23 Feb 2023 09:45 pm → 02:55 am Addis Ababa Dubai 4 hrs 10 mins Non-stop ET 600 Boeing 777-300ER

Earn up to 1,953 ShebaMiles Miles (Amenities may vary per flight)

Booking Complete page