THE ACCESSIBILITY OF AIRLINE WEBSITES TO THE HANDICAPPED

HALİL GÖKER ULAŞ

BOĞAZİÇİ UNIVERSITY

2019

THE ACCESSIBILITY OF AIRLINE WEBSITES TO THE HANDICAPPED

Thesis submitted to the

Institute for Graduate Studies in Social Sciences

in partial fulfillment of the requirements for the degree of

Master of Arts

in

Management Information Systems

by

Halil Göker Ulaş

Boğaziçi University

2019

The Accessibility of Airline Websites to the Handicapped

The thesis of Halil Göker Ulaş

has been approved by:

Prof. Birgül Kutlu Bayraktar
(Thesis Advisor) _____

Prof. Aslıhan Nasır _____

Asst. Prof. Çağla Şeneler
(External Member) _____

June 2019

DECLARATION OF ORIGINALITY

I, Halil Göker Ulaş, certify that

- I am the sole author of this thesis and that I have fully acknowledged and documented in my thesis all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
- this is a true copy of the thesis approved by my advisor and thesis committee at Boğaziçi University, including final revisions required by them.

Signature .....

Date 25.06.2019

ABSTRACT

The Accessibility of Airline Websites to the Handicapped

Website accessibility is very important for disabled people to use the Internet. In the light of this matter, the objective of this thesis is to measure the accessibility performances of airline website online ticketing flows for handicapped people. For this purpose, automated accessibility testing was performed for 27 airline websites with automated accessibility checker called Achecker. The tested ticketing flows of websites consisted of homepage, availability page, availability summary page, extra services page, profile page and payment page. According to the automated test results and the specifications of the airlines, statistical analyses were performed in order to see if any of the specifications has a relation with the accessibility performance of an airline. Analyses results show that having a flight to the United States and revenue have significant correlation with the accessibility performance of an airline. Two other specifications which are the profit and type of codebase used for testing also appeared to be significant to some extent despite being less significant than the former two specifications. Thus, it can be concluded that taking appropriate preventive legal measures seem to be a way for airline websites to comply more with accessibility standards. Like the United States, other countries who want to provide more accessible airline websites for disabled people may enact the relevant laws in order to force airlines to conform the accessibility standards.

ÖZET

Havayolu Web Sitelerinin Engelliler için Erişimi

İnternetin erişilebilirliği, engelli insanların konforlu bir şekilde İnternet kullanımı için oldukça önemlidir. Buradan yola çıkarak, bu tezin amacı havayolu web sitelerinde bulunan bilet alma akışlarının engelli kişilerin erişimine ne kadar uygun olduğunu ölçmektir. Bu hedef doğrultusunda, Achecker isminde bir otomatik erişilebilirlik test aracı ile 27 havayolu web sitesinin biletleme akışı test edilmiştir. Test edilen biletleme akışlarında bulunan sayfalar; anasayfa, uçuş listeleme sayfası, uçuş listesi özet sayfası, ekstra hizmetler sayfası, profil sayfası ve ödeme sayfasıdır. Otomatik test sonuçları ve havayollarının farklı özellikleri dikkate alınarak, havayolu özelliklerinin erişilebilirlik performansları ile ilişkisi olup olmadığını tespit etmek için istatistiksel analiz yapılmıştır. Analiz sonuçlarına göre, havayolunun Amerika'ya uçuşunun bulunması ve cirosunun, havayolu web sitesi erişilebilirlik performansı ile anlamlı kolerasyonu olduğu belirlenmiştir. Havayolunun elde ettiği kâr ve otomatik testlerin koşumu sırasında kullanılan kaynak kodu tipinin de belli ölçüde anlamlı kolerasyonunun bulunduğu saptanmıştır. Bu sonuçlardan havayolu websitelerinin erişilebilirlik standartlarına uyması için uygun önleyici yasal tedbirlerin gerekli olduğu sonucu çıkarılabilir. Amerika gibi diğer ülkeler de gerekli yasalar aracılığı ile havayolu websitelerinin engelliler için daha erişilebilir hale gelmesini sağlayabilirler.

ACKNOWLEDGMENTS

First of all, I would like to thank my thesis supervisor, Prof. Birgül Kutlu Bayraktar, for her understanding, continuous support and guidance. I would also like to thank my thesis jury members, Prof. Aslıhan Nasır and Assist. Prof. Çağla Şeneler for their valuable comments.

I am grateful to my manager at work, Mr. Zahid Özdoğan, and the director of my department, Mr. Cengiz Değirmenci, for their very kind understanding. Without their understanding, it would be very difficult for me to complete this master's degree.

A special gratitude goes to my friends, Fatih Küçükkara, Ali Alpaslan, Emrah Çınar and Erhan Dilaver who helped me get through when I lingered on some issues in the thesis.

I am very grateful to my parents, Fadime and Şaban Ulaş for their support in my whole life.

And finally, I would like to express the deepest thanks to my wife, Güzin Ulaş, and to my daughter, Gülru Neva Ulaş, for their invaluable patience, support and encouragement. Without their understanding and support, I could not be able to finish this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

DOT	Department of Transportation
IATA	The International Air Transport Association
MCAR	Missing Value Completely at Random
WAI	Web Accessibility Initiative
WCAG	Web Content Accessibility Guidelines

CHAPTER 1

INTRODUCTION

1.1 Websites in general and airline websites

A website is a collection of pages of knowledge and material on the Internet about a specific topic which covers text and multimedia content. A website is identified with a domain name and published on a web server.

Since the creation of World Wide Web by Tim Berners-Lee in 1990, websites have become an unavoidable element of our lives.

More than half of the world population is active Internet user and nearly half of the world population is active social media user (see Figure 1; Current World Population, n.d.).

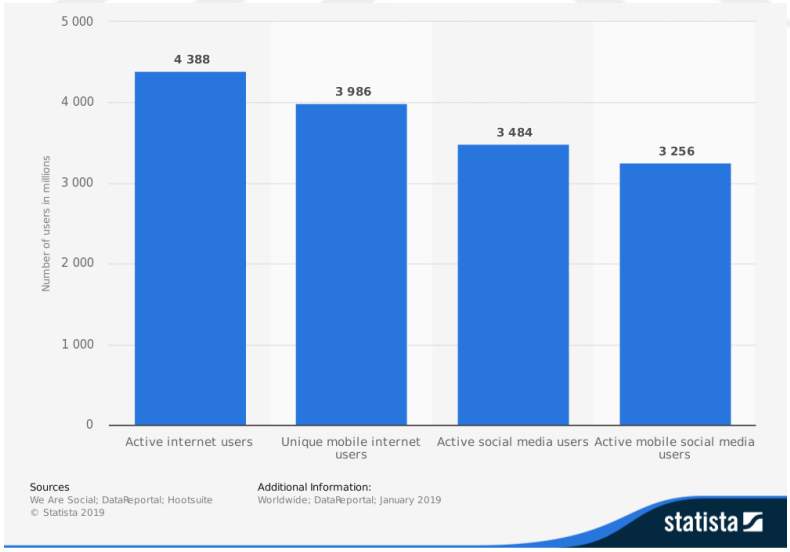


Figure 1. Global digital population as of January 2019 (in millions)

Source: [We Are Social, DataReportal, & Hootsuite, n.d.]

Websites are used in numerous sectors including but not limited to airline ticketing, hotel reservation, social media, news, university, school registration, academic sources, gaming, video, and movie watch.

Considering all the sectors, there are nearly 200 million active websites by 2019 (Total Number of Websites, n.d.)

In order to understand how websites and online services affect our daily lives, the commercials and purchasing figures should also be checked.

According to Young (n.d.), global online sales set a record of $2.86 trillion which accounts for 15% of the total retail sales in 2018. Moreover, share of online retail sales also continues to grow year by year.

When online travel bookings are considered, which covers online airline ticketing and hotel bookings, in 2017, online travel bookings revenue already passed the level of $500 billion (see Figure 2).

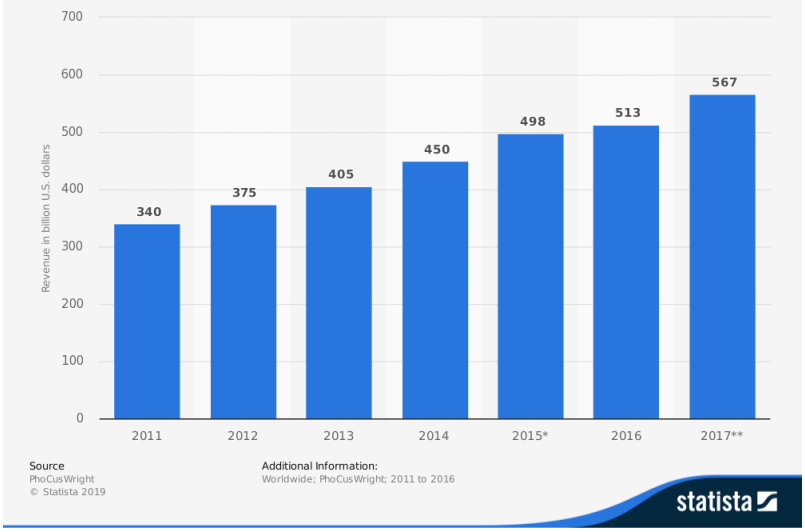


Figure 2. Online gross travel bookings revenue worldwide from 2011 to 2017 (in billion U.S. dollars)

Source: [PhoCusWright, n.d.]

Air travel online sales value changes worldwide from 2013 to 2015 and this change is between 5-8% yearly (World Travel Market, n.d.).

These figures are very clear indications of the fact that online airline ticketing is now a very common standard of our daily lives. For this reason, all the people including the disabled shall be able to reach the content and the functionality of the websites with ease. In order to accomplish this easiness, websites shall satisfy accessibility standards which will be covered in next chapters in detail.

1.2 Accessibility and website accessibility

Accessibility is a general term referring to suitable transportation means, ramps for wheelchairs, special pavements for blind people to easily walk on, website accessibility, and other measures taken for a more disabled-friendly environment. According to Web Accessibility Initiative (WAI, 2005), website accessibility means that "people with disabilities can use the Web". An example can be given to understand the obstacles that prevents disabled people to use the Web. If contact number provided in a website is in an image format and has no alternative text, this contact number cannot be accessed and understood by blind people. So, blind people cannot call the number in case of a need.

In order for disabled people to use the Web conveniently, some coding and content creation standards must be satisfied. WAI publishes guidelines, called Web Content Accessibility Guidelines (WCAG) that clearly states the standards to be satisfied. WAI (2008) states that in order to have more accessible websites for disabled people including the visually impaired ones, these guidelines are beneficial.

1.3 Why is web accessibility important, which users are affected and who is affected?

There are four steps for a person to use the Web. These are to perceive, understand, navigate, and interact (WAI, 2019a). If one has a problem with one of those, then he/she probably has difficulties while using web sites and needs an accessible website. There are some types of impairments which may result in a need for an accessible website.

As far as the duration of the impairment is concerned; situational, temporary and permanent impairments can be listed. Regarding the categories of impairments; visual, motor, hearing, and cognitive impairments can be given (Kearney, Boxhall, Gash, & Dodson, 2019).

Although it is generally thought that impairments are permanent anomalies, they can be short time circumstances as well. A mother holding a baby in her one arm is an example of situational impairment. While holding the baby, the mother can only use her one hand to surf on the Internet. This example is a fair proof of the fact that not only disabled people are affected from the inaccessible environments, but all the people may need accessible environments. Nevertheless, permanent impaired people are the most affected and the most vulnerable group since their whole world depend on a need for an accessible environment.

In fact, disability is not a very rare problem among people. World Health Organization (2018) estimates show that, according to 2018 figures, among the 1.3 billion visually impaired people in the world, 36 million are blind. In the U.S., around 15% of the population have some kind of a disability which may affect their experience in the Web (Interactive Accessibility, 2015). According to Kim, Smith-Jackson, and Kleiner (2013), visual impairment becomes very hard to challenge since

the number of visually impaired people keep an increasing trend. So, many people are classified as disabled and affected in terms of web experience. If accessible websites are not provided for them, then they will become deprived of certain services. These services include but not limited to social media platforms and online only job application platforms for some companies. Some specific examples are that tickets to 2012 Olympics just could be bought online and Huffington Post newspaper has an online version only (Hanson & Richards, 2013). Without accessible versions of those web services, disabled people surely become disconnected from real life.

1.4 Airline websites in terms of accessibility of disabled people

Airline websites are today's common platforms to buy airline tickets, to do online check-in or to get important information about baggage policy of an airline; and many people use these services. Therefore, it is very important for disabled people to use these services without difficulties.

There are legal, commercial, and social reasons for airlines to provide accessible websites for impaired people.

As for legal reasons, legislation of U.S. Department of Transportation (DOT) is a leading example. DOT requires U.S. air carriers and foreign air carriers which have flights to the U.S. to provide accessible websites for disabled people (Nondiscrimination on the Basis of Disability in Air Travel, 2013).

When it comes to commercial reasons, number of people with impairments are substantial; thus, there is a huge revenue potential for accessible websites.

Apart from legal and commercial purposes, it is also a social responsibility to provide accessible websites. If impaired people cannot buy tickets online, it creates a

considerable inconvenience for them. They either need to contact a call center or even worse they need to go to a ticket sales office.

1.5 Studies about airline website accessibility

Some studies have been done on website accessibility, mainly about websites' accessibility measures and accessibility guidelines. However, few studies were found about how airline websites perform in terms of accessibility.

One of the first website accessibility studies include Vanderheiden and Chisholm's (1996) article about html design principles in order to increase the accessibility of websites. Another one among the first articles about measuring and comparing accessibility scores of different websites is Oppenheim and Selby's (1999) article. First thesis in Turkey about accessibility of websites was written by Kalkancı (2009).

1.6 Problem statement and aim of the thesis

It is very hard for handicapped people to benefit from inaccessible websites. For the disabled people who wish to use airline web services, providing an accessible website is essential. The aim of this thesis is to observe the factors which may affect accessibility performances of airline websites. Primarily, legal obligations enforced by authorities and airline financial positions were inspected in order to check if there exists any correlation with accessibility scores. By this, important factors should be considered by legal and airline authorities in order to enable more accessible websites. Thanks to this, airline websites may become more comfortable for disabled people who benefit from airline web services.

CHAPTER 2

LITERATURE REVIEW

2.1 Airline websites

2.1.1 History of airline websites

The airline industry has been one of the leading sectors using the Internet to reach its customers since the World Wide Web was first initiated (Toh & Raven, 2003). Furthermore, “by the end of the 20th century, nearly every scheduled airline had its own website” (Shon, Chen & Chang, 2003, p. 326). Convenience of purchasing and cost effectiveness of the distribution system are assumedly the two main factors which facilitated airline ticketing services to be a pioneer among the sectors using Internet.

Convenience in the sense of customers is being able to buy airline tickets without going to ticket sale offices or contacting call centers. Checking the prices for different days of journey and completing ticketing is generally very easy and fast for websites compared to other channels.

When convenience is considered regarding the business type; compared to retail ecommerce businesses which sell tangible products, online airline ticketing sales are easier. Airline tickets are not tangible objects, so no shipping is required. Customers can start and finish the ticketing process in several minutes on airline website, and get electronic ticket containing ticket reservation number and flight details.

When it comes to the cost concern, airlines pay a lot of money in order to distribute tickets through ticket sales offices, call centers, and especially through ticket sale agencies. As for being competitive in the market, reducing cost is a key

for success. Airline websites may play an important role in decreasing distribution costs. In fact, according to Lubbe (2007), airline websites are known as the most cost-effective way of airline ticket distribution.

2.1.2 Airlines around the world and the type of airlines

The International Air Transport Association (IATA) is the association for the airlines globally. This association represents 290 airlines all around the world and 82% of the total air traffic is carried out by its members (IATA, n.d.a). According to the figures given by IATA (n.d.b), 4.3 billion people flew with airplanes in 2018 with regard to estimated values. IATA (n.d.b) also specified that the number of passengers carried has a positive trend and increasing year by year. This huge value is not the number of unique people flying but it increments with every flight a person takes.

There are mainly two types of passenger airlines. One is full-service network carrier and the other one is low-cost carrier (Acar & Karabulak, 2015). Full-service network carriers generally focus on service quality and have a wide network of destinations with good connections in hub point; while low-cost carriers' purpose is to benefit from the passenger type who is more cost sensitive.

2.1.3 Market size of airlines and airline websites

Market size of airlines is massive. Total revenue of commercial airlines worldwide regarding the year of 2017 is 755 billion dollars (see Figure 3). When the operating profit is considered for 2017 (see Figure 4), 57.8 billion dollars was earned by all commercial airlines.

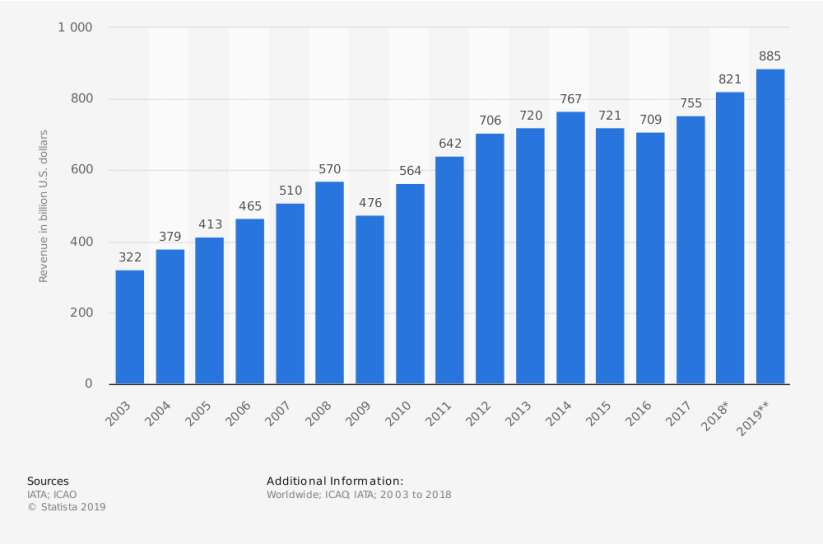


Figure 3. Revenue of commercial airlines worldwide from 2003 to 2019 (in billion U.S. dollars)

Source: [IATA, n.d.c]

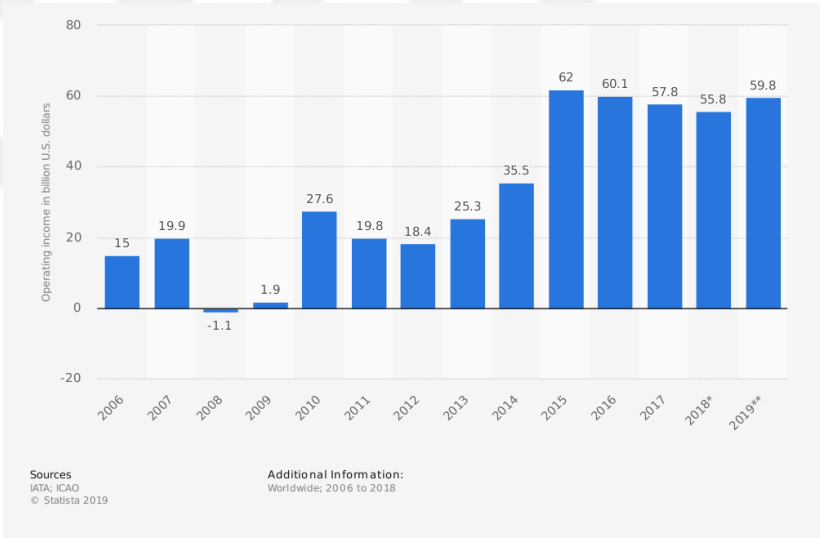


Figure 4. Operating profit of commercial airlines worldwide from 2006 to 2019 (in billion U.S. dollars)

Source: [IATA, n.d.d]

Airline websites constitute a substantial share of airline ticket sales and thus revenue of airlines. According to Statista (n.d.), airline websites constituted more than a quarter of the passenger revenue earned in 2017 (see Table 1). Indeed, for low cost carriers, this value went up to almost half of the revenue earned. When all online

channels are considered, which contains airline websites, airline mobile channels (mobile websites and applications) and online travel agencies, share of the passenger revenue earned exceeded half of the revenue for full fare carriers. As for low cost carriers, the rate was almost three quarters.

These are very clear indications of the fact that how airline business and airline websites are enormous in market size.

Table 1. Share of Global Airline Passenger Revenue in 2017, by Sales Channel and Carrier Type (in Percentages)

Carrier type	Airline website	Travel agencies, tour operators and consolidators	Online travel agencies	Airline call center(s)	Mobile	Airports	Total
Full Fare Carrier	26%	31%	20%	10%	5.5%	7.5%	100%
Low Cost Carrier	47%	16%	16%	7%	11%	3%	100%

Source: [Statista, n.d.]

2.2 Web accessibility

The Web carries its potential through its universality. Thus, it shall be accessible by everyone regardless of an impairment (Berners-Lee, n.d.). As Berners-Lee, who is the inventor of World Wide Web, also pointed out, web accessibility is essential for websites.

According to Akram and Sulaiman (2017), one of the leading factors for quality of websites is web accessibility. In addition, disabled people will not have the ability to utilize different services provided on websites unless accessibility standards are applied properly.

For ecommerce websites, accessibility may even be more important since losing customer means losing revenue. Ecommerce websites which provide accessible content with smooth navigation increase their credit in the eyes of the customers and attract customers to buy online (Cyr, 2013; Ethier, Hadaya, Talbot & Cadieux, 2008). So, online shopping websites shall be accessible for all the users including the impaired ones.

Having an accessible website is not just about software coding. Along with the coder of websites, website owner and manager, and accessibility experts who give advice for accessibility are also important for creating an accessible website (Petrie et al., 2011).

The importance of web accessibility standards in online shopping is well-known globally (as cited in Sohaib & Kang, 2017, p. 91). However, the importance is not solely about the website usage by impaired users but there are also some other advantages that accessibility standards can provide for a website. Mlynarczyk (2012) lists some of those benefits which contain enhancing search engine performance of websites and increasing website usability in general. Williams (n.d.) adds some other situations web accessibility can provide help for people who are not disabled. Those situations are mainly; noisy environment, low bandwidth of Internet or having poor language. Accessible websites work better under those conditions compared to inaccessible websites.

2.2.1 History and global initiatives

The World Wide Web Consortium is an international association which establishes Web standards in order to enhance the Web's power. One of the important issues this consortium faces is web accessibility. That's why, the consortium founded an

initiative which is WAI. This initiative particularly focuses on web accessibility and web accessibility standards (Yoon, Dols, Hulscher, & Newberry, 2016).

WCAG are the fundamental principles of web accessibility. They are published by WAI. The first version, version 1.0 of WCAG, was published in 1999, and in 2008 new items were added to the list and WCAG version 2.0 was created (WAI, 2008). WCAG version 2.1 was introduced recently, in 2018 (WAI, 2018a).

2.2.2 Guidelines

Web accessibility guidelines are reference documents which show the criteria to follow in building and managing accessible websites. There are a number of guidelines by different initiatives around the world. Some of the important ones are WCAG, Section 508 of the U.S. rehabilitation Act and ISO 9241-151 (Sohaib & Kang, 2017). However, WCAG covers the content of other two guidelines in general. Web accessibility legislation and country specific accessibility guidelines of some countries also take WCAG as the foundation guideline. One example is that Thailand created its local web accessibility guideline by adding and updating some points of WCAG according to the needs and requirements of the country (as cited in Akram & Sulaiman, 2017, p. 322). WCAG has versions of 1.0, 2.0 and version 2.1 which is the most recent version (WAI, 2018a). WCAG version 2.0 was the main guideline from 2008 to 2018. That's why, most of the academic sources regarding web accessibility used WCAG 2.0 in their studies. Some examples of these studies are the studies of Hanson and Richards (2013), Yoon et al. (2016), Sohaib and Kang (2017); Loureiro, Cagnin and Paiva (2015); and Hameed (2018). When it comes to ecommerce, it is also stated that WCAG 2.0 is very essential for ecommerce websites to comply with (Ganguly, Dash, Cyr & Head, 2010).

Yoon et al. (2016) argue that superiority of WCAG 2.0 over version 1.0 is that version 2.0 made the guideline more technology independent and version 2.0 guideline is more comprehensive in its scope. Nevertheless, having a more comprehensive scope makes the guideline less precise and thus creates uncertainty for developers how to meet the criteria (Rømen & Svanæs, 2012).

WCAG 2.0 has four main principles for web accessibility. These are being: perceivable, operable, understandable, and robust (WAI, 2018b). Perceivable means that the user shall notice the elements in the user interface. Operable is to be able to interact with the interface, navigation through keyboard or other input sources make this happen. By the principle understandable, providing an understandable content and structure for all users is implied (Hanson & Richards, 2013). Robust is to be compatible with different browsers and user agents (WAI, 2019a). Details of these principles are given in Table 2.

Under those principles there are 12 guidelines as shown on the same table. These guidelines provide the fundamental goals in order to create an accessible content. There are also success criteria beneath each guideline. Success criteria are testable statements and according to those website accessibility performance can be measured.

There are three levels of success criteria according to the priority of the checklist. Level A which corresponds to the minimum conformance level; level AA, medium; while level AAA is the highest level of accessibility conformance (WAI, 2008; Sohaib & Kang, 2017). Higher level checks contain the lower level items in the results. For example, if a website is tested against WCAG 2.0 level AA, then both Level A and level AA items are checked for the conformance. Abu Shawar (2015), and Hanson and Richards (2013) say that if level A is not satisfied then the website is

not possible to be accessed at all by some group of users. If level AA is not satisfied, then the website is difficult to use for some users while level AAA corresponds to a lower level of difficulty.

Table 2. Principles of Web Content Accessibility Guideline (WCAG) 2.0

Principle	Guideline
Principle 1: Perceivable	Alternative text for all non-text content shall be provided
	Captions and alternative ways shall be provided for multimedia components
	With or without the use of assistive technologies, content of the website shall not change
	Web content shall be easy to read an hear
Principle 2: Operable	All functionality of website shall be reachable by keyboard
	User should have enoug time to process and use the content
	Content and representation of the webpage should not cause seizures
	Navigation and search shall be very easy throughout the website
Principle 3: Understandable	Content should be readable and understanable
	All website contents should appear and operate in predictable way.
	Users shall be guided to avoid and correct mistakes
Principle 4: Robust	Website shall be compatible with different browsers and assistive technologies

Source: [WAI, 2019a; Akram & Sulaiman, 2017]

The full list of WCAG 2.0 success criteria along with the parent principle and guideline is provided in Appendix A with associated priority levels.

Web accessibility cannot be satisfied only by the content of the website, but also with the environment that the content is presented, such as web browsers shall also provide the accessibility. For that reason, along with WCAG, two other guidelines are presented by WAI. The first one, Authoring Tool Accessibility Guideline is the guideline for content creation and management platforms (WAI, 2015). These platforms shall be usable by disabled users and these users shall be able to embed content into a website. In addition, these platforms shall help content creators to build a more accessible content. The other guideline, which is User Agent Accessibility Guideline, is a guideline about browsers, media players, and other

content presenters (WAI, 2016a). Primarily, web browsers shall satisfy some technical specifications, so that content can be represented in an accessible manner in those platforms.

2.2.3 Common barriers – type of impairments

According to the Convention on the Rights of Persons with Disabilities (2007), "person with disabilities include those who have long-term physical, mental, intellectual or sensory impairments, which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others". Indeed, disabilities and even situational impairments create a barrier between a person and the environment.

Disabilities and other type of impairments can be classified as provided in Table 3 with some examples of impairments.

Table 3. Type of Impairments and Disabilities

	Situational	Temporary	Permanent
Visual	Missing glasses	Concussion	Blindness
Motor	Holding a baby	Broken arm	
Hearing	Noisy environment		Being deaf
Cognitive		Concussion	

Source: [Kearney, Boxhall, Gash, & Dodson, 2019]

Impairments are not just about permeant disabilities. For example, missing glasses makes you situationally impaired since without glasses you will experience low vision. When you find your glasses, then impairment also vanishes. When it comes to temporary impairments, they last longer than situational ones.

For instance, a broken arm may make you impaired for a month. As for the permanent ones, they last a lifetime or near a lifetime. That's why, disabled people are the most effected group from different barriers including inaccessible website.

Regarding the types of impairments, Tsaran (2019), who is a blind technical program manager at Google, gives some details. For visual impairments, he mentions the ones with no vision, low-vision and poor color vision or color blindness. He also points out that one in every 20 people is color blind, while for males, this ratio goes up to one in 10 people. For motor impairments, he mentions about the people who cannot use a mouse or keyboard due to problems in muscular or skeletal system. Concerning hearing impairments, he tells about being deaf and low hearing people. He also adds that along with vision, hearing also degrades with age. When it comes to cognitive disorders, these are mainly language and learning disabilities.

Sohaib and Kang (2017) say that hearing and visual impairments are the most common impairments affecting the use of websites. Nevertheless, the study of Ruth-Janneck (2011) indicates that there are more barriers for visually impaired people to access services on Internet while Brunsman-Johnson, Narayanan, Shebilske, Alakke and Narakesari (2011) add that along with the blind people, color blind customers have much trouble in using websites.

2.2.4 Importance and effects in detail

Impaired people have disadvantage regarding going shopping and activities involving physical action (Sohaib & Kang, 2017). Although Internet has been providing new opportunities for online shopping and other online activities, accessible website is a need for impaired people to use them effectively. As Yoon et al. (2016) state, digital world is standard for contemporary world, and providing

proper provision of online services to the disabled people is very important. Nevertheless, Lazar, Allen, Kleinman and Malarkey (2007) found in their study that 30% of the disabled people lose important time due to problems they face in the websites. When it comes to blind people, when doing a task on a website, they spend about twice as much time as sighted people (Bigham, Lin & Savage, 2017).

As Power, Freire, Petrie and Swallow (2012) argue, one of the issues blind users experience is that sometimes it is not clear which information is available but not accessible. That is to say, information may not be present on the website at all or it may be present but not accessible. If blind user knew the information is present but not accessible, he/she could ask other people to get the information or stop wasting time if the information is not present at all (Bigham et al., 2017).

Recognition of accessibility by websites is another topic. Hanson and Richards (2013) state that accessibility statement page in a website is one of the important signs for recognition of accessibility. Although having such a page may seem unimportant for websites, it gives information about accessibility level of the website and gives advice regarding accessibility.

2.2.5 Assistive technologies

Impaired people usually navigate through web pages utilizing special software or hardware. These special tools are generally called as assistive technologies and they help disabled people surf web more efficiently (WAI, 2017; Kurt 2011). The most common example of assistive technologies is screen readers (Hanson & Richards, 2013). Screen readers are used by visually impaired people and especially by the ones who are blind. Screen readers read aloud the content of webpages. While hearing what is on the screen with screen readers, blind person can navigate through

the webpage using special key combinations. Remarkable examples of screen readers include JAWS for Windows and VoiceOver for Macintosh. Some other tools used by impaired people are screen magnifiers, voice recognition software and braille display. Table 4 contains a list of assistive technologies in use.

Table 4. List of Assistive Technologies

#	Name of the tool	#	Name of the tool	#	Name of the tool
1	Screen reader	4	Refreshable braille display	7	Pop-up blocker
2	Screen magnifier	5	Voice recognition	8	Alternative keyboard and mouse
3	Eye tracking device	6	On-screen keyboard		

Source: [WAI, 2017]

There are also some strategies other than assistive technologies to better use Internet. These strategies are called adaptive strategies. Some examples of adaptive strategies are increasing the text font size and changing the mouse speed.

Kurt (2011) stated that assistive technologies cannot function appropriately without proper accessibility standards applied. So, assistive technologies alone are not enough for impaired people to easily use the Internet.

2.2.6 Web accessibility evaluation

Web accessibility can be measured via different methods. These are automated testing, testing with reals users, and expert opinion (Hanson & Richards, 2013). Testing with real users and expert opinion can be placed under manual testing as well. In order to get an optimum result from the evaluation, both automated and manual tests shall be performed on a website (Hameed, 2018). Study of Loureiro et

al. (2015) also confirms this case specifying that while one of the methods detected a problem in one of the success criteria, the other two could not detect, or vice versa.

Furthermore, according to Yoon et al. (2016), accessibility evaluation that focuses on only accessibility guidelines and standards is not enough. If the aim is the real access of disabled people to a website, then accessibility of the website must go beyond accessibility coding errors and include usability as a part of accessibility.

It is also important to track the status of the website regarding accessibility not only when it goes live but also during its whole lifetime (Hameed, 2018). It is conventional that when a system goes live, more focus is invested to fix its problems. However, sustaining accessibility of website in its whole lifetime is essential.

2.2.6.1 Automated testing

Web accessibility evaluation tools, which do automated testing, are software programs that check if a website is compliant with accessibility (Lazar, Dudley-Sponaugle & Greenidge, 2004). Although these tools easily inspect compliance of a website to accessibility guidelines, they are not enough to verify if a website is accessible (Hanson & Richards, 2013). Manual testing shall be included in order to achieve better results.

There are many automated tools in the market that evaluate webpages according to specific guidelines such as WCAG (WAI, 2016b). Some of the known examples of these tools are AChecker, EvalAccess, TAW4 and WAVE (Akram & Sulaiman, 2017). Lazar et al.'s (2004) study showed that almost 80% of the webmasters were knowledgeable about automated tools to inspect web accessibility. Nevertheless, having known about these tools does not guarantee using them and fixing errors properly.

One of the most popular automated tools in use is AChecker. Yoon et al. (2016) described AChecker's advantages as; good performance, familiarity of most of the researchers, no need for subscription or payment, and providing more extensive output compared to other automated tools. In this thesis, AChecker was selected as the automated checker especially because of its easy output generation mechanism and because it is free to use.

AChecker inspects the html content of a website for accessibility performance measurement through three ways: providing URL of the webpage, uploading the html file or pasting source code of the website (Achecker, n.d.a). AChecker can report three types of problems which are known, likely and potential problems. Known problems are the ones recognized with certainty and do not need human verification. Likely problems are more probable to be barriers than potential problems. Nevertheless, the latter two require human inspection to verify if the problem really exists.

Although Hanson and Richards (2013) pointed out the some of the success criteria which are automated testable, information on AChecker website does not tell exactly the same thing (Achecker, n.d.b). For instance, Hanson and Richards (2013) claimed that WCAG 2.0 success criteria 1.3.1 cannot be identified by automated tools; whereas AChecker checks almost 50 checkpoints in order to evaluate criteria 1.3.1 and identifies nearly half of them as known problems.

2.2.6.2 Testing with real users

As stated in the studies of Power et al. (2012), and Rømen and Svanæs (2012); only half of the problems encountered by real disabled users could be shown under WCAG 2.0 success criteria. This result would assumably be even sharper when we

compare real user testing with automated testing since automated testing cannot cover all the items in guidelines and cannot check any additional item other than the ones in the specified guideline. Riley-Huff (2012) also claims that many impaired users are not professionals in technology and the cases they are struggling cannot be easily detected by accessibility standards only. Therefore, real user testing shall also be utilized.

Accessibility user testing is generally done with blind participants or the ones with low vision since accessibility barriers are more common for visually impaired (Hassouna, Sahari & Ismail (2017); Bigham et al. (2017); Aizpurua, Arrue & Vigo (2015). In those tests, screen readers are used by blind participants. The user test in the study of Yoon et al. (2016) was also done by blind participants using screen readers. According to Yoon et al.'s (2016) study, the problems detected in AChecker had little correlation with the user testing. However, some of the items in accessibility guidelines are not for totally blind users. For instance, success criterion 1.4.4, resize text, is for the ones that have poor vision. This criterion does not affect the performance of screen readers. Therefore, if user testing is done with only totally blind users, it is expected that some issues detected by automated tools will not be caught by blind users.

As stated in the automated testing section, automated tools detect some of the issues as potential problems. One of the examples of potential problems is the wording provided in alternative text attribute for images. While automated tool can detect if an image is provided with an alternative text, it cannot verify if the wording is suitable for the image. Hameed (2018) and Mlynarczyk (2012) bring up this point and add that real users shall verify if the wording is true for the description of the image.

2.2.6.3 Expert opinion

Expert opinion is like user testing, but instead of real impaired users, people who are expert in accessibility topic inspect a website and prepare a report accordingly. This method is not likely to be seen in academic literature compared to the previous two methods.

2.2.7 Common accessibility failures

According to the previous studies and WCAG 2.0, there are a number of success criteria which are not frequently satisfied by websites. Some of those issues are listed in Table 5.

Table 5. List of Prevailing Issues Noticed in Different Studies

Guideline	Success Criterion	Common Problems Faced	Level of Conformance
1.1 Text Alternatives	1.1.1 Non-text Content	Alternative text not provided for images	A
1.3 Adaptable	1.3.1 Info and Relationships	i. Input element missing a label ii. Lack of heading structure	A
1.4 Distinguishable	1.4.3 Contrast (Minimum)	Contrast between the color of text and background is not enough	AA
1.4 Distinguishable	1.4.4 Resize text	Text is not resizable	AA
2.4 Navigable	2.4.1 Bypass Blocks	Skip links not provided	A
2.4 Navigable	2.4.3 Focus Order	Illogical tab order	A
2.4 Navigable	2.4.4 Link Purpose (In Context)	Insufficiently labeled link	A
3.1 Readable	3.1.1 Language of Page	Language of the page is not provided	A
3.3 Input Assistance	3.3.2 Labels or Instructions	Empty label text	A

Source: [Sohaib & Kang, 2017; Yoon et al., 2016; Hameed, 2018; Akram & Sulaiman, 2017; Abu Shawar, 2015, Lazar, Olalere, & Wentz, 2012]

When the details of success criterion 1.1.1 non-text content are investigated, it is seen that images without alternative text is one of the common errors (WAI, n.d.). Since blind people cannot see the images; any information, meaning or idea meant by the image shall be given in text format attached to the image. By this, screen readers can scan the alternative text and read aloud to the user when the focus is on that image. Regarding 1.4.3 contrast (minimum) success criterion, if the colors selected for the background and the text are not distinct enough and so if the contrast is low between those; then people with poor vision cannot distinguish the text from the background and cannot read what is written. If the contrast is fairly low, people with normal vision may even experience difficulty in reading the text.

2.2.8 Accessibility of websites according to previous studies

Although there are numerous studies in website accessibility, there are a few specifically for airline website accessibility. An example study about airline websites is Apostolou and Economides' (2008) study that does not just focus on accessibility but gives information about airline website evaluation in general. According to their study, 30 airline websites around the world are checked for accessibility; and only nine of them showed some good presence for disabled people. In addition, some suggestions are also given in order to increase website accessibility; such as providing a consistent page layout and background color with suitable contrast. However, in this thesis, factors which have association with the accessibility performance of airline websites are checked. Especially, legal enforcements or financial positions of airlines are examined if they have a relation with the accessibility scores. In that sense, this thesis differs from Apostolou and Economides's study.

Other studies which cover website accessibility for different type of websites usually claim that accessibility is not given an adequate priority and significance. According to Hameed (2018), among different country education ministry websites, only the website of two countries did not violate the accessibility checkpoints. Akram and Sulaiman (2017) state that, according to the articles reviewed by them, web accessibility is a worldwide concern and most countries are not giving enough attention to the accessibility guidelines. According to another study by Loureiro et al. (2015), among different social networking websites tests, none of them complied with WCAG 2.0 Level A. Although accessibility of websites is usually not satisfying, Hanson and Richards (2013) say that, some improvements can be identified on accessibility of websites over the years. They also added that government websites have improved more significantly in terms of accessibility compared to the previous years.

There are some other studies done on website accessibility which cover different fields including e-learning or government websites. Some of these studies used only automated testing, while some of them performed both automated and manual tests. Appendix B lists some of those studies.

2.2.9 Legal obligations

United Nations adopted the convention on the rights of persons with disabilities in 2007 which requires involved countries to put necessary efforts to enable impaired people access different services and facilities including information and communication technologies. These efforts shall include the eradication of different barriers to accessibility (Convention on the Rights of Persons with Disabilities, 2007).

As mentioned before in section 1.2, U.S. DOT forces a legislation to all air carriers which have flights to the U.S. to have an accessible website for disabled people (Nondiscrimination on the Basis of Disability in Air Travel, 2013). According to this legislation, these carriers are requested to provide accessible web pages for core services and travel information and comply with the standards given in WCAG 2.0 AA criteria within two years from the rule's effective date. For all the web pages in airlines' primary websites, compliance within three years is enforced. Mentioned core services include the services like booking, changing a reservation, checking for flight status, etc. Failure to comply with the law may result in huge penalties. For instance, DOT (2018) published a page for a penalty issued to Scandinavian Airlines. This airline had provided a separate accessible website rather than making primary website accessible and DOT fined this airline $200,000 for violating the law. It is also mentioned in the page that the airline provided an accessible primary website afterwards.

When it comes to Turkey, Turkish e-government portal turkiye.gov.tr has a certificate about accessibility in its website. It states that the website has got the first accessibility certificate approved by Turkish Standards Institute according to ISO 9241-151 and ISO/IEC 40500 standards since 2014 (Turkish e-Government, 2019). In a guide prepared for Turkish public websites by a project team in Turkish Ministry of Development, the United Nations' article above is mentioned (Kamis, n.d.). It is also emphasized that public websites and public web services shall be accessible by disabled people.

Regarding the banking services, accessibility legislation for banking sector has also been enacted in Turkey which does not focus on only public banks but also covers the private ones (Turkish Banking Regulation and Supervision Agency,

2016). Although this legislation enforces banks to provide accessible services for the disabled, the penalty for the insufficiently provided services is not well defined.

According to the findings of Abu Shawar (2015), university websites with enforced accessibility laws have much smaller number of accessibility errors compared to the ones with no accessibility law enforcements. On the contrary, Akram and Sulaiman (2017) state that, although some countries have regulations to provide accessible web services for disabled people, web accessibility problems do not seem to be fixed due to lack of enforcement on the laws.

CHAPTER 3

METHODOLOGY

3.1 Overall design of the study

In this thesis, 27 airline websites have been checked in terms of accessibility standards. Particularly, online ticketing flow from homepage up until to payment pages have been checked. AChecker accessibility checker program was used for automated testing and results were gathered according to WCAG 2.0 AA Criteria (Achecker, n.d.b). Airline specifications like being a low-cost carrier or fleet size were also collected from different sources. Then, those airline specifications were checked if they affect accessibility measures of airline websites. For statistical operations, IBM SPSS Statistics tool Version 25 has been used.

3.2 Research questions

The study aims to find if there exist any correlation between the accessibility performances of websites with airline specifications. As mentioned before, there is a law in the U.S. which forces airlines flying to the U.S. to have accessible websites. So, it may be expected that flying to the U.S. may have an effect on the accessibility performance. Therefore, research question one is formed as follows:

Question 1: Do airlines flying to the U.S. have smaller number of errors compared to the ones which do not fly to the U.S.?

The rank, type, or size of the airline may also affect the accessibility measure. Rank of an airline is specified by Skytrax ranking value. Type of an airline is identified as being a full-service network carrier or not. Size of an airline refers to number of

passengers carried, high revenue, high profit, and big fleet size. Therefore, questions two to seven are specified as:

Question 2: Do airlines which have higher Skytrax rank do better regarding website accessibility?

Question 3: Do full services network carriers do better than low cost carriers in terms of web accessibility?

Question 4: Do airlines with higher number of passengers carried have better accessibility scores?

Question 5: Are airlines with higher revenue better in terms of accessibility?

Question 6: Are airlines with higher profit better in terms of accessibility?

Question 7: Do airlines with a bigger fleet size do better accessibility scores?

The last specification to be analyzed is the code base used for testing. As aforementioned, testing with rendered source codes rather than original source codes would be affecting the accessibility results. Although it is not easy to find sources that mention the importance of the codebase used in the area of accessibility; when it comes to search engine optimization, there are some articles that comment on this topic. One of these articles, Burkholder (2018), states that, given the latest JavaScript technologies, it is now important how search engine optimization is impacted. Similarly, type of code base used may be affecting automated accessibility results. Therefore, research question eighth is stated as follows:

Question 8: Does testing with browser rendered source codes generate higher number of errors compared to testing with original source code?

3.3 Definition of variables

Variables of this thesis mainly consist of specifications of airlines and error counts on online ticketing flows. Airline specifications are the ones that may be affecting the error counts. Therefore, specifications will be listed as independent variables while error counts will be classified as dependent variables.

3.4 Pilot phase

In the first phase of the thesis, five airlines were selected to be analyzed and compared with each other as a pilot study. These airlines were Turkish Airlines and Pegasus Airlines from Turkey; Lufthansa Airlines from Germany; KLM Royal Dutch Airlines from the Netherlands; and Delta Airlines from the United States. Automated tests were run, and outputs were collected for these airlines.

3.5 Selected airlines and their specifications

According to the results of the pilot test and in order to increase the scope of the study, new airlines were added to the list. Airlines have different specifications and are different in size. For instance, airline rating, service type of airline (full network carrier or low-cost carrier); country and continent of airline; revenue and profit of the airline are some of the specifications. Since statistical analysis according to these different attributes meant to be done, airlines were selected according to these criteria. Regarding the airline rating, both high rated and low rated airlines were included in the list. Full network carriers along with low-cost carriers were also considered. There is also another attribute which specifically inspected if it affects airline website's accessibility performance. This attribute is flying or not flying to the United States. Because of a legal obligation enacted by DOT, all airlines flying to the

United States must satisfy web accessibility standards in their websites (Nondiscrimination on the Basis of Disability in Air Travel, 2013). Because of this law it is assumed that flying to the United States may affect the accessibility measure of the airline, thus this criterion is also considered; and both airlines flying and not flying were added to the airline list.

The full list of airlines which were analyzed is given in Table 6 in alphabetical order.

Table 6. List of Airlines Used

#	Airline Name	#	Airline Name	#	Airline Name	#	Airline Name
1	Aeromexico Airlines	8	EasyJet Airlines	15	KLM Royal Dutch Airlines	22	Ryanair
2	Air Nostrum	9	Emirates Airlines	16	LATAM Airlines	23	S7 Airlines
3	AirAsia	10	EVA Air	17	Lufthansa Airlines	24	Singapore Airlines
4	ANA All Nippon Airways	11	Garuda Indonesia Airlines	18	Norwegian Airlines	25	Turkish Airlines
5	AtlasGlobal Airlines	12	Hainan Airlines	19	PAL Express Airlines	26	Virgin Australia Airlines
6	Bangkok Airways	13	IndiGo Airlines	20	Pegasus Airlines	27	WestJet Airlines
7	Delta Airlines	14	Jetstar Airways	21	Qatar Airways		

The specification list used in the thesis for the airlines is given in Table 7. If specifications are needed to be explained, continent and country are the location where the airline is registered. Skytrax world rank is airline's global ranking by a prominent airline rating organization called Skytrax. Type of service is either full network carrier or low-cost carrier. It shows the service level of the airline. While full network carriers generally focus on better service, low-cost carriers aim to offer lower prices and target more price sensitive customers. Has U.S. flights is the attribute to denote if the airline has a flight to one of the cities in the United States.

Table 7. Specification List of Airlines

Number	Specification
1	Continent
2	Country
3	Skytrax World Rank
4	Type of Service
5	Has U.S. Flights
6	Number of Passengers Carried
7	Revenue
8	Profit
9	Fleet Size
10	Code Base Used for Test

Number of passengers carried is the number of passengers airline carries in a year. Revenue and profit are the financial indicators of airline. These variables are selected since they show the commercial value of the airline denoting that they have a profit-based structure. Also, if the airlines are financially strong it can be assumed that they will pay more for user friendly websites. Fleet size is the number of aircrafts that an airline owns and operates. The last specification which is code base used for test is a little bit different from the other ones. This specification is not related to the airline, but it is about how the automated tests are run. The website code inserted for testing can be directly the source of the website or the code can be gathered after the source code is rendered in browser. This attribute will be mentioned in automated tests section in more detailed.

The specifications that are has U.S. flights, continent, and country were generally collected from airline websites while the specification, Skytrax world rank, was collected from Skytrax website (Skytrax, n.d.a). The other specifications which are type of service, number of passengers carried, revenue, profit and fleet size are mostly downloaded from another website called airlinemonitor.com. While Skytrax

world rank specification is based on year 2018, the other specifications are mainly based on the data of 2017. Financial data is based on U.S. dollar currency. Nevertheless, for some of the airlines tested, data could not be found in airlinemonitor.com source. As a result, other sources were searched on Internet and some of the financial data needed to be converted to U.S. dollars. Bangkok Airways, Jetstar Airways, Air Nostrum, S7 Airlines, PAL Express, AtlasGlobal, and Pegasus Airlines are the ones whose data are collected from other sources.

Bangkok Airways' revenue, profit, passenger carried, and fleet size data were retrieved from the carrier's website (Bangkok Airways, 2018). Jetstar passenger count and profit data were gathered from https://investor.qantas.com website (Qantas, 2017). Revenue data is collected from another source (Qantas Group, 2017). Fleet data was obtained from https://www.planespotters.net (Jetstar Airways, 2019). For Air Nostrum, data for revenue, profit and passenger carried were retrieved from https://centreforaviation.com website (Capa, 2017). Fleet size was taken from https://www.planespotters.net website (Air Nostrum, 2019). As for S7 Airlines, passenger carried data was retrieved from https://corporate.amadeus.com (Amadeus, 2018). Revenue and profit data were obtained from http://www.rusaviainsider.com (Russia's S7 Airlines, 2018).

Airline list with the associated specifications is provided in Appendix C. There are a few missing values for specifications. Skytrax 2018 rank is not valid for Pegasus Airlines, number of passengers, revenue and profit could not be found for Pal Express Airlines, and profit could not be gathered for AtlasGlobal Airlines. Other than those, there are no missing variables in the specification list.

3.6 Selected guideline – criteria and tested pages

For WCAG 2.0 criteria, double A level is the medium level of conformance while single A is more basic and triple A is more detailed. In this thesis, AA criteria is selected as the accessibility criteria for measurements, since some of the academic sources used WCAG 2.0 as the reference guideline (Hanson & Richards, 2013; Aizpurua, Arrue & Vigo, 2015).

Regarding the tested pages, online ticketing flow of airline website were tested. The pages in online ticketing flow are homepage, availability page, availability summary page, extra services page, profile page and payment page. Homepage is basically the main page of a website. Availability page comes after homepage when necessary parameters like departure and arrival points are selected and search button is clicked. In the availability page, flight options are listed with departure and arrival times, and fares of the flights. There is also some other information shown in this page such as number of stops for a flight or amenities provided in the flight. Availability summary page is displayed after flights are selected in the availability page. Availability summary page is an information page for selected flights; and it is not shown or used in some of the airline websites. Extra services page is the page where extra baggage or preferred seat is selected. For some of the websites, these functions are not available in online ticketing flow or this page is put inside the profile page. There are also some websites, in which there are a number of extra services pages; such as one for extra baggage and another for seat selection. In the profile page, passenger information is needed to be filled. In most cases, name and surname fields, date of birth, and contact details like email address and phone number shall be filled out. Some airlines put profile page after extra services page whereas vice versa is also seen for others. Payment page is the page

where payment details shall be completed. Credit card or some other payment methods are generally listed in this page.

3.7 Automated tests

Automated tests are run for the airline online ticketing flow. Although there are 27 airlines in the tested airline list, some of the airline websites are tested more than once. So, the total test count is 31 online ticketing flows.

In the early phases of automated testing, AChecker website is used for the tests (https://achecker.ca/). AChecker was selected as the automated checker especially because of its easy output generation mechanism and because it is free to use. The homepage of this website is shown in Figure 5.

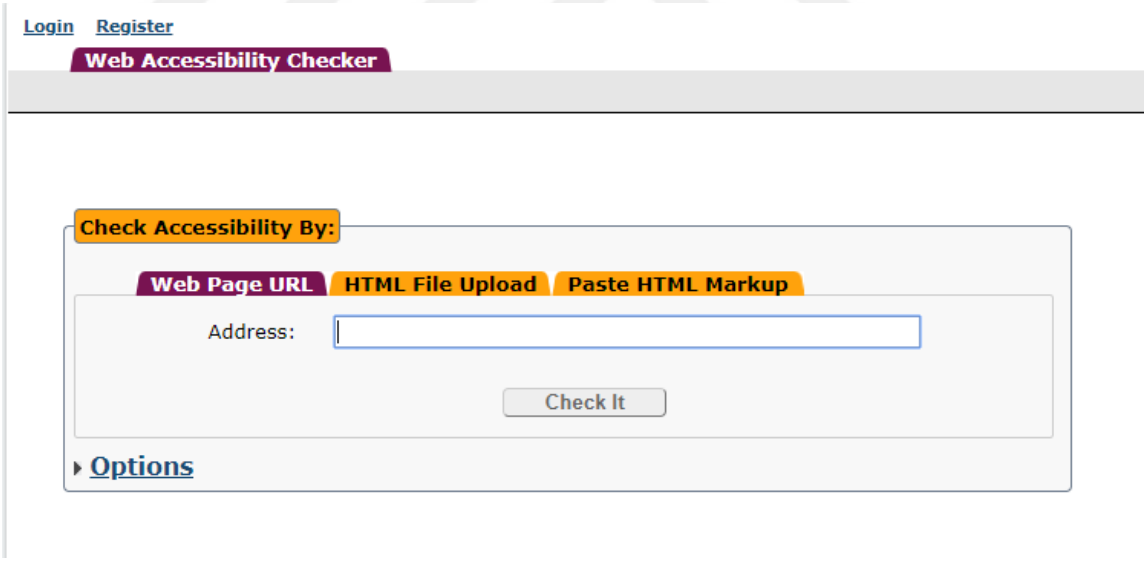


Figure 5. Achecker website homepage, automated test interface

Source: [https://achecker.ca/]

In order to check with the preferred options, options button is clicked and WCAG 2.0 (Level AA) is selected as the guideline while “enable html validator” and “enable css

validator" checkboxes are unchecked. Figure 6 is the representation of the selected options while testing.

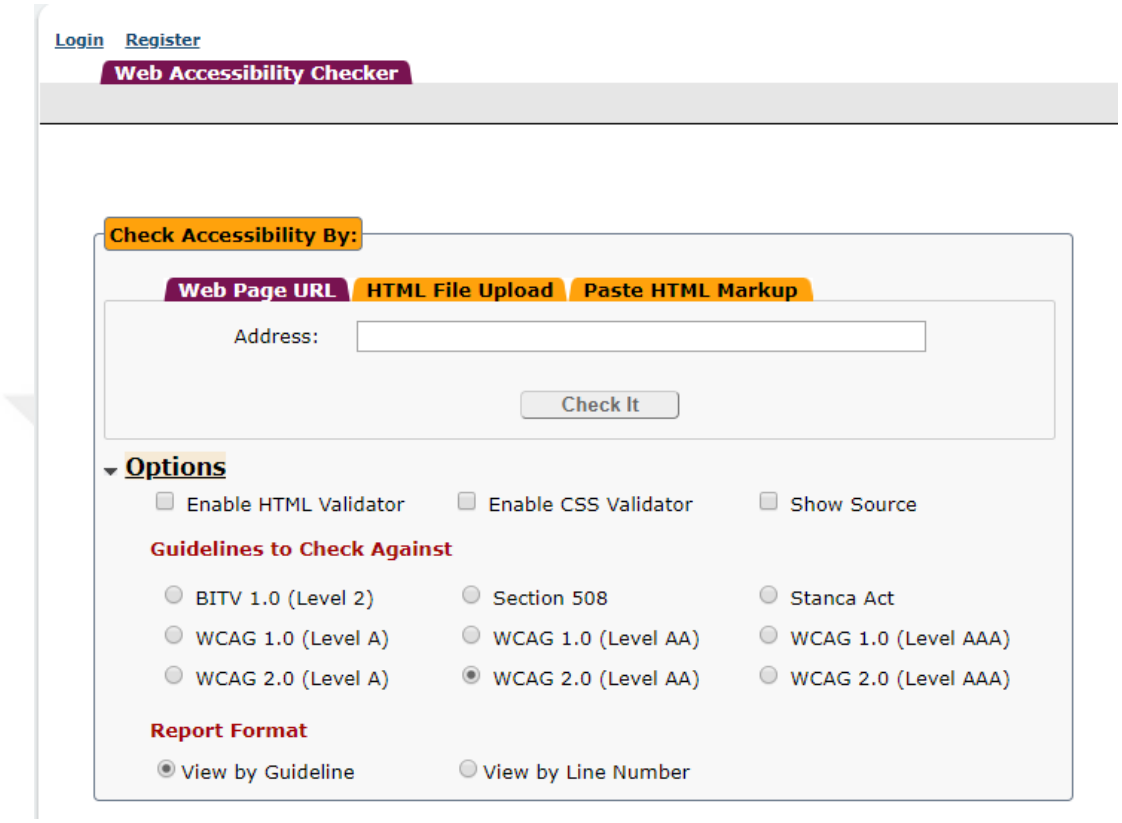


Figure 6. Achecker website, options selected

Source: [https://achecker.ca/]

Although for the homepages of airline websites, web page URL tab is used for testing, pages other than homepages could not be tested using this tab. This is due to the fact that online ticketing flow is not a series of static pages, but according to the parameters given such as departure point and departure date; and according to the availability and fares of the flights, other pages differ. That is to say, the pages other than homepages are dynamic pages and the associated URL cannot be called and retrieved by other clients most of the times including Achecker server itself. Since web page URL could not be used for the pages like availability or extra services,

“html file upload” or “paste html markup” tabs are used for testing those pages (see Figure 7).

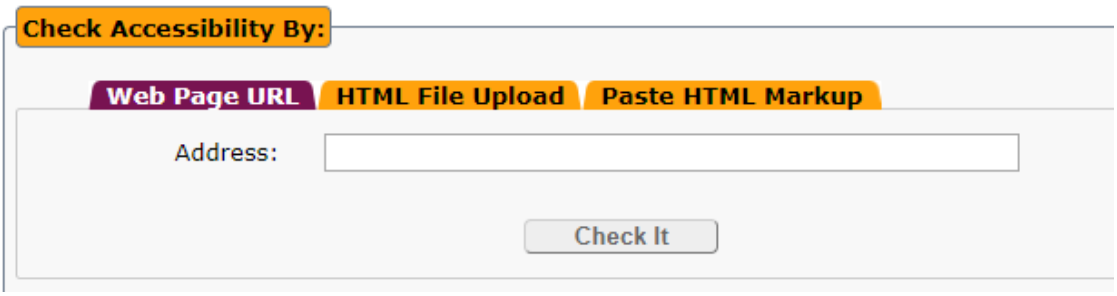


Figure 7. Achecker website, different testing options

Source: [https://achecker.ca/]

Moreover, for some of the airlines including KLM and Delta airlines, testing with URL did not even work for homepages possibly because of a block done by these websites for unreal, bot clients.

In the first phases of the thesis, Google Chrome had been used as the web browser. Nevertheless, Chrome had given errors while testing with AChecker website. So, it is switched to Mozilla Firefox and it has generally been used afterwards.

It is conventional to use website source code while testing with AChecker’s “paste html markup” method, so this method is used while testing. About half of the tests are done based on the source codes of websites. An example of a source code is given in Figure 8.

However, when inspected in more detail, websites may have very short or long source codes with low relevance on the bulkiness of the page. Air Asia availability page and Aeromexico’s homepage are the two examples where short source codes exist. Although availability pages are usually not very small in file size,

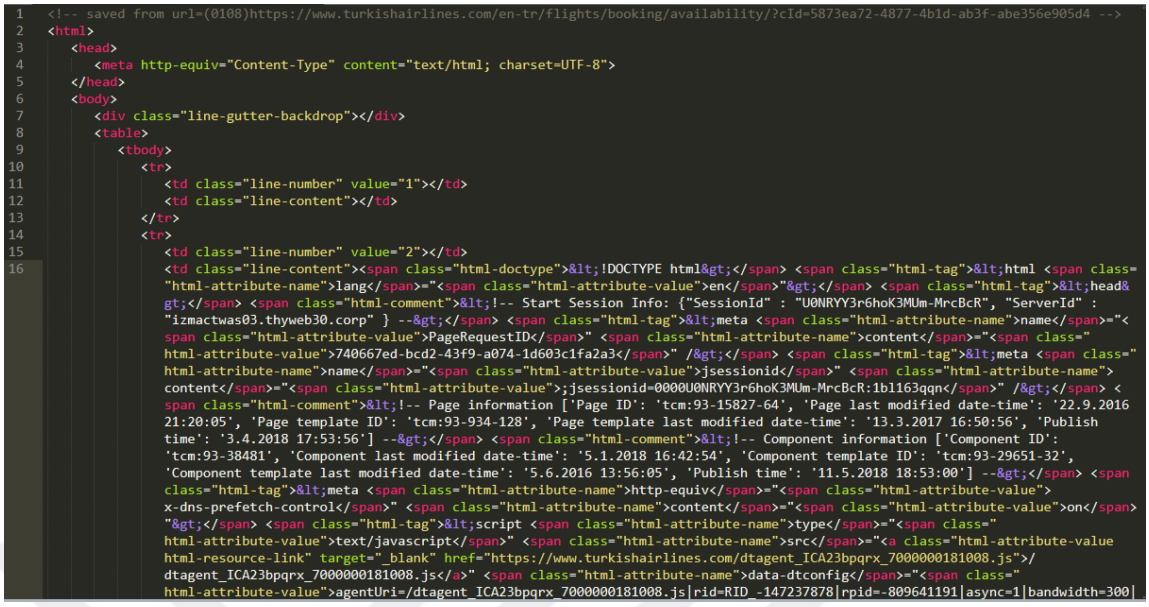


Figure 8. The beginning of source code of Turkish Airlines' availability page

Source: [https://www.turkishairlines.com/]

Air Asia availability page differs. This is possibly due to heavy usage of JavaScript coding. Instead of regular html tags in the source code, JavaScript code may be used and some of the html tags are to be rendered with the browser.

Although not many sources could be found referring to this subject, this situation seemed to be affecting the tests with Achecker. Achecker does not render the web site source codes, but it just evaluates the source codes. Rendering is primarily browser's job to do. Furthermore, there are some accessibility tools which work as an extension of browsers like Wave or Axe by which accessibility testing can be done automatically after rendering of the source code in the browser.

After getting aware of Achecker's not rendering situation which corresponds to the time half of the tests were already run, it is decided to use the rendered version of the source code of the websites for automated testing. The remaining half of the tests, roughly 15 tests, are done with rendered source codes. The airline specification

mentioned in section 3.1.1, code base used for test, is indeed about this issue. The ones which are run with source codes take “1” for this attribute while the ones that rendered version is used is denoted with “0”. In the automated tests data, the last two tests which have test numbers 30 and 31 are done on the same airline website with the same flow but first one is done with the source code of the website while the other one is run with rendered source code. The difference can be seen on the error counts.

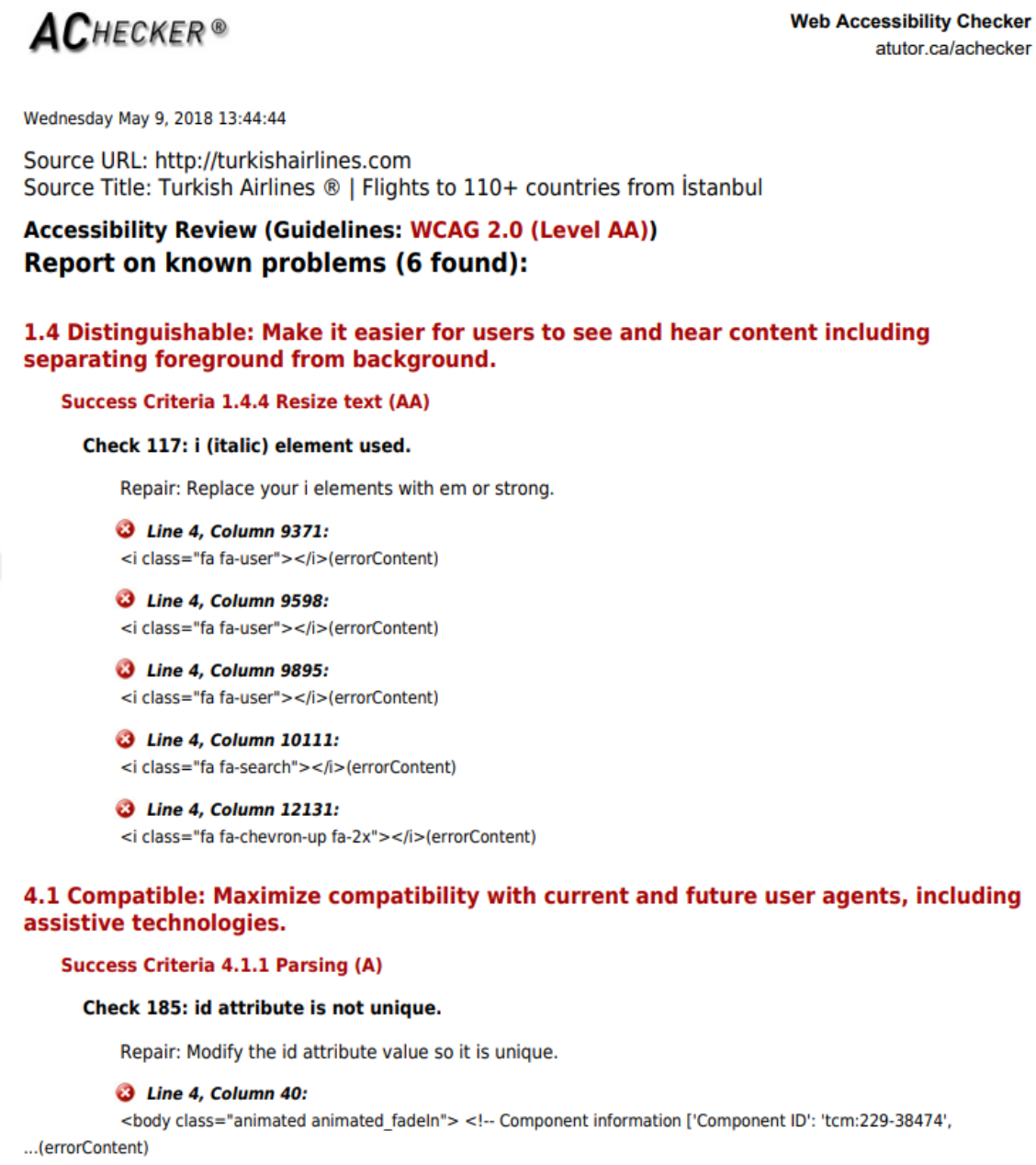
While testing was going on, another issue emerged. Although for some of the errors Chrome gave, Firefox allowed for testing; for some of the errors, Firefox also gave errors and did not allow automated testing. For instance, while testing Qatar Airways availability page, either 504 – “gateway timeout” or 413 – “request entity too large” errors appeared. Emirates Airlines website availability page also gave 413 – “request entity too large” error. Even though this issue had been valid while testing with source codes, after switching to rendered versions, many more tests failed and could not be completed. So, causes of the problems and possible alternative solutions were assessed. 413 – “request entity too large” error was the main error faced. The reason for this error is that Achecker website cannot check the file because file size is bigger than a pre-defined limit. Different websites with different file sizes were tested and the file size limit is noticed as one MB. The ones exceeding this limit gave the error. In order to solve the issue, Internet is searched and the source files of Achecker from github are reached (https://github.com/inclusive-design/AChecker).

Although the source files were available, a server is needed to be created. This is accomplished with the help of a website URL provided by a friend. Then, this URL, https://pacsent.net/AChecker/, is used for the tests. Interface is the same with Achecker website with this configuration. Thanks to new structure, 1 MB file size

limit could be surpassed. However, for bigger file sizes like 8 MB of Bangkok Airways seat page, new structure did not work either. This time, the error faced was "ac_error_no_enough_memory" from Achecker. No solution to fix this problem is found and inevitably the test is terminated. Although there are some pages that could not be tested due to those technical problems; finally, the automated tests are completed for 27 airline websites and 31 online ticketing flow. As for the result of the tests, known, likely and potential error counts are used. Likely and potential errors need human verification and so they are not direct measure of website's accessibility performance. Thus, just known error counts are considered. An example of Achecker's output can be seen in Figure 9. This figure shows how known problems are listed in the output file. Each violation in this figure is included in the error counts. So, according to this output, the error count is six.

The results of the tests are shown in Appendix D**.** First of the attributes is "code base used for test" which is already told in the specification list. Because this attribute is different from other specifications and more affiliated to the testing procedure, it is put under Appendix D. The second of the attributes is the retrieval time for html. It denotes the date for the source of the website in case the website is changed afterwards. The other attribute is homepage, which is the main page for the website. The other attributes are also the other pages in online ticketing flow which were told previously. There is only one last attribute, mean_booking flow, which was not mentioned beforehand. This attribute is the mean of errors got from all the pages in online ticketing flow for an airline website.

There are also a few cases where two pages are put in one page like S7 Airlines' profile and payment pages.



ACHECKER®

Web Accessibility Checker
atutor.ca/achecker

Wednesday May 9, 2018 13:44:44

Source URL: http://turkishairlines.com
Source Title: Turkish Airlines ® | Flights to 110+ countries from İstanbul

Accessibility Review (Guidelines: WCAG 2.0 (Level AA))

Report on known problems (6 found):

1.4 Distinguishable: Make it easier for users to see and hear content including separating foreground from background.

Success Criteria 1.4.4 Resize text (AA)

Check 117: i (italic) element used.

Repair: Replace your i elements with em or strong.

Line 4, Column 9371:
(errorContent)

Line 4, Column 9598:
(errorContent)

Line 4, Column 9895:
(errorContent)

Line 4, Column 10111:
(errorContent)

Line 4, Column 12131:
(errorContent)

4.1 Compatible: Maximize compatibility with current and future user agents, including assistive technologies.

Success Criteria 4.1.1 Parsing (A)

Check 185: id attribute is not unique.

Repair: Modify the id attribute value so it is unique.

Line 4, Column 40:
<body class="animated animated_fadeIn"> <!-- Component information ['Component ID': 'tcm:229-38474',
...(errorContent)

Figure 9. Achecker automated test output file

Both profile and payment pages are in one page. In this situation, the error count of this page is put under profile page performance while payment page performance is left as blank. Another point to mention is that two of the websites do not have their own website for the booking flow. For Air Nostrum, after pushing search button in homepage, it redirected to Iberia Airline availability page. From then, all the process

can be done on Iberia website. The other airline website, PAL Express Airline website, does not exist at all. This airline uses the same website with its parent company, Philippine Airlines. During statistical analysis, this factor is also considered.

Another important point to indicate is that some websites have one page for the availability page while some other have two pages. For instance, Turkish Airlines has one page for availability page while Garuda Indonesia Airlines has two pages. Similarly, for extra services page some airlines have more than one page. As an example, Bangkok Airways has two pages while Ryanair has three pages for extra services. For those cases, mean error counts is considered for the page performance. As an illustration, for Ryanair extra services performance, error counts in all the three pages are counted, mean value is calculated and used as the error count for extra services page.

CHAPTER 4

ANALYSIS AND RESULTS

4.1 Data preparation

For statistical analysis, IBM SPSS Statistics tool Version 25 has been used. As mentioned in section 3.1, PAL Express Airlines and Air Nostrum Airlines do not have their own websites for online ticketing flow. In order to perform consistent analyses, the tests for these airlines are removed from the data set and the statistical analyses are performed. Thus, automated test numbers 11, 14 and 29 are removed from the original data set.

Next step is to inspect if there exists any missing data using SPSS's missing data analysis function. The missing data can be seen in Table 8.

Table 8. Missing Values

Univariate Statistics

		Missing	
	N	Count	Percent
Skytrax_Rank	24	1	4.2
Number_of_Pax	25	0	0
Revenue	25	0	0
Profit	24	1	4.2
Fleet_Size	25	0	0
Homepage	28	0	0
Availability	25	3	10.7
Av_Summary	12	16	57.1
Extra_Services	22	6	21.4
Profile	28	0	0
Payment	24	4	14.3
Mean_Booking_Flow	28	0	0
Type_of_Service	25	0	0
Has_US_Flights	25	0	0
Year_of_Data	25	0	0
Code_Base_Used	28	0	0

For independent variables, Skytrax rank and profit have one missing variable each. By looking at the data, it can be noticed that Pegasus does not have a Skytrax rank and AtlasGlobal does not have a profit value.

Pegasus could not be found in Skytrax top 100 airline list. This can be either from the fact that Pegasus is worse than 100 airlines according to Skytrax, or this airline may also have opted out from Skytrax rankings. According to airlinequality.com website, which is an associated website with Skytrax, Pegasus Airlines is a two-star airline (Skytrax, n.d.b). This could be an indication of the fact that, Skytrax evaluated Pegasus Airlines for the top 100 list but the airline could not qualify to be the in the top 100. That's why, Skytrax rating for Pegasus Airlines is given as 101.

For the other missing variable, profit value of AtlasGlobal, imputation technique is utilized. However, before performing imputation, it is needed to check if the data satisfies the structure of so called being missing value completely at random (MCAR). In order to test being MCAR, Little's MCAR test is used. All independent variables are included for this test. According to the results (see Table 9), significance value is greater than 0.05.

Table 9. Little's MCAR Test If the Missing Data is Missing Completely at Random

EM Means[a]

Skytrax_Rank	Number_of_Pax	Revenue	Profit	Fleet_Size
40.69	40289.46	$8,122.11	$751.47	169.43

a. Little's MCAR test: Chi-Square = 5.130, DF = 8, Sig. = .744

So, it can be concluded that the data does not violate MCAR. In other words, the data can be treated as MCAR and imputation techniques for the missing data can be performed. Expectation-Maximization imputation technique, which is one of the best

imputation techniques for low number of missing variables, is used for imputation. According to this imputation technique, SPSS predicted AtlasGlobal profit value as -$243 million and the data is updated accordingly.

When it comes to dependent variables, there are also missing values. As shown in Table 8; apart from the pages of homepage, profile and mean booking flow, all other pages have missing values. For this thesis, the dependent variables of home page, profile page and mean booking flow that have no missing values are used.

4.2 Normality tests

Normality checks should be performed to decide which tests will be used for statistical analysis. Because the sample size is less than 50, Shapiro-Wilk test results are checked. The SPSS results can be seen for this test in Table 10.

Table 10. Normality Test for Dependent Variables

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Homepage	.279	28	.000	.751	28	.000
Profile	.365	28	.000	.344	28	.000
Mean_Booking_Flow	.254	28	.000	.734	28	.000

a. Lilliefors Significance Correction

If the significance values are larger than 0.05, then it can be concluded that the data follows normal distribution. On the contrary, for three of the dependent variables, it is concluded that data is not normally distributed. So, parametric tests cannot be used. From non-parametric tests, Spearman Rho test is performed for ordinal and continuous independent variables, whereas Mann-Whitney test is used for the variables with only two discrete values.

Ordinal and continuous independent variables can be listed as Skytrax rank, number of passengers carried, revenue, profit, and fleet size. Among those, Skytrax rank variable is ordinal while the others are continuous variables. All of these continuous variables are ratio variables since they all have a zero point. The variables with two values are the variables; type of service, has U.S. flights, and code base used. These variables are categorical and nominal variables. In addition, they are also binary variables since they can only get two values.

4.3 Mann-Whitney tests

Mann-Whitney test results are shown in Tables 11 and 12.

Table 11. Mann-Whitney Test Statistics for Variable, Type of Service with the Three Dependent Variables

Test Statistics[a]

	Homepage	Profile	Mean_Booking_Flow
Mann-Whitney U	61.000	54.000	51.000
Wilcoxon W	251.000	244.000	241.000
Z	-1.205	-1.555	-1.697
Asymp. Sig. (2-tailed)	.228	.120	.090
Exact Sig. [2*(1-tailed Sig.)]	.243[b]	.129[b]	,.95[b]

a. Grouping Variable: Type_of_Service

b. Not corrected for ties.

For the variable of type of service, for all the dependent variables, it can be seen that significance values are greater than 0.05 (see Table 11). Therefore, the relation between the value of type of service variable and number of accessibility errors is not accepted.

Table 12. Mann-Whitney Ranks for Variable, Type of Service with the Three Dependent Variables

Ranks

	Type_of_Service	N	Mean Rank	Sum of Ranks
Homepage	Low Cost Carrier (LCC)	9	17.22	155.00
	Full Service Network Carrier (FSNC)	19	13.21	251.00
	Total	28		
Profile	Low Cost Carrier (LCC)	9	18.00	162.00
	Full Service Network Carrier (FSNC)	19	12.84	244.00
	Total	28		
Mean_Booking_Flow	Low Cost Carrier (LCC)	9	18.33	165.00
	Full Service Network Carrier (FSNC)	19	12.68	241.00
	Total	28		

Mann-Whitney test results for "has U.S. flights" variable are shown in Tables 13 and 14. Table 13 shows that significance values for all the dependent variables are less than 0.05.

Table 13. Mann-Whitney Test Statistics for Variable has U.S. Flights with the Three Dependent Variables

Test Statistics[a]

	Homepage	Profile	Mean_Booking_Flow
Mann-Whitney U	17.000	32.000	21.000
Wilcoxon W	227.000	242.000	231.000
Z	-3.204	-2.450	-3.000
Asymp. Sig. (2-tailed)	.001	.014	.003
Exact Sig. [2*(1-tailed Sig.)]	.001[b]	.013[b]	,002[b]

a. Grouping Variable: Has_US_Flights

b. Not corrected for ties.

Table 14. Mann-Whitney Ranks for Variable has U.S. Flights with the Three Dependent Variables

Ranks

	Has_US_Flights	N	Mean Rank	Sum of Ranks
Homepage	No	8	22.38	179.00
	Yes	20	11.35	227.00
	Total	28		
Profile	No	8	20.50	164.00
	Yes	20	12.10	242.00
	Total	28		
Mean_Booking_Flow	No	8	21.88	175.00
	Yes	20	11.55	231.00
	Total	28		

Therefore, it can be concluded that there is a correlation between has U.S. flights variable with the dependent variables tested. Mean rank values in Table 14 specifies that airlines which have flights to the U.S. have much smaller number of website accessibility errors.

For code base used variable, according to Tables 15 and 16, Mann-Whitney test results show that significance is satisfied for profile variable while significance could not be satisfied for homepage and mean booking flow variables.

Table 15. Mann-Whitney Test Statistics for Variable Code Base Used with the Three Dependent Variables

Test Statistics[a]

	Homepage	Profile	Mean_Booking_Flow
Mann-Whitney U	65.000	51.000	56.000
Wilcoxon W	170.000	156.000	161.000
Z	-1.516	-2.167	-1.930
Asymp. Sig. (2-tailed)	.129	.030	.054
Exact Sig. [2*(1-tailed Sig.)]	.137[b]	.031[b]	.056[b]

a. Grouping Variable: Code_Base_Used

b. Not corrected for ties.

Table 16. Mann-Whitney Ranks for Variable Code Base Used with the Three Dependent Variables

Ranks

	Code_Base_Used	N	Mean Rank	Sum of Ranks
Homepage	0	14	16.86	236.00
	1	14	12.14	170.00
	Total	28		
Profile	0	14	17.86	250.00
	1	14	11.14	156.00
	Total	28		
Mean_Booking_Flow	0	14	17.50	245.00
	1	14	11.50	161.00
	Total	28		

However, significance value for mean booking flow variable is slightly over 0.05. So, significance is slightly missed. According to these significance levels, it can be asserted that profile variable is dependent on code base used variable. Mean rank values also show that using rendered source codes results in higher number of accessibility errors for profile page.

4.4 Spearman Rho tests

As for the ordinal and continuous variables, Spearman Rho test is applied. In order to see the correlation within and between the groups of independent and dependent variables, both independent and dependent variables are included in the test. As it can be seen from the Appendix E, some significant values are gathered.

Starting from the top left to the right, Skytrax rank has significant correlation with all the independent variables except the variable of number of passengers carried while it has no significant relationship with the dependent variables. By looking at the correlation coefficients, Skytrax rank has a negative correlation with revenue, profit and fleet size. The correlation coefficient is around -0.4 and -0.6 which shows that there is a medium-large negative relationship between Skytrax rank

and those variables. Nevertheless, the relation between Skytrax rank and revenue is a bit stronger than the others. In short, the airlines having lowest Skytrax ranks are better ranked for financials and have more airplanes.

The second variable on Appendix E is number of passengers carried. Similar to the last-mentioned variable, with regard to the other independent variables except Skytrax ranking, there are significant correlations. When the correlation coefficients are considered, it can be noticed that there are strong-very strong relationships. However, no significant relationship can be seen with regard to the dependent variables. Precisely, airlines which carry more passengers have more revenue, profit and airplanes.

The third variable, revenue has again a strong relationship with profit and fleet size. The airlines which earn more revenue have more profit and airplane. In the case of the dependent variables, significant relationships with all the dependent variables are seen. The correlation coefficients are negative and around -0.4, -0.5. So, it can be understood that airlines which generate higher revenues have lower number of accessibility errors in their homepage, profile page and mean booking flow.

Another variable, profit, has a significant relationship with fleet size and the significance is strong with positive and strong correlation. Airlines having higher profits generally have a bigger fleet size. On the issue of dependent variables, it is understood that there is a significance relationship between profit and profile page while no significance can be seen for the other two dependent variables. The correlation coefficient for the relation between profit and profile shows a medium negative relationship. Therefore, having a bigger profit is an indication of a moderately lower number of accessibility errors in profile page.

For the variable fleet size, relationship with respect to the independent variables are covered above. For the dependent variables, significant relationships are not seen. Thus, it can be concluded that there is no evidence that with different number of airplanes owned accessibility error count changes.

When it comes to the relationship within dependent variables, it can be seen that there is a significant relationship in the number of errors got in the homepage, profile page and mean booking flow. Although the strength of the correlation is moderate-strong between homepage and profile page, it is very strong between mean booking flow with the other two. Indeed, having a relationship among dependent variables is not extraordinary, since it can be expected that error counts for an airline do not fluctuate much in different pages of online ticketing flow.

CHAPTER 5

DISCUSSION AND CONCLUSION

The aim of this thesis is to inspect accessibility performances of airline website ticketing flows for handicapped people with automated testing. 27 airline websites are tested, and 31 automated tests are performed. Airline specifications are also gathered, and analyses are done to see the existing relationships between accessibility performances of websites and airline specifications. The analyzed specifications are global rankings of airlines (Skytrax rank), type of service (either full service network carrier or low cost carrier), has U.S. flights (if airline flies to the U.S.), number of passengers carried in a year, yearly revenue, yearly profit, fleet size, and the source base used for automated testing (if source code of the website or rendered version of source code is used). For Skytrax rankings, data of 2018 rankings is used. For the variables of type of service, passengers carried, revenue, profit and fleet size; data of 2017 is used with a few exceptions where 2017 data could not be found. Automated accessibility tests are performed with Achecker with respect to the guideline WCAG 2.0 AA. Number of known problems which are the exact errors Achecker can detect are considered for measuring accessibility performance of websites. Then, airline specifications and automated test results are merged, and statistical analyses are performed with SPSS tool regarding the research questions.

Two of the selected airlines are removed from the statistical procedure since they were using the websites of their parent company. The missing values for the specifications of airlines are imputed.

As for independent variables, among all the pages in online ticketing flow, homepage, profile page and mean booking values are analyzed because of the missing values for the other dependent variables.

First research question asks if flying to the U.S. has an association with the accessibility measure of airline websites. Indeed, because of a law enacted by U.S. Department of Transportation, all the air carriers which have flights to the U.S. must have an accessible website. As mentioned before, DOT (2018) issued a penalty to Scandinavian Airlines for not satisfying the enforcements. So, it can be assumed that airlines flying to the U.S. shall have smaller number of accessibility errors in their websites in order not to face a penalty. Analysis results significantly show that airlines which have flights to the U.S. have smaller number of accessibility errors. Furthermore, mean rank values of airlines flying to the U.S. are dramatically lower compared to the values of ones not flying to the U.S. Though it cannot be exactly proven, flying to the U.S. may be a reason for lower number of errors which can be an indication that airlines take appropriate measures more cautiously in order not to face a penalty.

Research question two inspects that if Skytrax ranking of an airline has a relation with the accessibility performance. According to the statistical results, there is no evidence that ranking of an airline has a relation with the accessibility performance. Thus, it may be concluded that having a higher or lower global rank does not affect the accessibility performance.

Research question three inquires the airline's type of service correlation with accessibility scores. Results indicate that correlations are not statistically significant. That is to say, website accessibility performance does not depend on being a full-service network carrier or a low-cost one.

Research question four indicates if carrying higher number of passengers has an association with accessibility performance. Statistical results show that error counts do not depend on the number of passengers carried. Therefore, it can be claimed that accessibility performance is not affected by the number of passengers carried.

Research question five asks if revenue of airline has a relation with accessibility scores. Statistical results indicate that airlines with higher revenues have smaller number of accessibility errors.

As for research question six, correlation between profit of airline and accessibility errors is questioned. Statistical results indicate that just for profile page, profit has a negative correlation with accessibility error counts. In other words, profile page error count tends to become smaller when airline has higher profit. Nevertheless, for homepage and mean booking flow, the correlation is not statistically significant. In short, it can be claimed that accessibility performance of a website is dependent on profit to some extent.

When it comes to research question seven, fleet size of airline and accessibility performance association is queried. There is not a statistically significant relation between the two variables.

The last research question, number eight, is about the code base used for testing. It asks if testing with rendered source results in higher number of accessibility errors rather than original source codes. Results show that, for profile page, there is statistically significant increase in the error counts when rendered source code is used. For homepage, there is no evidence if there exists any difference between the two. When mean booking flow error count is considered, it can be noticed that statistical significance is slightly missed to imply a difference. In short, it

can be claimed that accessibility performance of a website is dependent on code base used to some extent.

The results of the study show that among different factors, variables which are flying to the U.S. and revenue of airline have statistically significant correlation with accessibility performance of an airline website. In addition, profit of airline and code base used for testing are also factors that have relation with accessibility error counts but to some extent.

Thus, it can be concluded that taking appropriate preventive legal measures seem to be a way for airline websites to comply more with accessibility standards. Like the United States, other countries who want to provide more accessible airline websites for disabled people may enact the relevant laws in order to force airlines to conform the accessibility standards. These findings verify the findings of Abu Shawar's (2015) study which stated that university websites where accessibility laws are enforced have much smaller number of errors for accessibility. The findings of Akram and Sulaiman (2017) also show some alignment in which they mentioned that regulations without enforcement do not benefit the accessibility performance of websites. Similarly, because legislation of US DOT really enforces airlines to act and DOT may penalize the airline if the necessary measures are not taken; legislation works and contributes to accessibility performances of airline websites. When it comes to the revenue and the profit that an airline earns, it can be said that, airlines which have more money can spend more money for better accessibility compliance for their websites. In order for the airlines which have low-average financials to have better websites in terms of accessibility, Civil Aviation Authorities of countries may give support. If money is required to be created for the support, a new airline ticket tax can even be introduced. So, support can be given to needing airlines since

providing better environments for handicapped people is an important aim for most of the countries. As for code base used variable, it is worth to point out that automated accessibility testing procedures shall be inspected carefully. Without using rendered version of the source codes for the tests, Achecker accessibility checker and possibly other similar accessibility tools will detect fewer number of problems whereas using rendered version of the source code may reveal some other accessibility problems in a website. Although it is not easy to find sources mentioning the importance of code base used in the accessibility field; when it comes to search engine optimization topic, there are some articles commenting on this issue. Among one of those articles, Burkholder (2018) states that with the recent JavaScript technologies in use, it is now important how search engine optimization is affected. He points out how search engines behave when encountered with high JavaScript usage. Because there are possibly a few sources mentioning about code base used in automated testing in website accessibility topic, this thesis is one of the pioneers that showed the importance of automated testing procedure with regard to code base used.

5.1 Limitations

There were some limitations for this thesis. Firstly, only automated tests were performed but user testing and expert opinion could not be evaluated due to the time constraint and the size of the scope. Not using manual testing possibly caused not revealing all the accessibility errors of the websites and might have produced some false positives in the test results.

Another limitation of the thesis is using only Achecker for automated testing. Although this tool is widely accepted as one of the best accessibility checkers, it

might be worthy to add some other accessibility tools for testing purposes. Nevertheless, confronting inconvenient output generation mechanism for other automated test tools made reporting difficult and thus other tools were not included in the study.

One other limitation can be stated as the number of airlines tested. Although 27 airlines with 31 automated tests is not a narrow test data size, having a bigger data size might increase the power of statistical analyses; and possibly some of the insignificant variables might have resulted in appearing significant.

5.2 Recommendations for future research

This thesis only covered airline website ticketing flows for automated testing. In order to have a better understanding how airlines do in terms of accessibility for disabled people, other pages and services like online check-in flow, static content pages, and ticket change flow can be inspected in terms of accessibility. Along with automated testing, manual testing procedures can be applied to increase the accuracy of the test results. Compliance with success criteria can also be checked one by one. By this, list of success criteria for which airline websites highly violate can be shown and airlines can use this list as a guideline to fix highly occurring problems.

APPENDIX A

WCAG 2.0 GUIDELINE AND SUCCESS CRITERIA

Principle	Guideline	Success Criterion	Level of Comformance		
			Level A	Level AA	Level AAA
1. Perceivable					
	1.1 Text Alternatives				
		1.1.1 Non-text Content	✔		
	1.2 Time-based Media				
		1.2.1 Audio-only and Video-only (Prerecorded)	✔		
		1.2.2 Captions (Prerecorded)	✔		
		1.2.3 Audio Description or Media Alternative (Prerecorded)	✔		
		1.2.4 Captions (Live)		✔	
		1.2.5 Audio Description (Prerecorded)		✔	
		1.2.6 Sign Language (Prerecorded)			✔
		1.2.7 Extended Audio Description (Prerecorded)			✔
		1.2.8 Media Alternative (Prerecorded)			✔
		1.2.9 Audio-only (Live)			✔
	1.3 Adaptable				
		1.3.1 Info and Relationships	✔		
		1.3.2 Meaningful Sequence	✔		
		1.3.3 Sensory Characteristics	✔		
	1.4 Distinguish-able				
		1.4.1 Use of Color	✔		
		1.4.2 Audio Control	✔		
		1.4.3 Contrast (Minimum)		✔	
		1.4.4 Resize text		✔	
		1.4.5 Images of Text		✔	
		1.4.6 Contrast (Enhanced)			✔
		1.4.7 Low or No Background Audio			✔
		1.4.8 Visual Presentation			✔
		1.4.9 Images of Text (No Exception)			✔
2. Operable					

Principle	Guideline	Success Criterion	Level of Comformance		
			Level A	Level AA	Level AAA
	2.1 Keyboard Accessible				
		2.1.1 Keyboard	✔		
		2.1.2 No Keyboard Trap	✔		
		2.1.3 Keyboard (No Exception)			✔
	2.2 Enough Time				
		2.2.1 Timing Adjustable	✔		
		2.2.2 Pause, Stop, Hide	✔		
		2.2.3 No Timing			✔
		2.2.4 Interruptions			✔
		2.2.5 Re-authenticating			✔
	2.3 Seizures and Physical Reactions				
		2.3.1 Three Flashes or Below Threshold	✔		
		2.3.2 Three Flashes			✔
	2.4 Navigable				
		2.4.1 Bypass Blocks	✔		
		2.4.2 Page Titled	✔		
		2.4.3 Focus Order	✔		
		2.4.4 Link Purpose (In Context)	✔		
		2.4.5 Multiple Ways		✔	
		2.4.6 Headings and Labels		✔	
		2.4.7 Focus Visible		✔	
		2.4.8 Location			✔
		2.4.9 Link Purpose (Link Only)			✔
		2.4.10 Section Headings			✔
3. Understan-dable					
	3.1 Readable				
		3.1.1 Language of Page	✔		
		3.1.2 Language of Parts		✔	
		3.1.3 Unusual Words			✔
		3.1.4 Abbreviations			✔
		3.1.5 Reading Level			✔
		3.1.6 Pronunciation			✔
	3.2 Predictable				
		3.2.1 On Focus	✔		
		3.2.2 On Input	✔		

Principle	Guideline	Success Criterion	Level of Comformance		
			Level A	Level AA	Level AAA
		3.2.3 Consistent Navigation		✔	
		3.2.4 Consistent Identification		✔	
		3.2.5 Change on Request			✔
	3.3 Input Assistance				
		3.3.1 Error Identification	✔		
		3.3.2 Labels or Instructions	✔		
		3.3.3 Error Suggestion		✔	
		3.3.4 Error Prevention (Legal, Financial, Data)		✔	
		3.3.5 Help			✔
		3.3.6 Error Prevention (All)			✔
4. Robust					
	4.1 Compatible				
		4.1.1 Parsing	✔		
		4.1.2 Name, Role, Value	✔		

Source: [WAI, 2019b]

APPENDIX B

SOME OF THE RECENT STUDIES ABOUT WEBSITE ACCESSIBILITY

Author and Year	Subject	Objective	Tests Done
Bigham, Lin & Savage, 2017	The Effects of Not Knowing What You Don't Know on Web Accessibility for Blind Web Users		No automated tests, but comparison done between sighted and blind users while using internet (like manual test)
Sohaib & Kang, 2017	E-Commerce Web Accessibility for People with Disabilities	Top 30 Australian ecommerce websites were tested against WCAG 2.0	Only automated testing with AChecker
Akram & Sulaiman, 2017	A Systematic Literature Review to Determine the Web Accessibility Issues in Saudi Arabian University and Government Websites for Disable People	A comprehensive literature review	No test done
Yoon, Dols, Hulscher, & Newberry, 2016	An exploratory study of library website accessibility for visually impaired users	Three library websites were tested for accessibility. Compared automated and manual test with each other	Automated (only AChecker) and manual test with blind users

Author and Year	Subject	Objective	Tests Done
Abu Shawar, 2015	Evaluating Web Accessibility of Educational Websites	E-learning websites from different countries were checked regarding accessibility	Automated test (with Wave and Cynthia Says) and some manual checks on the potential errors caught by automated tools
Hanson & Richards, 2013	Progress on Website Accessibility?	Test done according to WCAG 2.0 A, different websites checked in different years and progress inspected	Only automated testing
Aizpurua, Arrue & Vigo, 2015	Prejudices, memories, expectations and confidence influence experienced accessibility on the Web	Test done according to WCAG 2.0 AA	Automated test (AChecker, EvalAccess, TAW4 and WAVE), expert evaluation and manual test by totally blind users
Loureiro, Cagnin & Paiva, 2015	Analysis of Web Accessibility in Social Networking Services Through Blind Users' Perspective and an Accessible Prototype	An accessible social network service prototype created; test done according to WCAG 2.0. Violations are also evaluated, and hints given how to fix them	Automated test, expert evaluation and manual test by totally blind users
Hassouna, Sahari & Ismail, 2017	University website accessibility for totally blind users	Accessible university website prototype created; test done according to WCAG 2.0 A	Automated test (CynthiaSays), expert evaluation and manual test by blind users

APPENDIX C

AIRLINES WITH THEIR ASSOCIATED SPECIFICATIONS

Airline	Airline Name	Continent	Country	Skytrax World Rank Year 2018	Type of Service (Low-cost=0)	Has U.S. Flights (Yes =1, No=0)	Year of Data (for Pax, Revenue, Fleet Size..)	Number of Passengers Carried in Billion (Yearly)	Revenue (in Million USD)	Profit (in Million USD)	Fleet Size
1	Delta Airlines	North America	United States	37	1	1	2017	145,646	$35,669	$6,150	862
2	KLM Royal Dutch Airlines	Europe	Netherlands	19	1	1	2017	32,689	$11,755	$1,035	108
3	Lufthansa Airlines	Europe	Germany	7	1	1	2017	60,526	$26,509	$3,092	268
4	Pegasus Airlines	Europe	Turkey	-	0	0	2017	27,820	$1,452	$137	75
5	Turkish Airlines	Europe	Turkey	18	1	1	2017	68,274	$11,185	$1,252	276
6	Singapore Airlines	Asia	Singapore	1	1	1	2017	19,448	$8,570	$520	112
7	Qatar Airways	Asia	Qatar	2	1	1	2017	29,948	$11,597	$540	186
8	ANA All Nippon Airways	Asia	Japan	3	1	1	2017	49,356	$15,633	$1,417	209
9	Emirates Airlines	Asia	United Arab Emirates	4	1	1	2017	58,054	$25,136	$1,112	242

Airline	Airline Name	Continent	Country	Skytrax World Rank Year 2018	Type of Service (Low-cost=0)	Has U.S. Flights (Yes =1, No=0)	Year of Data (for Pax, Revenue, Fleet Size..)	Number of Passengers Carried in Billion (Yearly)	Revenue (in Million USD)	Profit (in Million USD)	Fleet Size
10	EVA Air	Asia	Taiwan	5	1	1	2017	12,097	$4,137	$196	68
11	Air Nostrum	Europe	Spain	96	1	0	2016	4,300	$472	$8	45
12	Aeromexico Airlines	North America	Mexico	97	1	1	2017	11,562	$3,257	$165	72
13	S7 Airlines	Asia	Russia	98	1	0	2017	14,000	$2,030	$76	95
14	PAL Express Airlines	Asia	Philippines	99	0	0	2016	-	-	-	31
15	AtlasGlobal Airlines	Europe	Turkey	100	1	0	2017	4,500	$450	-	18
16	AirAsia	Asia	Malaysia	28	0	1	2017	34,983	$2,758	$469	112
17	Norwegian Airlines	Europe	Norway	32	0	1	2017	45,229	$5,275	-$243	141
18	EasyJet Airlines	Europe	United Kingdom	43	0	0	2017	80,250	$6,427	$514	273
19	Jetstar Airways	Australia	Australia	46	0	1	2017	40,472	$3,600	$417	76
20	WestJet Airlines	North America	Canada	54	0	1	2017	23,163	$3,472	$339	121
21	Garuda Indonesia Airlines	Asia	Indonesia	9	1	0	2017	24,187	$4,177	-$76	126
22	Hainan Airlines	Asia	China	8	1	1	2017	71,092	$8,899	$638	208
23	Bangkok Airways	Asia	Thailand	21	1	0	2017	6,000	$863	$26	38

Airline	Airline Name	Continent	Country	Skytrax World Rank Year 2018	Type of Service (Low-cost=0)	Has U.S. Flights (Yes =1, No=0)	Year of Data (for Pax, Revenue, Fleet Size..)	Number of Passengers Carried in Billion (Yearly)	Revenue (in Million USD)	Profit (in Million USD)	Fleet Size
24	Virgin Australia Airlines	Australia	Australia	22	1	1	2017	19,649	$3,222	-$92	97
25	IndiGo Airlines	Asia	India	55	0	0	2017	41,062	$2,774	$252	126
26	LATAM Airlines	South America	Chile	63	1	1	2017	32,904	$10,164	$715	158
27	Ryanair	Europe	Ireland	64	0	0	2017	128,907	$8,422	$1,964	412

APPENDIX D

AUTOMATED TEST RESULTS

Test	Airline Name	Code Base Used for Test (Source Code or URL = 1, Browser Rendered Html = 0)	When Html is Retreived & Tested	Homepage	Availability	Availability Summary	Extra Services	Profile	Payment	Mean_Booking Flow
1	Delta Airlines	1	09.05.2018	8	8	1	-	1	1	3.80
2	KLM Royal Dutch Airlines	1	09.05.2018	54	1	1	6	1	1	10.67
3	Lufthansa Airlines	1	09.05.2018	20	1	-	15	3	-	9.75
4	Pegasus Airlines	1	09.05.2018	320	231	-	260	38	131	196.00
5	Turkish Airlines	1	12.03.2018	6	1	-	-	1	1	2.25
6	Singapore Airlines	1	23.11.2018	86	152	-	36	98	27	79.80
7	Qatar Airways	1	24.11.2018	117	-	7	43	10	49	45.20
8	ANA All Nippon Airways	1	24.11.2018	0	62	6	0	1	6	12.50
9	Emirates Airlines	1	24.11.2018	362	-	117	13	10	37	107.80
10	EVA Air	1	24.11.2018	2	1	-	1	1	1	1.20
11	Air Nostrum	1	25.11.2018	17	4	19	3	3	11	9.50

Test	Airline Name	Code Base Used for Test (Source Code or URL = 1, Browser Rendered Html = 0)	When Html is Retreived & Tested	Homepage	Availability	Availability Summary	Extra Services	Profile	Payment	Mean_Booking Flow
12	Aeromexico Airlines	1	25.11.2018	2	2	-	2	3	2	2.20
13	S7 Airlines	1	25.11.2018	527	272	272	-	187	-	314.50
14	PAL Express Airlines	1	25.11.2018	644	235	106	17	346	124	245.33
15	AtlasGlobal Airlines	1	25.11.2018	170	218	-	-	163	274	206.25
16	AirAsia	0	18.02.2019	77	118	-	790	1129	34	429.60
17	Norwegian Airlines	0	16.02.2019	26	106	-	15.33	30	20	39.47
18	EasyJet Airlines	0	16.02.2019	92	14		8.5	11.66	15	28.23
19	Jetstar Airways	0	18.02.2019	42	100	100	143	62	104	91.83
20	WestJet Airlines	0	18.02.2019	286	75	2	14.5	4	4	64.25
21	Garuda Indonesia Airlines	0	20.12.2018	897	682	1011	-	56	231	575.40
22	Hainan Airlines	0	23.12.2018	7	44	25	-	21	26	24.60
23	Bangkok Airways	0	23.12.2018	740	30	-	31	14	-	203.75
24	Virgin Australia Airlines	0	20.02.2019	116	-	-	27	33	26	50.50
25	WestJet Airlines	0	01.01.2019	287	1	1	14.5	4	2	51.58
26	IndiGo Airlines	0	19.02.2019	509	611	-	60	59	175	282.80

Test	Airline Name	Code Base Used for Test (Source Code or URL = 1, Browser Rendered Html = 0)	When Html is Retreived & Tested	Homepage	Availability	Availability Summary	Extra Services	Profile	Payment	Mean_Booking Flow
27	LATAM Airlines	0	19.02.2019	105	107	-	15	75	28	66.00
28	Ryanair	0	19.02.2019	84	19	14	114.66	49	-	56.13
29	Air Nostrum	0	19.02.2019	31	64.5	101	1	101	26	54.08
30	Aeromexico Airlines	0	19.02.2019	19	4	-	13	11	17	12.80
31	Aeromexico Airlines	1	19.02.2019	3	3	-	3	3	3	3.00

APPENDIX E

SPEARMAN RHO TEST AMONG ORDINAL AND CONTINUOUS VARIABLES

Correlations

			Skytrax_Rank	Number_of_Pax	Revenue	Profit	Fleet_Size	Homepage	Profile	Mean_Booking_Flow
Spearman's rho	Skytrax_Rank	Correlation Coefficient	1.000	-.308	-.636**	-.427*	-.387*	.165	.315	.192
		Sig. (2-tailed)		.110	.000	.023	.042	.402	.103	.327
		N	28	28	28	28	28	28	28	28
	Number_of_Pax	Correlation Coefficient	-.308	1.000	.681**	.725**	.907**	-.198	-.154	-.151
		Sig. (2-tailed)	.110		.000	.000	.000	.312	.433	.443
		N	28	28	28	28	28	28	28	28
	Revenue	Correlation Coefficient	-.636**	.681**	1.000	.821**	.768**	-.387*	-.512**	-.482**
		Sig. (2-tailed)	.000	.000		.000	.000	.042	.005	.009
		N	28	28	28	28	28	28	28	28
	Profit	Correlation Coefficient	-.427*	.725**	.821**	1.000	.744**	-.366	-.398*	-.363
		Sig. (2-tailed)	.023	.000	.000		.000	.055	.036	.057
		N	28	28	28	28	28	28	28	28

Fleet_Size	Correlation Coefficient	-.387*	.907**	.768**	.744**	1.000	-.102	-.213	-.167
	Sig. (2-tailed)	.042	.000	.000	.000		.604	.276	.396
	N	28	28	28	28	28	28	28	28
Homepage	Correlation Coefficient	.165	-.198	-.387*	-.366	-.102	1.000	.553**	.837**
	Sig. (2-tailed)	.402	.312	.042	.055	.604		.002	.000
	N	28	28	28	28	28	28	28	28
Profile	Correlation Coefficient	.315	-.154	-.512**	-.398*	-.213	.553**	1.000	.835**
	Sig. (2-tailed)	.103	.433	.005	.036	.276	.002		.000
	N	28	28	28	28	28	28	28	28
Mean_Booking_Flow	Correlation Coefficient	.192	-.151	-.482**	-.363	-.167	.837**	.835**	1.000
	Sig. (2-tailed)	.327	.443	.009	.057	.396	.000	.000	
	N	28	28	28	28	28	28	28	28

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

REFERENCES

Abu Shawar, B. (2015). Evaluating web accessibility of educational websites. *International Journal of Emerging Technologies in Learning (iJET), 10*(4), 4-10. doi:10.3991/ijet.v10i4.4518

Acar, A. Z., & Karabulak, S. (2015). Competition between full service network carriers and low cost carriers in Turkish airline market. *Procedia-Social and Behavioral Sciences*, 207, 642-651.

Achecker (n.d.a). Web accessibility checker. Retrieved May 31, 2019, from https://achecker.ca/documentation/index.php?p=checker/index.php

Achecker (n.d.b). Checks. Retrieved May 31, 2019, from https://achecker.ca/guideline/view_guideline.php?id=8

Air Nostrum (2019). Air Nostrum fleet details and history. Retrieved February 20, 2019, from https://www.planespotters.net/airline/Air-Nostrum

Aizpurua, A., Arrue, M., & Vigo, M. (2015). Prejudices, memories, expectations and confidence influence experienced accessibility on the Web. *Computers in Human Behavior, 51*, 152-160.

Akram, M., & Sulaiman, R. B. (2017). A systematic literature review to determine the web accessibility issues in Saudi Arabian University and government websites for disable people. *International Journal of Advanced Computer Science and Applications, 8*(6). doi:10.14569/ijacsa.2017.080642

Amadeus (2018). Good business growth. Retrieved March 4, 2019, from https://corporate.amadeus.com/documents/en/investors/2018/cnmv-and-other-regulations/h1-2018-results-press-release.pdf

Apostolou, G., & Economides, A. A. (2008, September). Airlines websites evaluation around the world. In *World Summit on Knowledge Society* (pp. 611-617). Berlin, Heidelberg: Springer.

Bangkok Airways (2018). Bangkok Airways announces operating results of 2017 total net profit 846.4 million baht. (2018). Retrieved March 4, 2019, from https://www.bangkokair.com/press-release/view/Bangkok%20Airways%20announces%20Operating%20Results%20of%202017%20%20Total%20net%20profit%20846.4%20%20Million%20Baht

Berners-Lee, T. (n.d.). Accessibility. Retrieved May 31, 2019, from https://www.w3.org/standards/webdesign/accessibility

Bigham, J. P., Lin, I., & Savage, S. (2017, October). The effects of not knowing what you don't know on Web accessibility for blind Web users. In *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility* (pp. 101-109). ACM.

Brunsman-Johnson, C., Narayanan, S., Shebilske, W., Alakke, G., & Narakesari, S. (2011). Modeling web-based information seeking by users who are blind. *Disability and Rehabilitation: Assistive Technology, 6*(6), 511-525.

Burkholder, B. (2018, July 6). Javascript SEO: server side rendering vs. client side rendering [Web blog post]. Retrieved July 07, 2019, from https://medium.com/@benjburkholder/javascript-seo-server-side-rendering-vs-client-side-rendering-bc06b8ca2383

Capa (2017). Air Nostrum reports third consecutive year of profitability in 2016. Retrieved February 20, 2019, from https://centreforaviation.com/news/air-nostrum-reports-third-consecutive-year-of-profitability-in-2016-670260

Convention on the Rights of Persons with Disabilities (2007, March 30). 2515 U.N.T.S. Retrieved July 07, 2019 from https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-15&chapter=4

Current World Population (n.d.). Retrieved April 08, 2019, from http://www.worldometers.info/world-population/

Cyr, D. (2013). Website design, trust and culture: An eight country investigation. *Electronic Commerce Research and Applications, 12*(6), 373-385. doi:10.1016/j.elerap.2013.03.007

Department of Transportation (2018, November 16). Scandinavian airline system (SAS) fined for violating rules protecting air travelers with disabilities. Retrieved May 31, 2019, from https://www.transportation.gov/briefing-room/dot7418

Ethier, J., Hadaya, P., Talbot, J., & Cadieux, J. (2008). Interface design and emotions experienced on B2C Web sites: Empirical testing of a research model. *Computers in Human Behavior, 24*(6), 2771-2791. doi:10.1016/j.chb.2008.04.004

Ganguly, B., Dash, S. B., Cyr, D., & Head, M. (2010). The effects of website design on purchase intention in online shopping: the mediating role of trust and the moderating role of culture. *International Journal of Electronic Business, 8*(4-5), 302-330.

Hameed N. (2018). *Evaluation of the accessibility of websites of ministry of education of countries in the world*. (Unpublished master's thesis in English). Çankaya University, Ankara, Turkey.

Hanson, V. L., & Richards, J. T. (2013). Progress on website accessibility?. *ACM Transactions on the Web, 7*(1), 1-30. doi:10.1145/2435215.2435217

Hassouna, M. S., Sahari, N., & Ismail, A. (2017). University website accessibility for totally blind users. *Journal of ICT, 16*(1), 63-80.

IATA (n.d.a). About us. Retrieved May 31, 2019, from https://www.iata.org/about/Pages/index.aspx

IATA (n.d.b). Number of scheduled passengers boarded by the global airline industry from 2004 to 2019 (in millions). In *Statista - The Statistics Portal*. Retrieved May 19, 2019, from https://www.statista.com/statistics/564717/airline-industry-passenger-traffic-globally/

IATA (n.d.c). Revenue of commercial airlines worldwide from 2003 to 2019 (in billion U.S. dollars). In *Statista - The Statistics Portal*. Retrieved April 30, 2019, from https://www.statista.com/statistics/278372/revenue-of-commercial-airlines-worldwide/

IATA (n.d.d). Operating profit of commercial airlines worldwide from 2006 to 2019 (in billion U.S. dollars). In *Statista - The Statistics Portal*. Retrieved April 30, 2019, from https://www.statista.com/statistics/227242/operating-income-of-commercial-airlines-worldwide/

Interactive Accessibility (2015). Accessibility statistics. Retrieved April 8, 2019, from http://www.interactiveaccessibility.com/accessibility-statistics

Jetstar Airways (2019). Jetstar Airways fleet details and history. Retrieved March 4, 2019, from https://www.planespotters.net/airline/Jetstar-Airways/historicFleet?sort=dd&dir=desc

Kalkancı, I. (2009). *The accessibility and usability of the websites of Turkish universities* (Unpublished master's thesis in Turkish). Istanbul University, Istanbul, Turkey.

Kamis. (n.d.). The importance of accessibility. Retrieved May 31, 2019, from https://kamis.gov.tr/erisilebilirlik-neden-onemlidir/

Kearney, M., Boxhall, A., Gash, D., & Dodson, R. (2019). Accessibility. Retrieved April 18, 2019, from https://developers.google.com/web/fundamentals/accessibility/

Kim, H. N., Smith-Jackson, T. L., & Kleiner, B. M. (2013). Accessible haptic user interface design approach for users with visual impairments. *Universal Access in the Information Society, 13*(4), 415-437. doi:10.1007/s10209-013-0325-0

Kurt, S. (2011). The accessibility of university web sites: The case of Turkish universities. *Universal Access in the Information Society*, *10*(1), 101-110.

Lazar, J., Allen, A., Kleinman, J., & Malarkey, C. (2007). What frustrates screen reader users on the web: A study of 100 blind users. *International Journal of Human-Computer Interaction*, *22*(3), 247-269.

Lazar, J., Dudley-Sponaugle, A., & Greenidge, K. D. (2004). Improving web accessibility: A study of webmaster perceptions. *Computers in Human Behavior*, *20*(2), 269-288.

Lazar, J., Olalere, A., & Wentz, B. (2012). Investigating the accessibility and usability of job application web sites for blind users. *Journal of Usability Studies, 7*(2), 68–87.

Loureiro, J. R., Cagnin, M. I., & Paiva, D. M. (2015). Analysis of web accessibility in social networking services through blind users' perspective and an accessible prototype. *Computational Science and Its Applications -- ICCSA 2015 Lecture Notes in Computer Science*, 117-131. doi:10.1007/978-3-319-21413-9_9

Lubbe, B. (2007). The effect of Internet apprehension and website satisfaction on air travellers' adoption of an airlines website. *Journal of Air Transport Management, 13*(2), 75-80. doi:10.1016/j.jairtraman.2006.10.007

Mlynarczyk, G. (2012, July 26). 7 web accessibility myths. Retrieved May 31, 2019, from https://www.nomensa.com/blog/2012/7-web-accessibility-myths-2

Nondiscrimination on the Basis of Disability in Air Travel (2013). Retrieved July 07, 2019 from https://www.regulations.gov/document?D=DOT-OST-2011-0177-0111

Oppenheim, C., & Selby, K. (1999). Access to information on the world wide web for blind and visually impaired people. In *Aslib Proceedings, 51*(10), 335-345, doi:10.1108/EUM0000000006993

Petrie, H., Power, C. D., Swallow, D., Velasco, C. A., Gallagher, B., Magennis, M., ... & Down, K. (2011). The value chain for web accessibility: Challenges and opportunities. In *Proceedings of Accessible Design in the Digital World 2011*. University of York.

PhoCusWright. (n.d.). Online gross travel bookings revenue worldwide from 2011 to 2017 (in billion U.S. dollars). In *Statista - The Statistics Portal*. Retrieved April 9, 2019, from https://www.statista.com/statistics/238852/online-travel-bookings-worldwide/

Power, C., Freire, A., Petrie, H., & Swallow, D. (2012, May). Guidelines are only half of the story: Accessibility problems encountered by blind users on the web. In *Proceedings of the SIGCHI conference on human factors in computing systems*(pp. 433-442). ACM.

Qantas (2017). Qantas annual report. Retrieved March 4, 2019, from https://investor.qantas.com/FormBuilder/_Resource/_module/doLLG5ufYkCyEPjF1tpgyw/file/annual-reports/2017AnnualReport.pdf

Qantas Group (2017). Qantas group full year 2017 financial result. Retrieved March 4, 2019, from https://www.qantasnewsroom.com.au/media-releases/qantas-group-full-year-2017-financial-result/

Riley-Huff, D. A. (2012). Web accessibility and universal design. *Library Technology Reports*, *48*(7), 29-35.

Rømen, D., & Svanæs, D. (2012). Validating WCAG 1.0 and WCAG 2.0 through usability testing with disabled users. *Universal Access in the Information Society*, 11(4), 375-385.

Russia's S7 Airlines (2018). Russia's S7 Airlines sees net profit grow by 10.3 per cent in Q1 2018. Retrieved March 4, 2019, from https://docs.google.com/spreadsheets/d/1EwmrVJWMqBZImpBZe1ahIGBsKIZtP77VlYbSfPE_Hl4/edit#gid=1521556213

Ruth-Janneck, D. (2011, November). Experienced barriers in web applications and their comparison to the WCAG guidelines. In *Symposium of the Austrian HCI and Usability Engineering Group* (pp. 283-300). Springer, Berlin, Heidelberg.

Skytrax. (n.d.a). World's top 100 airlines 2018. Retrieved October 28, 2018, from https://www.worldairlineawards.com/worlds-top-100-airlines-2018/

Skytrax. (n.d.b). Pegasus airlines customer reviews. Retrieved May 31, 2019, from https://www.airlinequality.com/airline-reviews/pegasus-airlines/

Shon, Z., Chen, F., & Chang, Y. (2003). Airline e-commerce: The revolution in ticketing channels. *Journal of Air Transport Management, 9*(5), 326. doi:10.1016/s0969-6997(03)00040-1

Sohaib, O., & Kang, K. (2017). E-commerce web accessibility for people with disabilities. *Complexity in Information Systems Development Lecture Notes in Information Systems and Organisation,* 87-100. doi:10.1007/978-3-319-52593-8_6

Statista. (n.d.). Share of global airline passenger revenue in 2017, by sales channel and carrier type. In *Statista - The Statistics Portal.* Retrieved April 27, 2019, from https://www.statista.com/statistics/889461/airline-travel-passenger-revenue-by-sales-channel-worldwide/

Tsaran, V. (2019). Accessibility. Retrieved May 31, 2019, from https://developers.google.com/web/fundamentals/accessibility/

Toh, R. S., & Raven, P. (2003). Perishable asset revenue management: Integrated Internet marketing strategies for the airlines. *Transportation Journal*, 32-33.

Total Number of Websites (n.d.). Retrieved April 08, 2019, from http://www.internetlivestats.com/total-number-of-websites/

Turkish Banking Regulation and Supervision Agency (2016). Regulation about accessibility of banking services. Retrieved May 31, 2019, from http://www.resmigazete.gov.tr/eskiler/2016/06/20160618-2.htm

Turkish E-Government. (2019). About the certificate. Retrieved May 31, 2019, from https://www.turkiye.gov.tr/bilgilendirme?konu=sertifika

Vanderheiden, G. C., & Chisholm, W. A. (1996). Design of HTML pages to increase their accessibility to users with disabilities: Strategies for today and tomorrow. *ACM SIGWEB Newsletter, 5*(1), 9-20. doi:10.1145/232782.232786

We Are Social, DataReportal, & Hootsuite. (n.d.). Global digital population as of January 2019 (in millions). In *Statista - The Statistics Portal*. Retrieved April 9, 2019, from https://www.statista.com/statistics/617136/digital-population-worldwide/

Web Accessibility Initiative. (n.d.). Non-text content: Understanding SC 1.1.1. Retrieved May 31, 2019, from: https://www.w3.org/TR/UNDERSTANDING-WCAG20/text-equiv-all.html

Web Accessibility Initiative. (2005). Introduction to web accessibility. Retrieved May 31, 2019, from: https://www.w3.org/WAI/intro/accessibility.php

Web Accessibility Initiative (2008). Web content accessibility guidelines 2.0. Retrieved May 31, 2019, from http://www.w3.org/TR/WCAG20/

Web Accessibility Initiative. (2015, September 24). Authoring tool accessibility guidelines (ATAG) overview. Retrieved May 31, 2019, from https://www.w3.org/WAI/standards-guidelines/atag/

Web Accessibility Initiative. (2016a, May). User agent accessibility guidelines (UAAG) overview. Retrieved May 31, 2019, from https://www.w3.org/WAI/standards-guidelines/uaag/

Web Accessibility Initiative. (2016b). Web accessibility evaluation tools list. Retrieved May 31, 2019, from https://www.w3.org/WAI/ER/tools/?q=online-tool&q=generating-reports-of-evaluation-results

Web Accessibility Initiative. (2017, May). Tools and techniques. Retrieved May 31, 2019, from https://www.w3.org/WAI/people-use-web/tools-techniques/

Web Accessibility Initiative. (2018a). Web content accessibility guidelines (WCAG) overview. Retrieved May 31, 2019, from https://www.w3.org/WAI/standards-guidelines/wcag/

Web Accessibility Initiative. (2018b). Web content accessibility guidelines (WCAG) 2.1. Retrieved May 31, 2019, from: https://www.w3.org/TR/WCAG21/

Web Accessibility Initiative. (2019a). Accessibility principles. Retrieved May 31, 2019, from https://www.w3.org/WAI/fundamentals/accessibility-principles/

Web Accessibility Initiative. (2019b). How to meet WCAG 2 (Quick Reference). Retrieved May 31, 2019, from https://www.w3.org/WAI/WCAG21/quickref/?currentsidebar=%23col_customize&versions=2.0

Williams, S. (Ed.). (n.d.). Accessibility. Retrieved May 31, 2019, from http://www.exeter.ac.uk/staff/web/accessibility/

World Health Organization (2018). Blindness and vision impairment. Retrieved April 09, 2019, from https://www.who.int/en/news-room/fact-sheets/detail/blindness-and-visual-impairment

World Travel Market (n.d.) Change in air travel online sales value worldwide from 2013 to 2015. Retrieved April 9, 2019, from www.statista.com/statistics/493537/change-in-online-air-travel-sales-value-worldwide/

Yoon, K., Dols, R., Hulscher, L., & Newberry, T. (2016). An exploratory study of library website accessibility for visually impaired users. *Library & Information Science Research, 38*(3), 250-258. doi:10.1016/j.lisr.2016.08.006

Young, J. (n.d.). Global e-commerce sales grow 18% in 2018. Retrieved April 08, 2019, from https://www.digitalcommerce360.com/article/global-ecommerce-sales/