

**Czech University of Life Sciences Prague**

**Faculty of Economics and Management**

**Department of Information Technologies**



**Bachelor Thesis**

**E-Government Website Comparison**

**Benyamin Keymanesh**

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

## BACHELOR THESIS ASSIGNMENT

Benyamin Keymanesh

Systems Engineering and Informatics  
Informatics

Thesis title

**E-Governments Website Comparison**

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### Objectives of thesis

The main objective is to analyze, evaluate and compare selected e-government websites. The partial objectives of the thesis are:

- Literature review regarding the topics of e-government, website analysis, website comparison and multiple criteria decision analysis
- Define a set of criteria for the comparison of different e-government websites
- Evaluate and compare chosen e-government websites based on defined criteria using multiple criteria decision analysis
- Formulate thesis conclusions based on the e-government website evaluation and comparison

### Methodology

The methodology of the theoretical part consists in the review of available literature and online resources. Based on the knowledge obtained in the theoretical part, a set of evaluation and comparison criteria will be proposed for the practical part. The methodology of the practical part will utilize MCDA (multiple criteria decision analysis) to compare selected e-government websites based on the proposed criteria. Final conclusions will be formulated based on both parts of the thesis.

**The proposed extent of the thesis**

40-50

**Keywords**

e-government, MCDA, website evaluation, website comparison

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- Figueira, J., Greco, S., & Ehrgott, M. (2005). Multiple Criteria Decision Analysis: State of the Art Surveys. Boston, U.S.A.: Springer Science + Business Media, Inc.
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- United Nations. (2020). E-Government Survey 2020 – Digital Government in the Decade of Action for Sustainable Development (With addendum on COVID-19 Response). United Nations – Department of Economic and Social Affairs.
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## **Declaration**

I declare that I have worked on my bachelor thesis titled "E-Government Websites Comparison" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 29.11.2021

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I would like to thank my supervisor, Ing. Jan Pavlík, for all the work and guidance he provided me throughout the completion of this thesis.

In addition, I would like to thank my family and my partner in supporting me during the preparation of this thesis.

# **E-Government Website Comparison**

## **Abstract**

The aim of this bachelor thesis is to evaluate and analyze selected e-government websites with applying Multi Criteria Decision Analysis. This work is intended to rank selected e-government websites based on Weighted Sum Model. Thesis itself will consist of two parts: theoretical background and practical work.

In the theoretical part of this thesis, the concept of e-government, Multi Criteria Decision Analysis, and different models of website qualities will be thoroughly described. Furthermore, in the practical part, selected e-government will be introduced, criteria will be defined and justified based on own preference. Lastly, using the above-mentioned method, the calculation will be explained and evaluated in form of various tables.

Based on both parts of this thesis, results and discussions will be provided to the reader. At the final part, conclusion will be made accordingly.

**Keywords:** e-government, MCDA, website evaluation, website comparison

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## List of Abbreviations

CLS	Cumulative Layout Shift
COVID19	Corona Virus Disease 2019
EDPB	The European Data Protection Board
EU	European Union
FCP	First Contentful Paint
FID	First Input Delay
G2B	Government to Business
G2C	Government to Citizen (Consumer)
G2E	Government to Employee
G2G	Government to Government
ICT	Information and Communication Technology
IEC	International Electro-technical Commission
ISO	International Organization for Standardization
LCP	Largest Contentful Paint
MCDA	Multi Criteria Decision Analysis
PDA	Personal Digital Assistant
PEPP-PT	Pan-European Privacy-Preserving Proximity Tracing
QM	Quality Model
SDG	Sustainable Development Goals
SI	Speed Index
TBT	Total Blocking Time
TTI	Time to Interactive
UN DESA	United Nations Department of Economic and Social Affairs
W3C	World Wide Web Consortium
WCAG	Web Content Accessibility Guidelines
WHO	World Health Organization
WLAN	Wireless Local Area Network
WSM	Weighted Sum Model

# 1 Introduction

Electronic government or e-government has had an enormous impact on all the countries all over the world. E-government is not just a movement that has risen in one particular country, but it is truly a global phenomenon, impacting both developing and developed nations. In some degree, e-government has influenced countries on all corners of the earth. The discussion of e-government is not only about implying that websites are the only way for its remark, but many new technologies have emerged and became a part of this e-government movement such as wireless and new social media technologies. Many opted for e-government to be revolutionary and promise to change both the nature of government functions and the course the citizens reach out to their government.

My passion towards statistics and mathematics gave me the idea of comparing selected e-government websites with a method commonly used in information technology. The focus of this thesis is on the review of the usage of Multi Criteria Decision Analysis in website comparison and evaluation.

Multi Criteria Decision Analysis involves evaluating real-world situations by applying criteria in certain aspects and finding a suitable course of action to solve it. It is extensively applicable in website evaluation from a quality and usability point of view.

The topic of e-government will be discussed in depth with defining a set of criteria for evaluating e-government websites based on own justification to show Multi Criteria Decision Analysis utilization from information technology perspective. Furthermore, I will be pinpointing the flaws and shortcoming of Czech e-government website on par with the other selected e-government websites.

## **2 Objectives and Methodology**

### **2.1 Objectives**

The main objective is to analyze, evaluate and compare selected e-government websites. The partial objectives of the thesis are:

- Literature review regarding the topics of e-government, website analysis, website comparison and multiple criteria decision analysis
- Define a set of criteria for the comparison of different e-government websites
- Evaluate and compare chosen e-government websites based on defined criteria using multiple criteria decision analysis
- Formulate thesis conclusions based on the e-government website evaluation and comparison

### **2.2 Methodology**

The methodology of the theoretical part consists in the review of available literature and online resources. Based on the knowledge obtained in the theoretical part, a set of evaluation and comparison criteria will be proposed for the practical part. The methodology of the practical part will utilize MCDA (multiple criteria decision analysis) to compare selected e-government websites based on the proposed criteria. Final conclusions will be formulated based on both parts of the thesis.

## **3 Literature Review**

### **3.1 E-Government**

E-government (Electronic Government) is the usage of information and communication technologies, especially the Internet, in government. Additionally, the central E-Governance is to manufacture more efficient, accessible, and convenient government services.

Overcoming the boundaries is one of the biggest and most important usages of e-governance. Not only is to replace traditional paper-based system but also it is an enhancement to the current government. (United Nations, 2020)

#### **3.1.1 E-Government Definitions**

Beyond this simple explanation, e-government definition can be more difficult than that. This phenomenon is under constant state of evolution and there is indefinite number of national interpretations to this term. Although, it is undoubtedly crossed borders with ease, making it one of the most intriguing and fastest-spreading public sector reform ideas in history.

Information and communication technology usage in government were first introduced during 1950s and '60s. the zenith of ideas of scientific administration. It was United States President Bill Clinton introduced the 1993 National Performance Review of the federal bureaucracy. But it was the explosion of Internet usage in the mid 1990's that gave the incentive to the idea and countries such as United Kingdom, Australia, New Zealand and Canada implemented their own versions. In 1997, the United Kingdom the Labour Party put electronic service delivery at their heart of their program called Modernizing Government. (Chadwick, 2013)

Unsurprisingly, there is not one unique definition to e-government. But this definition from the World Bank that does the meaning justice: "The use by government agencies of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions." (The World Bank, 2015)

Maybe the biggest reason why it is mostly preferred is that it defines e-government in a very concisely and easiest way possible along with describing how e-government is utilized in simple words.

United Nations has given a slight brief definition to e-government: “E-government is defined as utilizing the Internet and the world-wide-web for delivering government information and services to citizens.” (United Nations, 2021)

E-governments are in the first stages of development. Most governments have already taken initiatives, offering online government services. E-government is not only the process of transferring existing government sectors to an electronic platform. But it cries for reassessing the way government functions are executed nowadays to improve services and introduce some new ones. The range of services provided by e-governments are from just a simple information-based website to fully fletched interactive experience where the government and the user can engage through information technology.

Information kiosks, automated telephone information services, internal information systems of government agencies and other systems are all constituted e-government services. All of these are application of Information and Communication Technologies (ICT) to develop such services towards its main client: the consumers.

Over the past few years, there has been talk and rumors about m-government (mobile government) which refers to wireless usage technologies such as cellular, personal digital assistants (PDA) for delivering government services. But one must note that m-government should not be a substitute to e-government, but it complements it.

### **3.1.2 E-Government Taxonomy**

An e-government can be segregated to different criteria according to its reach, audience and last but certainly not least, delivery mechanism.

#### **Reach**

E-government are divided in the following five specific levels:

- International

- National
- Regional
- State
- Local

## **Audience**

To conceptualize e-government, there are four spheres of technologically mediated interactions to distinguish.

### 1. Government-to-Citizen (G2C)

The Government-to-Citizen refers to the interactions involving the Internet to provide public services, online transactions, design improvement and quick deliverance of services by integrating various rapid electronic feedback mechanisms like web surveys or instant polls. In addition, providing facilities and support to public in order to reduce the cost and time to operate a transaction. These services are to be accessed by anyone, anytime from anywhere.

Some of the online services provided are:

- File income taxes
- Pay taxes
- Pay traffic tickets
- Change their address
- Make appointments for vehicle emission inspections
- Driving test arrangement
- Driver's license renewal

Additionally, a government could potentially offer:

- Downloadable online forms
- Assistance in finding employment
- Touristic/recreational information
- Health advices and benefits
- Natural disaster compensation electronically

## 2. Government-to-Business (G2B)

The Government-to-Business refers to the interactions involving the Internet to provide services from or to firms and reduce the costs to government for buying and selling goods. This is bidirectional approach: G2B and Business-to-Government (B2G). These exchanges of services are efficient to both business organizations and government. B2G is selling products and offering services to the government. G2B administers access to proper and related forms needed to submit so that business could attend to their business matter in proper time manner. It also plays an integral role in business development for the enhancement of efficiency, transparency of government projects and quality of communication. eProcurement is one of the important G2B areas which is a reverse auction of government surpluses.

## 3. Government-to-Government (G2G)

The Government-to-Government refers to the interactions and communications between different organizations and government departments with the usage of technologies to maximize the internal efficiency. G2G allows various government agencies to share and access the same database by online communication, granting them the opportunity of working together. Ever increasing international diplomacy is one of the biggest strengths in G2G. These services can also be at local level. InteLink is a brilliant example that an intranet carries classified information between different intelligence agencies.

## 4. Government-to-Employee (G2E)

Most academic researchers have failed to properly introduce G2E services as the fourth part of the interaction of the e-government. Usually, G2E is included as part of G2G block or failed to be mentioned at all. G2E solution is about empowering their own employees to assist citizens in the fastest and most appropriate way, speed-up administrative processes, and optimize governmental solutions.

### **Delivery mechanism**

Internet is not the only way that e-government services can be provided. In fact, studies and reports indicate that there are other means for carrying out of eGovernment services For example:



- Telephony dominates channel usage in some situations: Accenture reports 63% of industrialized country respondents contacting government by telephone; compared to 31% using the Internet over a 12-month period. (Irani, et al., 2008)
- In-person visits dominate in other situations: an Australian survey reports half of government contacts to be face-to-face compared to one-fifth undertaken via the Internet. (Irani, et al., 2008)
- Survey data also reflects an ongoing preference for telephone or in-person channels especially for transactional, problem-solving, urgent and complex interactions. (Irani, et al., 2008)

### **Multichannel Examples**

Some Governments have embraced this reality and adopted a multichannel approach to the services they offer. For Example:

- In Malta, citizens can access their personal social security records and payments via the internet, and may also opt to be notified about their social security payments via SMS rather than receiving printed payment advice by post. However, the most innovative initiative is the introduction of eGovernment Agents that act as intermediaries to those without access. (European Commission, et al., 2007)
- In Austria, all websites that belong to the gv.at domain are available free of charge or connection fees via wireless hotspots (WLAN), and via public kiosks, thanks to an excellent cooperation between the Austrian Government and two major telecommunication providers. Similar to Malta, Austria also has legislation in place allowing officials to act as intermediaries for citizens who do not have online access or a citizen. (European Commission, et al., 2007)
- In Spain, 060 is the magic code providing a single access point. Many services provided by different administrations can be accessed via the 060 network, whether they are office-, internet-, or phone-based. Citizens can access the network's 2800 points of presence in the street or their office on the web, by the phone (060) or SMS. The 060 phone number is intended to replace over 1000 phone numbers available for citizens to access information of the General Administration of the State. The network is available 24/7 and currently offers 1225 national, regional and local public services. It is worth

noting that In August 2007, only 15 months after its creation, the citizen information phoneline 060 had already dealt with 700000 enquiries. (European Commission, et al., 2007)

## **3.2 Evolution Stages of E-Government**

In addition to classifying e-government taxonomy, starting any project undergoes several stages based on their level of development. Some argue that one of the overall themes of e-government is to perfectly comprehend the capabilities of available information technology to change government from agency-centric, limited-service operation into an automated, citizen-centric operation capable of delivering government services to citizens, businesses, and other government agencies 24 hours a day, seven days a week. (Seifert, 2003)

However, for various reasons, from technical to political and economic reasons, these changes will take time to evolve into their full potential. That is why, some observers use a common schema for classification of the stages of e-government evolution. The schema is based on the level to which extent of information technology have been used to enable the delivery of services electronically.

There are 4 stages of evolution of presence, interaction, transaction, and transformation. It is essential to note that an e-government initiative or project can skip levels and it does not necessarily need to start from the first stage.

### **3.2.1 Presence**

Presence is the first stage of the evolution and is the inauguration of a placeholder for future delivering information. It serves as the least expensive and simplest way into e-government but on the other hand it represents narrower options. A typical example is a basic Web site that lists cursory information about an agency, such as hours of operation, mailing address, and/or phone numbers, but has no interactive capabilities. It is a passive presentation of general information. Some observers refer to these types of sites as ‘brochureware,’ suggesting they are the electronic equivalent of a paper brochure. (Seifert, 2003)

### **3.2.2 Interaction**

The second is called the interaction, which are relatively simple and commonly rotates around information provision. Interactive Web-based projects and initiatives provide enhanced

capabilities, but it is still limited in their ability streamline and automate government functions. These sorts of initiatives are designed to help the consumer with avoiding a trip to an office or making a phone call through having the desired information and forms available around the clock. These options include instructions for accessing services, downloadable forms to be printed or email contacts to respond back and forth.

### **3.2.3 Transaction**

The third stage in evolution of e-government stages in transaction, which is needed for more complex than simple information provision and illustrates different types of activities popularly associated with e-government. This will allow the consumers to complete entire task electronically no matter at which time of the day. These initiatives effectively create self-service operations for tasks such as license renewals, paying taxes and fees, and submitting bids for procurement contracts. Although the level of interactivity is of a higher magnitude than second stage initiatives, the activities still involve a flow of information that is primarily one-way (either to government or to the client, depending on the activity). The electronic responses are generally highly regularized and create predictable outcomes (e.g., approving a license renewal, creating a receipt, acknowledging a bid). (Seifert, 2003)

### **3.2.4 Transformation**

The peak of the evolution stage is transformation, which projects utilize their full capabilities and abilities of the technology to transform how government functions are perceived, accomplished, formulated, and executed. At this level, initiatives would have the booming consumer relationship with managing various types of services. One of the characteristics of these initiatives is that they simplify flow of information seamlessly between federal, state, local and public partners. To put it on another way, transformative e-government initiatives often seek to remove the organizational barriers that promote agency-centric solutions and, instead, promote customer-centric solutions. Some advocates suggest that, at its most advanced level, e-government could potentially reorganize, combine, and/or eliminate existing agencies and replace them with virtual organizations. (Seifert, 2003)

### **3.3 E-Government Outcomes**

According to the public value hypothesis, the government is responsible for providing public services and creating public value. Achieving both tangible and intangible goals are component of developing public value. (Moore, 1995)

The government's tangible goals, according to public administration literature, include economic gains to meet administrative and political objectives; meanwhile, intangible goals include efficiency in service delivery to ensure social inclusion, trust development, and so on. (Chircu, 2008) (Andersson & Twezimimana, 2019). We argue that e-government has the potential to improve the efficiency of government administration through automation and the delivery of tangible outcomes such as cost advantage, time advantage, and efficiency, based on public value theory. (Alford & O'flynn, 2009). E-government not only delivers tangible outcomes like citizen happiness and trust in government, but it also gives intangible outcomes like efficiency and openness.

#### **3.3.1 Tangible outcomes**

##### **Cost advantage**

Cost advantage in the context of e-government refers to the government's capacity to reduce the cost of delivering public services through the use of information technology and automation. Administrative expenditures, labour costs, procurement prices, and other operational costs are predicted to be reduced as a result of e-government. (Karunasena, Deng, & Mohini, 2011) (Evans & Yen, 2006) (Moon, 2002)

E-government helps save money by integrating multiple decision-making units, centralizing decisions like procurement, and reducing redundant activities (Evans & Yen, 2006). This is especially true for hyper-integrated and evolutionary e-government initiatives.

## **Time advantage**

The potential of an e-government initiative to achieve efficiency through time compression, which can then be explicitly assessed in monetary value, is known as time advantage. A fully integrated e-government platform has the ability to use artificial intelligence to automate procedures and eliminate the need for human interaction. (Fagan & Condit, 2001). Accounting, record keeping, and information retrieval are just a few of the tasks that may be accomplished quickly, therefore saving a lot of time.

Digitisation of government services allows citizens to access services 24 hours a day, seven days a week, resulting in time savings for both service providers and end-users. The time saved by service providers and users can subsequently be put to better use in other productive activities, resulting in cost savings. As a result, citizen-centric and integrated e-government projects save governments and their stakeholders a significant amount of time.

## **Efficiency**

Efficiency in the context of e-government is defined as the government's ability to eliminate resource waste while continuing to provide similar or improved services to its consumers. Efficiency in the delivery of public services is one of the primary strategic goals of e-government. (Chircu, 2008) (Moore, 1995)

### **3.3.2 Intangible outcomes**

#### **Citizen satisfaction**

Citizen satisfaction is defined in the context of e-government as citizens' overall evaluation of the e-government system's performance based on their experiences with the quality of e-government services at various touchpoints. The public value framework focuses on increasing citizen satisfaction as a key result of e-government implementation. (Heeks, 2008)

A well-designed e-government system has the potential to improve the quality and ease of government-citizen engagement, resulting in higher levels of citizen satisfaction. (Evans & Yen, 2006) Citizen satisfaction not only accelerates e-government adoption, but it also boosts trust in government, which strengthens e-government adoption even more.

### **Trust in e-government**

The essential goal of e-government, we say, is to restore citizens' faith in the governing system and in the government itself. As a result, we suggest government trust as a key intangible result of well-designed e-government. We define citizen trust in e-government as citizens' perceptions of the transparency and accountability of e-government delivery. (Bannister & Connolly, 2011). Citizens' relationships with the government are considerably improved by e-government, which increases citizens' trust in both e-government and government in general.

Though e-government is likely to produce both tangible and intangible benefits, the government's major goal when adopting e-government projects should be to improve governance efficiency and generate quantifiable benefits, such as cost and time savings. These tangible results are the result of government efforts to integrate numerous agencies, improve operational efficiency, and eliminate redundant tasks, all of which help to promote intangible outcomes like citizen pleasure and faith in government.

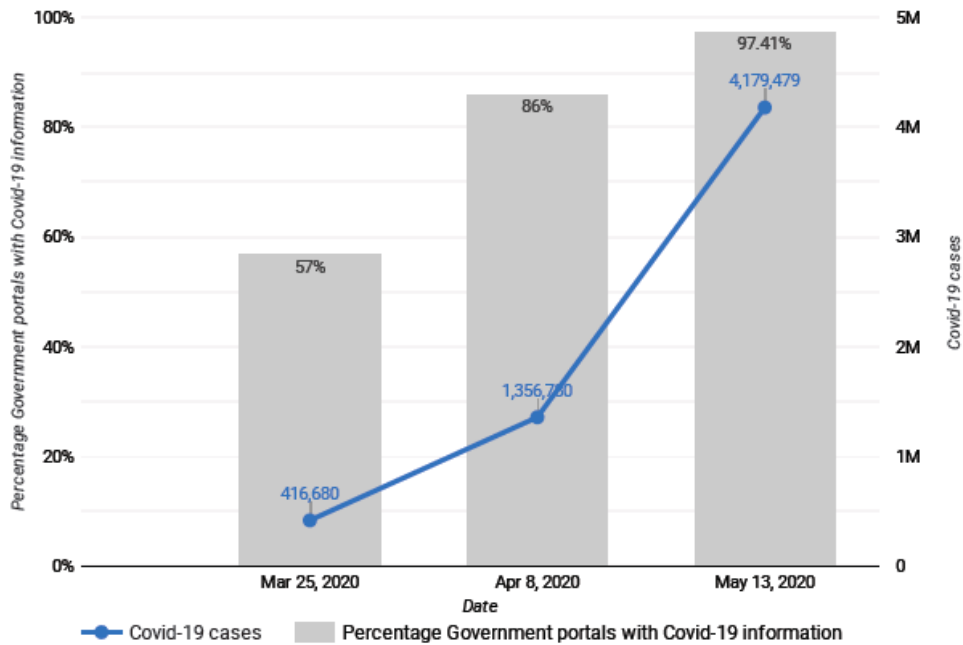
### **3.4 E-government during COVID-19 pandemic**

During the COVID-19 epidemic, e-government has taken a more prominent role as a crucial component of communication, leadership, and collaboration between policymakers and society. Digital technologies have permitted greater knowledge sharing, promoting collaborative study to develop solutions and providing clear instructions to governments and citizens. The same technology has also been used to rapidly disseminate fraudulent or dubious information, raising privacy and security problems. Policymakers have been urged to collect and process COVID-19-related data in a manner that is ethical, transparent, safe, interoperable, and secure, protecting individuals' privacy and data security. However, the advantages of adopting technology appear to have surpassed the disadvantages.

During the COVID-19 epidemic, digital government offices underwent significant digital change as well. In less than two weeks after UN DESA issued a quick call for submissions, government authorities from all across the world shared approximately 500 COVID-19-related applications. Policymakers must embrace technology even more in the future to help accomplish the Sustainable Development Goals (SDGs). After the COVID-19 incident, efforts to establish digital government strategies should focus on increasing data protection and global digital inclusion policies, as well as strengthening public institutions' policy and technical capabilities.

During the current COVID-19 crisis, information and communication technologies (ICTs) are critical to people's health and safety, as well as the functioning of economies and society. During the outbreak, digital government technology kept governments and citizens linked, whether through information sharing or the delivery of online services. For example, these technologies have aided governments in enforcing stay-at-home policies by obtaining movement permits from citizens via text messages, web applications, or platforms.

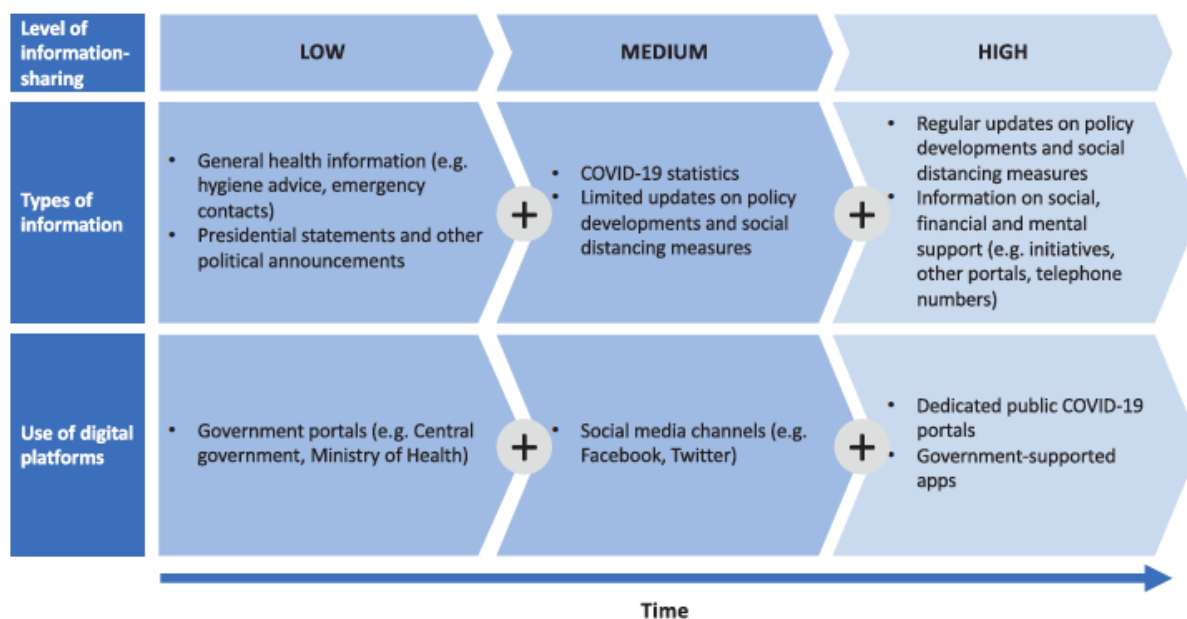
Governments have also been able to make quick policy decisions based on real-time data and analytics, allowing national and local governments to better coordinate and provide evidence-based services to people who need them the most. During the COVID-19 epidemic, the fundamental need for accurate, meaningful, and up-to-date information provided by governments was accentuated. Only 57 percent (110 nations) of the 193 United Nations Member States had placed information on COVID-19 in place by March 25, 2020, according to an examination of their national portals. By April 8, 2020, approximately 86 percent of countries (167 countries) had provided such information and guidance. Finally, on May 13, over 97.5 percent (188 nations) of national portals had information regarding COVID-19. (United Nations, 2020)



**Figure 1: Percentage of Government portals with Covid-19 information and world total, Source: United Nations Survey, 2020**

Governments improved their level of information sharing as the COVID-19 outbreak spread (see Figure 2). According to portal study data, countries in March 2020 concentrated on delivering fundamental information such as general health precautions and emergency numbers, as well as public announcements on national portals (low level). As the crisis worsened, governments expanded their reach and began using more social media outlets to report on COVID-19 statistics (such as total number of cases in a country, total fatalities, and reporting instances by jurisdictions), as well as providing some limited national policy updates (medium level). More governments began offering regular updates on policy developments and information on where citizens might get social, financial, or mental health help later in the crisis (high level).





**Figure 2: Different levels of -government information-sharing during COVID-19, Source: United Nations Survey, 2020.**

To centralize information, several governments have begun to use specific COVID-19 portals. Other governments, on the other hand, have elected to keep using their national government portals to disseminate significant information on platforms that are already recognized by the public. As part of the COVID-19 pandemic response, policymakers were asked to participate in the development of new services and apps. Some of these new services and apps went beyond information exchange to provide food and other necessities to those in need, thereby improving the entire supply chain through digital government services. Policymakers used several digital communication channels and increased information sharing by offering up-to-date public data, according to an analysis of government portals conducted during COVID-19. Governments are in charge of determining which channels are best suitable for reaching a broad audience and providing accurate and timely information on the platforms chosen.

During a national crisis, trustworthy and accurate information allows governments to act quickly, assisting citizens in making informed decisions about their everyday lives and providing a sense of support, all of which contributes to public trust. Simultaneously, as online information sharing has increased, a flood of fake news, disinformation, and viral hoaxes has emerged. People with ulterior motives or limited understanding have contributed to the circulation of inaccurate data and information, causing further concern in society. Thousands

of COVID-19 fraud and malware sites pop up on a daily basis, selling bogus surgical masks and self-testing kits, for example. This is classified as a secondary concern of a "infodemic" by the World Health Organization (WHO): "an overabundance of information — some accurate, some not — that makes it difficult for individuals to access trustworthy sources and solid counsel when they need it." (World Health Organization, 2020) Some governments have responded by forming teams or launching campaigns to coordinate the battle against COVID-19 online falsehoods. (United Nations, 2020)

### **3.4.1 Regional and Local Cooperation**

#### **Regional**

Several new projects for regional digital cooperation emerged during the COVID-19 crisis, including digital connection, data governance, e-learning, technology resilience, and digitization of public service delivery. These regional projects attempt to assist Member States in responding to the crisis using e-government. Regional organizations should look into how technology may be used to equip governments and their citizens with the tools they need to deal with the medical and socioeconomic issues that the COVID-19 pandemic has posed.

Policymakers in the European Union (EU) recognized the relevance of contact tracing apps in the fight against the epidemic. They also understood that, as a result of the EU's internal market, countries must collaborate closely to flatten the COVID-19 curve. As a result, an international group of scientists, academics, technology experts, and businesses has been working on the Pan-European Privacy-Preserving Proximity Tracing (PEPP-PT) project, which aims to create a standardized smartphone data processing tool that will allow for coordinated contact tracing across Europe and beyond. The PEPP-PT intends to improve the efficiency of European contact tracing apps while also reducing the possibility of intrusive location-tracking apps gaining traction during the crisis. In addition, on April 17, 2020, the European Commission issued recommendations on "Apps supporting the fight against the COVID 19 pandemic" in order to protect personal data while using contact tracking technologies. (PEPP-PT, 2020) (EUR-LEX,2020)

The European Data Protection Board (EDPB) published rules on the use of location data and contact tracking tools in the context of the COVID-19 epidemic, following the European Commission's lead. In addition to the PEPP-PT project, the EU's detailed COVID-19 data privacy guidance demonstrates how a region might coordinate a portion of its digital response to solve the issue while preserving data privacy. (European Data Protection Board, 2020)

COVID-19 should not only be viewed as a sequence of national health crises, but also as a regional and worldwide economic and social catastrophe that requires a well-coordinated response, as evidenced by the aforementioned initiatives.

## **Local**

During the pandemic, city portals offered information pointing individuals to central government COVID-19-related services. The urban emergency response relied heavily on the public sharing of COVID-19 data. At the local and state levels, dashboards were utilized to give transparent and reliable information, raise awareness, and connect individuals with available resources (home care for the elderly, first aid provision, etc.).

### **3.5 Multi-Criteria Decision Analysis (MCDA)**

A multi-criteria decision analysis is a decision-making analysis that assesses multiple criteria, leading to easier decision-making process. This analysis is utilized by everyone in their daily lives where humans make thousands and thousands of decisions daily. But this tool is specifically more visible in the corporate world, medical centers and for the sake of this thesis, government organs. Making decisions based on various criteria with the help of MCDA can clear the path in heavily structured and more complex problems when analysis is need to for the decisions to be more justifiable.

‘MCDM – if not a Roman numeral, then what?’ was the first article published by Stanley Zionts in 1979, it popularized the concept among his business audience. A comprehensive Multiple Criteria Decision Analysis (MCDA) draws knowledge from several different fields,

including mathematics, economics, information technology, software engineering, and other information systems.

### 3.5.1 Mathematical definition

Let  $A = \{A_i \text{ for } i = 1, 2, 3, \dots, n\}$  be a (finite) set of decision alternatives and  $G = \{g_j \text{ for } j = 1, 2, 3, \dots, m\}$  a (finite) set of goals according to which the desirability of an action is judged. Determine the optimal alternative  $A^*$  with the highest degree of desirability with respect to all relevant goals; (Triantaphyllou, 2000)

		<b>C r i t e r i a</b>				
		$C_1$	$C_2$	$C_3$	...	$C_n$
<b>Alts.</b>		( $w_1$ )	$w_2$	$w_3$	...	$w_n$ )
$A_1$		$a_{11}$	$a_{12}$	$a_{13}$	...	$a_{1n}$
$A_2$		$a_{21}$	$a_{22}$	$a_{23}$	...	$a_{2n}$
⋮		⋮	⋮	⋮	⋮	⋮
$A_m$		$a_{m1}$	$a_{m2}$	$a_{m3}$	...	$a_{mn}$

**Figure 3: Illustration of the criteria, (Triantaphyllou, 2000)**

There are three steps in using any decision-making technique involving numerical analysis of alternatives: 1) Determination of the applicable criteria and alternatives. 2) Attachment of numerical measures to the respective importance 3) Application of proper methods and processing the calculated numerical values for determining the rank. (Triantaphyllou, 2000)

## 3.6 The Weighted Sum Model

The weighted sum model (WSM) is the most common used among the analytics especially when it comes to single dimensional problems. The following expression is used for WSM method:

$$A_{WSM-score}^* = \max_i \sum_{j=1}^n a_{ij} w_j, \quad \text{for } i = 1, 2, 3, \dots, m.$$

Figure 4: WSM formula, (Triantaphyllou, 2000)

If there are  $m$  alternatives and  $n$  is the criteria, the best alternative is the one satisfies the above expression where the WSM-score is the best alternative in terms of maximization of the  $i$ -th alternative, the  $j$ -th criterion, and  $W_j$  is the weight of importance of the  $j$ -th criterion.

### 3.6.1 Steps and processes

MCDA has a lot of methods to approach, and they are widely diverse but many of them have certain steps in common. These steps are the following:

- Alternatives: They represent the different choice and courses of action which are made available to the decision maker
- Multiple attributes: Each MCDA method and problem is associated with various attributes. These attributes are also commonly known as “goals” or “decision criteria” and they serve as the distinct dimensions and perspectives from which the alternatives are viewed. In different cases of where the number of criteria is large, they may be arranged in hierarchical way. In those cases, some criteria could be considered major by the decision maker. In more complex situations, each criterion could be associated by sub-criterion and sub-sub-criterion.
- Decision weight: After assuming the attributes, most of the MCDA methods may require weights of importance to be assigned. In most cases, these weights are normalized by the decision maker to add up to one. The application of these weights will be described in more depth in the practical part of this thesis. As previously mentioned, a MCDA problem can be expressed in matrix format which is called a decision matrix. A decision matrix  $A$  is an  $(m \times n)$  matrix in which element  $a_{ij}$  indicates the performance of alternative  $A_i$  when it is evaluated in terms of decision criterion  $C_j$ ; (for  $i = 1, 2, 3, \dots, m$ , and  $j = 1, 2, 3, \dots, n$ ). It is also assumed that the decision maker has determined the weights of relative performance of the decision criteria (denoted as  $w_j$  for  $j = 1, 2, 3, \dots, n$ ). (Triantaphyllou, 2000)

## **3.7 Website Analysis and Comparison**

In this world of new technology, new websites are being launched every day but the ones with simple and similar quality content will not last long in comparison to more detailed and well-balanced ones. Poor quality could potentially cause the websites to have no users visiting them and generally this would mean no second chances to get them back.

A website of good quality can be profitable, accessible and it could present a great opportunity to be useful with reliable information. Good design with appealing visualization can cause a user-friendly approach to meet their needs and expectations. These sorts of criteria can be viewed from two perspectives, programmers, and end-users. Programmers focus on the degree of functionality, maintainability, and security aspects of a quality website, while on the other hand end-users turn their attention into more usability, credibility and efficiency.

### **3.7.1 Quality Model**

A quality model (QM) is a “defined set of characteristics, and of relationships between them, which provides a framework for specifying quality requirements and evaluating quality.” (Quality Model, 2014)

The first model identifying quality was introduced in mid-1970’s by the International Organization for Standardization (ISO) in cooperation with the International Electro-technical Commission (IEC). Therefore, the model was called ISO/IEC 9126 as part of Information Technology Software Product Evaluation-Quality characteristics and guidelines. This model can be applied to every kind of software service or product. In parallel to this standard revision, another series called ISO 14598 has been established for the quality evaluation process. This standard categorized and divided quality into six characteristics functionality, usability, efficiency, reliability, maintainability, and portability.

A subset of characteristics from the ISO model was introduced as the second level in the proposed model, where each characteristic is split to set of sub-characteristics. These sub-characteristics and indicators are defined on a set of web quality guidelines (Henry, Shawn Lawton, 2020), W3C standards and the analysis of the existing websites. However, looking from the top, there is a definite correlation between each characteristic and its sub-characteristic

but in order to definitely define the quality of the website, sub-characteristics are defined first and then work their way down to the characteristics in the quality model. (Anusha, 2014)

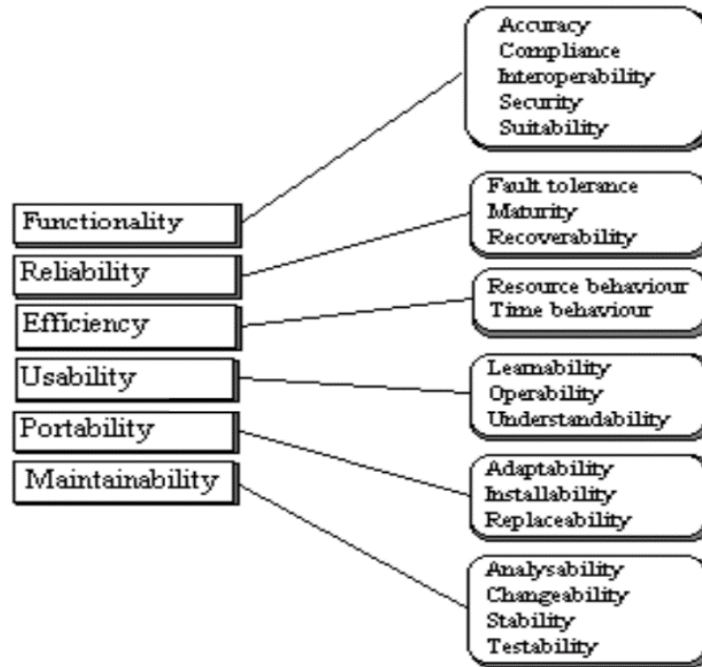


Figure 5: ISO 14598 Quality Model, (ISO, Software engineering, 1999)

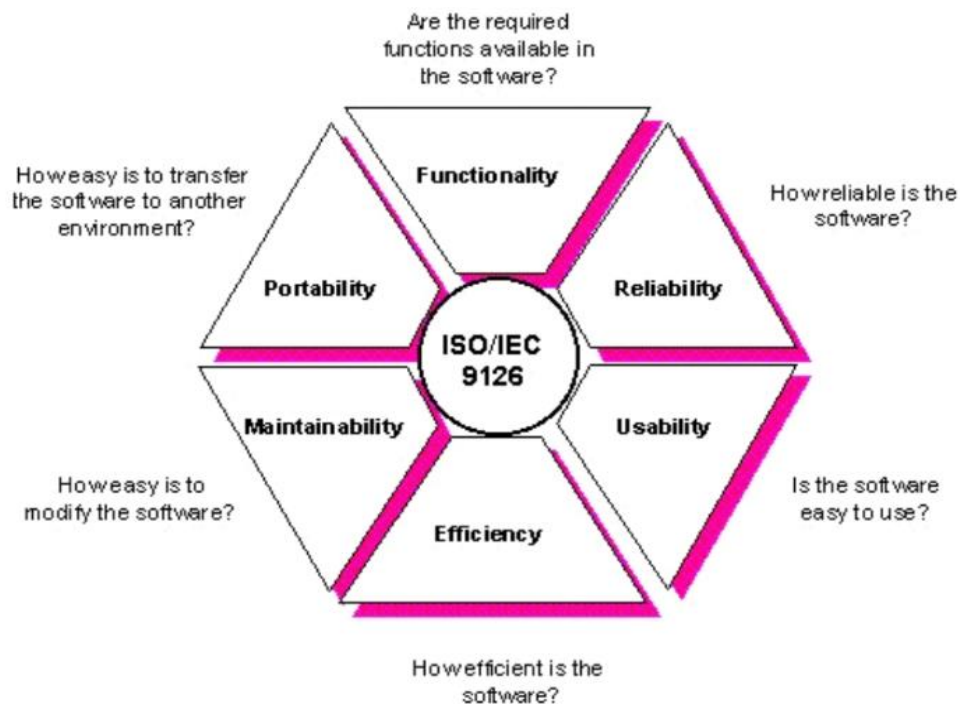


Figure 6: ISO/IEC 9126 Quality Model (ISO/IEC, Software engineering, 1991)

### **3.8 Introduction to the criteria**

In this part, criteria are defined from user-end view. There are many criteria to use for website evaluation and analysis but when it comes to e-government websites, we have personally chosen the following criteria, which we have deemed to be important for best experience.

- Quality and quantity of the provided information
- Presentability of the provided information
- Interactivity
- Availability of online services
- Accessibility for the disabled and alternative technologies

#### **3.8.1 Quality and quantity of the provided information**

A high-quality website should draw new visitors to the content as well as keeping those who visited the website engaged in order for them to keep coming back.

However, the quantity of these websites correlates directly with the quality. Having more frequent and relevant amount of content could potentially be beneficial. But large quantity of content will not guarantee a better-quality website and vice versa. This case is more important and visible to e-government websites, where the quantity matters as much as the quality in a way that the visitor of the website should trust the information provided. To simplify there are 2 occasions that can happen when an audience engages with a website. 1. The audience could open the website but suddenly quits regardless of any reason. 2. The audience can open the website, look through the pages, and finally quits the page. We can assume that the audience have either found what they came looking for or the website has failed to provide quality content and they gave up. For these websites, I used a web analytics tool that can provide quite interesting information for us to understand the quality and quantity of these e-government websites in depth. This tool is called SimilarWeb, which is a digital intelligence provider for enterprises and businesses. With the help of this tool, we can understand these e-government websites traffic. Similarweb offers total visits to a website over the 6 month period, which shows the engagement of the website by calculating its Total Visits, Avg. Visit Duration, Pages per visit and Bounce Rate. Total Visits is the sum of the all the visits that the domain received



over a time period. This can be used to measure the overall number of interactions. Avg. Visit Duration, understandably is the average time that a visitor spends on the website before leaving. This time is measured from the moment a visitor opens the website and until they exit (or stay inactive for a predetermined amount of time). Pages per visit is the amount of pages a visitor goes through in a session. Bounce rate, also known as “exit rate” is the percentage of audience that a website receives who left without interacting from the same page they entered. A high bounce rate indicates that fewer people are interacting with the website, whereas a low bounce rate shows more people are clicking on links to other pages. (Similarweb, 2021)

### **3.8.2 Presentability of the provided information**

Any website represents the message they are trying to convey and presentability of websites is what makes the visitors engaged. There are several factors such as correct color scheme simplicity, Font, visualization usage, simplicity, usability, and consistency can make the website more presentable. (Digital Media Thoughts, 2019)

1. **Color:** The color should complement with the brand and be consistent throughout the website. Color plays the biggest role in evoking emotions and keeping the visitors engaged with the content. But, on the other hand, the chosen color should be easy to read and easy on the eyes. Bright colors should only be used when is necessary or goes with your brand. Otherwise, looking at a screen with a lot of flamboyant colors is pretty difficult.
2. **Font:** The font for the website does not necessarily need to go with the brand. Ensuring that the font is readable and legible should be the main goal. Font can also be used to add interest and increase visual appeal.
3. **Imagery:** Imagery is quite important when it comes to decorating and editing your website. Using the right amount of pictures is essential to give your website the right appearance.
4. **Simplicity:** Keeping the design simple can be calming and it adds a clean look to the website. Especially to those websites where the audience end up reading a lot of content.

5. Usability: The website should be user-friendly. This is absolutely more important when it comes to e-government website, where there are different range of people visiting the website. Easy-to-understand navigation and page layout is the defining factor of how the visitors interact with the website.
6. Consistency: Keeping the design consistent is key. If you have a one page with a different background color or design than the main page, it could cause confusion and disorientation. The website color, button styles, image styles, fonts and background should and must be consistent to keep the appealing look intact for the user.

### **3.8.3 Interactivity**

Web interactivity is a way of communication between the user and the website. This active engagement includes elements that provide a better experience. A well interactive website includes clickable buttons, review questions, FAQs and contact forms. Interactivity should be designed in a way to easily guide the visitor to their desired information and capture user experience. (nexusadmin, 2010)

I will be also using another web analytic tool called PageSpeed Insights (PSI). PSI reports about the performances of a page in terms of interactivity. This tool collects data over a period of 28 days, on various network connections, full visit duration of the website, and presents the information by the following indexes:

1. First Contentful Paint (FCP): FCP is a measurement metric that calculates from the time as soon as the page starts loading until any part of the page's content is rendered. For this metric, "content" refers to text, images (including background images), <svg> elements, or non-white <canvas> elements. A good FCP score is 1.8 seconds or less, which means at least 75th percentile of the page should load.
2. First Input Delay (FID): FID calculates the time the visitor first starts interacting with the page (meaning clicking a link, tap on a button, or any control powered by JavaScript) until the time when the browser starts the processing in response to the

interaction. A good FID score is a 100 milliseconds or less, which means 75th percentile of the page loads across all the devices.

3. Largest Contentful Paint (LCP): LCP is a metric that reports the rendering time of the largest text block or image visible, relative to the page starting from scratch. It should take 2.5 seconds or less which means 75th of the percentile of the loaded page.
4. Cumulative Layout Shift (CLS): CLS is the measurement of the largest burst of layout shift scores for every unexpected layout shift that might occur during the entire of a page that the visitor stays on. A burst of layout shifts, known as a session window, is when one or more individual layout shifts occur in rapid succession with less than 1-second in between each shift and a maximum of 5 seconds for the total window duration. (PageSpeed Insights, 2021) The largest burst is the session window with the maximum cumulative score of all layout shifts within that window. A good CLS score should be 0.1 or less which is 75Th percentile.
5. Speed Index (SI): SI measures how fast the content is displayed during page loading. A good Speed Index is 0-3.4 seconds, which is considered to be fast.
6. Total Blocking Time (TBT): TBT is a metric measurement for the total amount of time between FCP and TTI (Time to Interactive), where the thread was blocked long enough to prevent the input responsiveness. (PageSpeed Insights, 2021)
7. Time to Interactive (TTI): TTI is a measurement of the amount time it takes a page to be fully interactive. There are 3 things that are important to consider the page fully interactive.
  - The page displays useful content, which is measured by the FCP.
  - Event handlers are registered for most visible page elements, and
  - The page responds to user interactions within 50 milliseconds.

### **3.8.4 Availability of online services**

The availability of online services is measured by the four spheres e-government transactions, which was discussed in e-government taxonomy of this thesis. However, we will stick to G2C and G2B part of the websites.

### **3.8.5 Accessibility for the disabled and alternative technologies**

Web accessibility ensures that all people with the widest range of capabilities and disabilities can have easy access to information and functions provided on the Internet. This standard should be based on Web Content Accessibility Guidelines (WCAG), which were provided by the World Wide Web Consortium (W3C) as part of the web accessibility initiative. The websites should follow these principles also known as POUR (European Parliament, 2016):

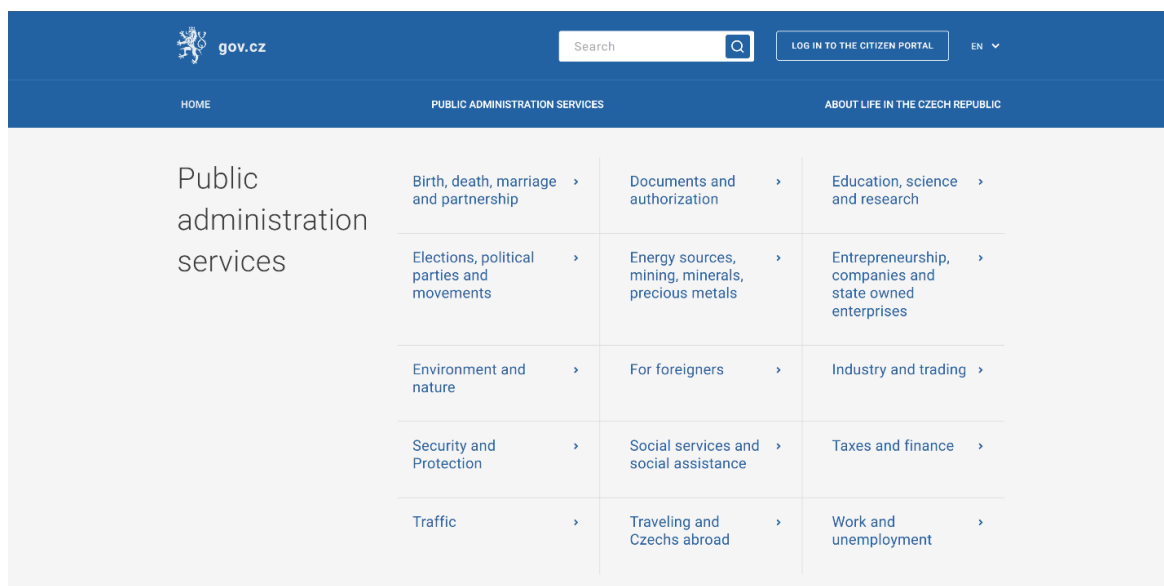
1. **Perceivable:** availability of the content to at least one of the user's senses. For example, images can be described with an alternative text for visually impaired users.
2. **Operable:** ability to control content by a variety of tools such as keyboard for people who are unable to use a mouse.
3. **Understandable:** usage of simple language and consistent interfaces which benefits people with reading and cognitive disabilities.
4. **Robust:** usability of the website on other platforms and devices (including assistive technology) such as mobile devices.

Therefore, I used [webaccessibility.com](http://webaccessibility.com), approved by WCAG 2.1 standards, that examines the websites based on its own tests and identifies its violations by running 267 automated tests.

## 4 Practical Part

### 4.1 Introduction of Websites

Czech the Public Administration Portal is an official single electronic gateway for citizens, business, and institution of Czech Republic, which allows them to communicate with Public Administration Entities. It offers the option of digital identification, several fully automated digital services, provision of extracts from state base registers, information on the current status of individuals' submissions to public administration as well as a personal archive of public administration-related documents. (European Commission, 2019)



**Figure 7: GOV.CZ main page (gov.cz, 2020)**

Borger.dk, which was launched in January 2007, is the Danish single Internet entry point e-government website to the public sector's information and eServices, regardless of the origin of the public authority. The portal is collectively being operated and funded by national, regional and local authorities. The portal was updated in 2012 and since then it allows for easier user-interphases, personalization of content, and syndication of borger.dk content and flexibility for authorities adding location-specific content to the portal User surveys shows that 92 % of the users are satisfied or very satisfied with the Citizen portal. 93 % of the users feel confident using it. (European Commission, 2019)

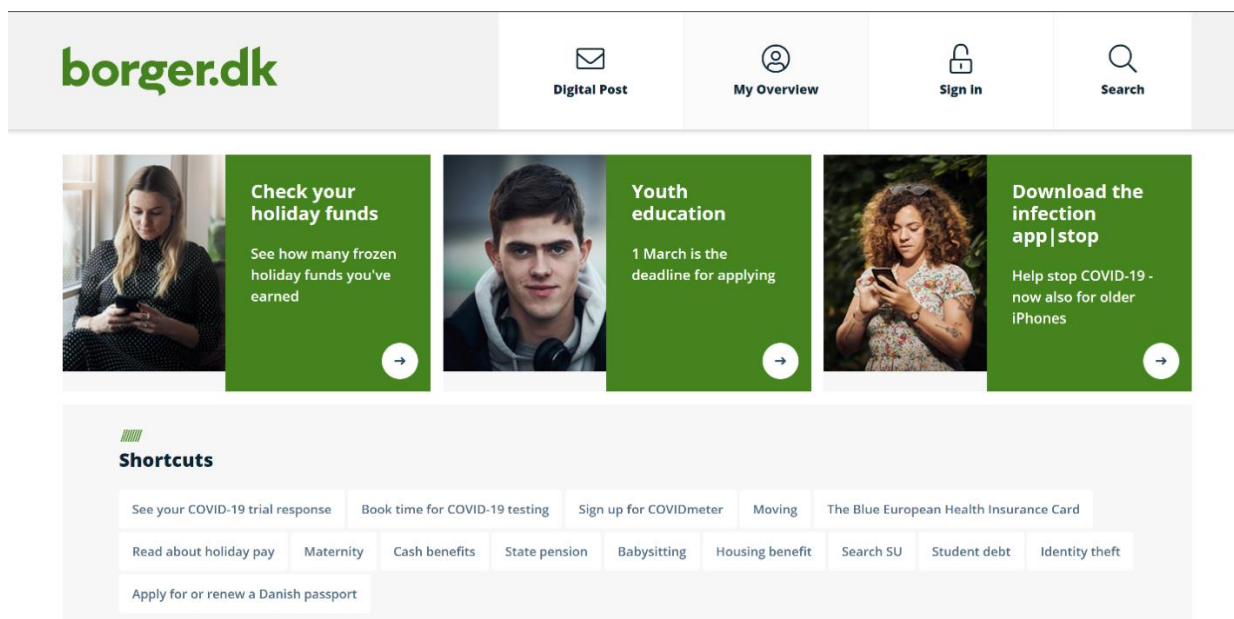


Figure 8: BORGER.DK main page, (borker.dk, 2020)

GOV.UK is the e-government website for the UK government where it provides easy and effective digital access to all public services to their people and businesses. This site has been available since 2012 and provides a single point access as well as the individual access to hundreds of hundreds of government departments and public bodies. It is the website used to register for online government services, both at the national and local level. Services on the Government Gateway are gradually being moved to replacement systems. Services on the Government Gateway are gradually being moved to replacement systems. (European Comission, 2019)

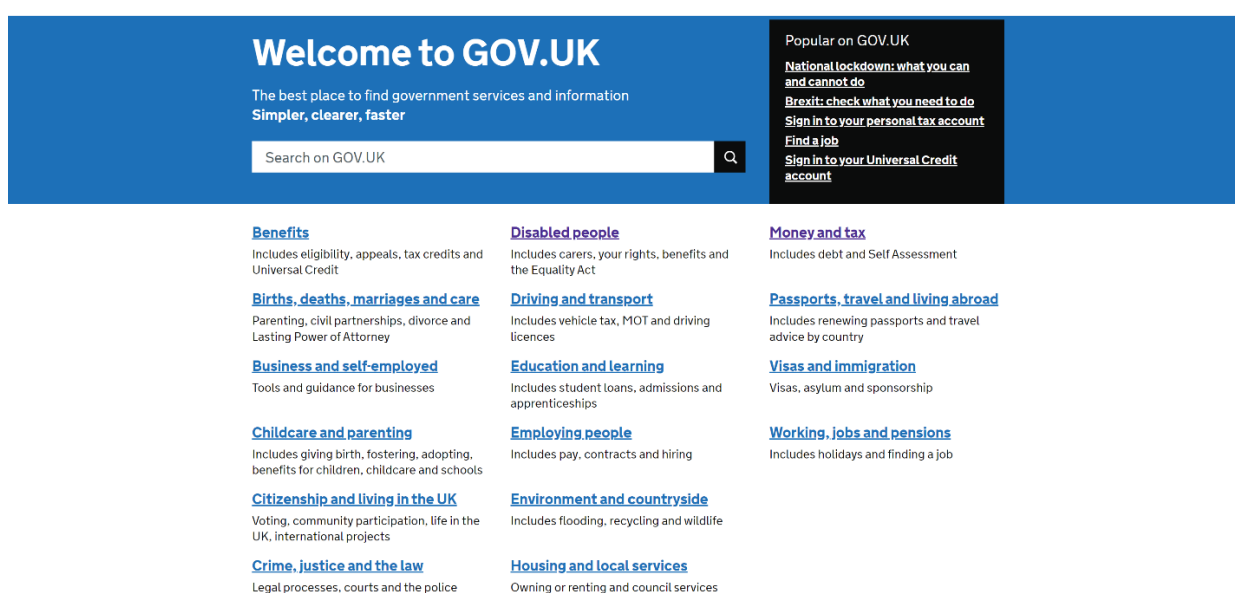


Figure 9: GOV.UK main page (gov.uk, 2020)

## 4.2 Criteria

Based on the criteria that we discussed in the theoretical part of the thesis, we will test the aforementioned e-government websites, assign a score from 1-5 (1-lowest and 5-highest) and decide which website has a better performance overall.

### 4.2.1 Quality and quantity of the provided information

Borger.dk is the best when it comes to keeping the balance between the quality and quantity. The portal provides general, location specific (e.g. regional or municipality specific) and personal information, data and eServices including access to Digital Post for citizens. It features a range of 'self-service' sections, thus allowing citizens to manage their communications with the public sector effectively and efficiently. (European Commission, 2019). According to SimilarWeb, Borger.dk receives about 4.27 million visitors. Assuming that only people over the legal age (18 years old) interact with the website, we can normalize the data for us to gain a better understanding of how many visitors does the website receive. According to World Population Review, Denmark has 4,663,492 people over the age of 18, therefore 915,622 visits per 1000 people. This data with the Avg. Visit Duration of 00:04:13, 4.84 Pages per visit with the Bounce Rate of 28.83 % shows that Borger.dk is relatively engaging, which can be understood that the website has enough quantity and quality to keep the audience around.



**Figure 10: Similarweb web traffic analysis of borger.dk, (Similarweb, 2021)**

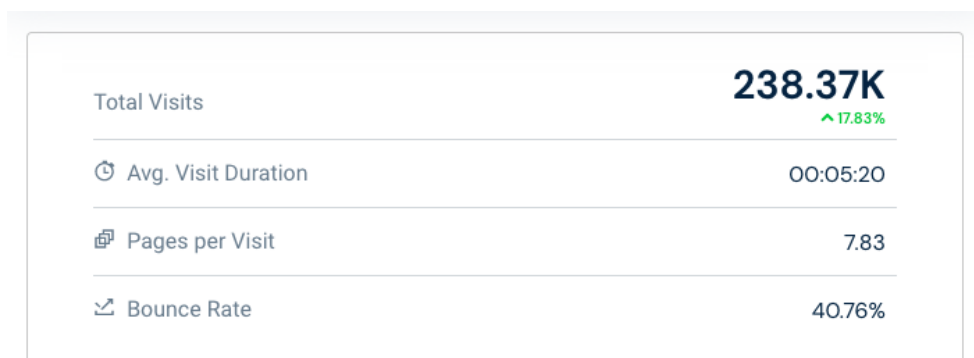
In gov.uk, 385 agencies and Arm's Length Bodies websites were transitioned to GOV.UK and over 1 800 separate sites have been closed. This transition was completed in December 2014, has given a high quantity amount of information where quality has been kept in order. (European Commission, 2019). According to SimilarWeb, GOV.UK receives about 174,37 million visitors. Again assuming the visitors are over the legal age (in UK, there are 53,930,490 people over the age of 18), we get 3233 visits per 1000 persons visiting the. This, along with the fact that Avg. Visit Duration is 00:03:03 with 2.34 pages per visit, might seem like very good number but given the fact that the Bounce Rate is 57.25 % shows that the content might not be as engaging enough.



**Figure 11: Similarweb web traffic analysis of gov.uk, (Similarweb, 2021)**

This matter and consideration is the shortcoming in Czech e-government website, where there is no doubt in the quality of the information provided but generally lacks a bit of quantity. This is also true when you look at the data. On SimilarWeb, we can see that 238.37 thousand visit the page but there are 8,713,363 people over the age of 18 in Czech Republic, meaning that there are only 20 visits per 1000 people, with Avg. Duration of 00:05:20 and 7.83 pages per visit. Also, we should consider that a Bounce Rate of 40.76% is high considering the average duration and pages per visit.





### Total Visits to portal.gov.cz

Growth & total visits to portal.gov.cz over time

On desktop & mobile web, in the last 6 months

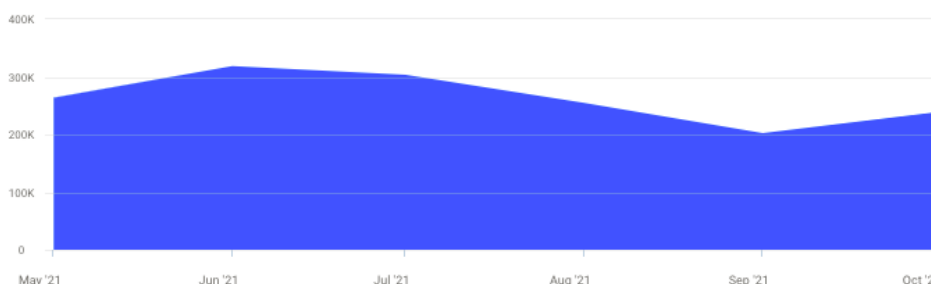


Figure 12: Similarweb web traffic analysis of gov.cz, (Similarweb, 2021)

Table 1: Quality and Quantity Score

Criteria	DK	UK	CZ
Number of visitor (million per day)	4.27	174.37	0.23
Total population of over 18 years (millions)	4.66	53.93	8.71
Ratio of visits (number of visit per 1000 citizens)	0.91	3.23	0.02
Average visit duration (in minutes)	04:13	03:03	05:20
Pages per visit	4.84	2.34	7.83
Bounce rate (in percentage)	28.83 %	57.25 %	40.76 %
<b>Scale: 1-5 (5=best, 1=poor)</b>			
Quality and Quantity	5	4	3

#### 4.2.2 Presentability of the provided information

Borger.dk uses white green as the primary colors of the website. This color scheme conveys warmth and calmness. The fonts used are Open Sans and Arial, which are consistent throughout their website pages. Concerning the imagery, Borger.dk uses well-balanced number of images that not only has kept its simplicity but also it is quite easy on the eye and keep the visitor engaged. The website is quite easy to use. The main page is divided to 3 parts, where the user is welcomed with the 3 hot news of the day, shortcuts and key words, all topics.

Gov.uk uses dark blue, black and white as their main colors. Arial is the only font that is used on the site. Not only gov.uk lacks imagery like gov.cz but the website is packed with a lot of information on the homepage, which is very disorienting, confusing and it could not be further than simple and rather the opposite.

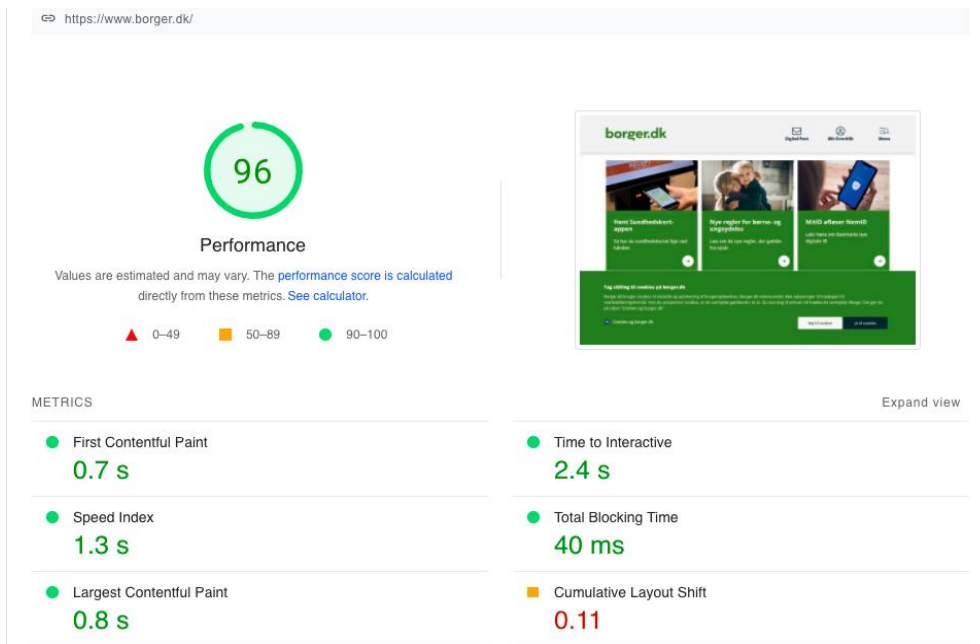
Lastly, light blue and white are primary colors of gov.cz. As font, they use Roboto, which is a sans-serif typeface that is geometric. This font is friendly, professional and is used majorly by Android and Google services. However, gov.cz lacks imagery but you are presented by a lot of information such as events, public administration services and FAQs, which are neatly oriented and quite helpful.

**Table 2: Presentability Score**

Scale: 1-5 (5=best, 1=poor)	DK	UK	CZ
Presentability	5	3	4

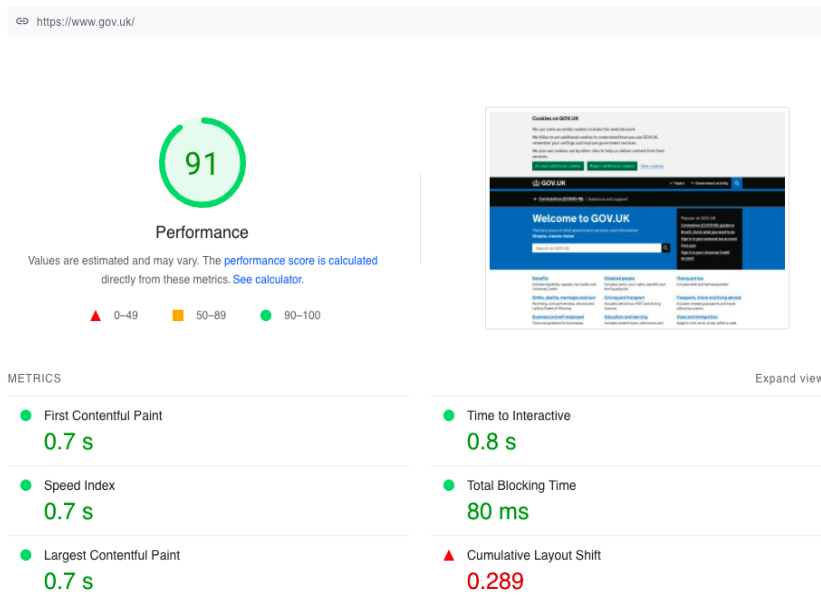
#### 4.2.3 Interactivity of the website

Borger.dk is doing a very good job, with clickable images with most recent added services of the website, online-form of contact and application forms and usage of word tags and shortcuts for easier search. On PageSpeed Insights, they scored 96 performance with FCP of 0.7 s, FID of 3 ms, LCP of 0.8, CLS of 0.11, Speed Index (SI) of 1.3 s, TTB of 40 ms and TTI of 2.4.



**Figure 13: PageSpeed Insights analysis of borger.dk (<https://pagespeed.web.dev/>, 2021)**

Gov.uk, user is welcomed with popular searches and articles of the month followed by recent news regarding the government. On PageSpeed Insights, they scored 91 on performance with FCP of 0.7, FID of 3 ms, LCP of 0.7 s, CLS of 0.289, SI of 0.7 s, TTB of 80 ms, TTI of 0.8.



**Figure 14: PageSpeed Insights of gov.uk (<https://pagespeed.web.dev/>, 2021)**

Gov.cz has used a simpler approach with putting all the content on display of the homepage with clickable buttons and tabs. However, an interesting usage of review questions at the bottom of each page has given the website a fresh and innovative design to engage the

visitor with the website. On PageSpeed Insights they scored 99 on performance with the FCP of 0.5, FID of 3 ms, LCP of 1.0, CLS of 0.002, SI of 0.6 s, TTB of 0 ms and TTI of 0.5 s.

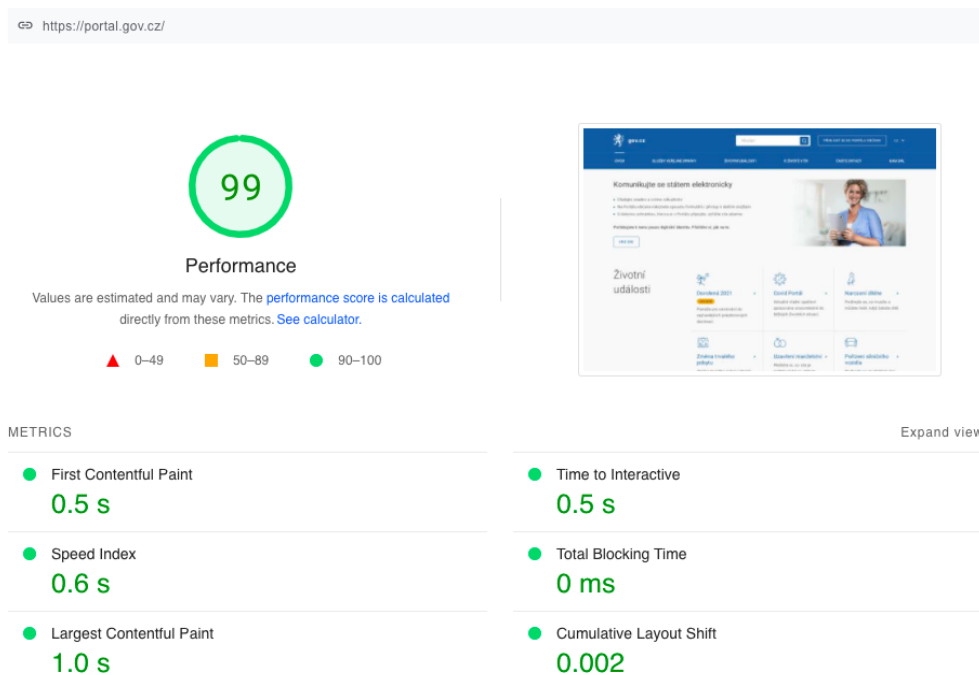


Figure 15: PageSpeed Insights of gov.cz (<https://pagespeed.web.dev/>, 2021)

Table 3: Interactivity Score

Criterion	DK	UK	CZ
Performance Score	96	91	99
FCP	0.7	0.7	0.5
FID	3	3	3
LCP	0.8	0.7	1.0
CLS	0.11	0.289	0.002
SI	1.3	0.7	0.6
TTB	40	80	0
TTI	2.4	0.8	0.5
<b>Scale: 1-5 (5=best, 1=poor)</b>			
Interactivity	4	3	5

#### 4.2.4 Availability of services to the public

This criterion is one of the most important factors in evaluating e-government websites. The number of online services provided is where these websites differ from one another. Borger.dk presents a big range of online services, such as digital post, eHealth portal, online

patents and trademark and new company registration to their public and business sectors. Gov.uk online services are quite strong and effective in residence formalities such as announcement moving, criminal police records and certificate and etc. This is where gov.cz falls short on limited online services. There are services available such as “datové schránky” and eObčanka but the other services are limited only to availability of forms and application for downloading. (European Commission, 2019)

**Table 4: Availability of Online Services Score**

Category	Service	DK	UK	CZ
<b>Public Sector</b>				
<b>Travel</b>	<b>Passport</b>	✓	✓	✓
	<b>Lost or Stolen ID/Passport</b>	-	✓	-
	<b>Passport Renewal</b>	-	✓	-
	<b>Air Passengers Rights</b>	✓	-	-
	<b>Disabled Travelers</b>	-	-	✓
<b>Health</b>	<b>e-Health services</b>	✓	✓	✓
	<b>e-Prescription</b>	-	-	✓
	<b>Medicine Abroad</b>	✓	-	-
	<b>EU Health Insurance Card</b>	✓	✓	✓
<b>Education &amp; Youth</b>	<b>Enrolment in higher education/university</b>	✓	✓	✓
	<b>Exchange Study</b>	-	✓	✓
	<b>Public Libraries</b>	✓	✓	✓
	<b>Research Funding Support</b>	✓	✓	-

	<b>Student Grants</b>	✓	✓	-
<b>Residence Formalities</b>	<b>Moving Announcement</b>	✓	✓	✓
	<b>Criminal Record Certificate</b>	-	✓	✓
	<b>Voting When Abroad</b>	✓	✓	-
<b>Work &amp; Retirement</b>	<b>Job Search Services</b>	✓	✓	✓
	<b>Unemployment Benefits</b>	✓	✓	✓
	<b>Taxes and Declaration Information</b>	✓	✓	✓
	<b>Job Search Fraud Reporting</b>	-	✓	-
	<b>Personal Tax Account</b>	-	✓	-
<b>Business Sector</b>				
	<b>Company Registration</b>	✓	✓	✓
	<b>Patents, Trademarks and Designs</b>	✓	-	-
	<b>Start Up</b>	✓	✓	✓
	<b>VAT services</b>	✓	✓	✓
<b>Scale: 1-5 (5=best, 1=poor)</b>		<b>DK</b>	<b>UK</b>	<b>CZ</b>
	<b>Online Services</b>	4	5	3

#### 4.2.5 Accessibility for the disabled and alternative technologies

Webaccessibility.com has identified 1 violation for borger.dk. therefore, giving it 98% performance score. Interestingly, it had not found any violations for gov.uk, giving it 100% performance score. Lastly, gov.cz was scored 93% for its performance after finding 6 violations.

All websites are compatible with their offered mobile apps as an alternative technology.

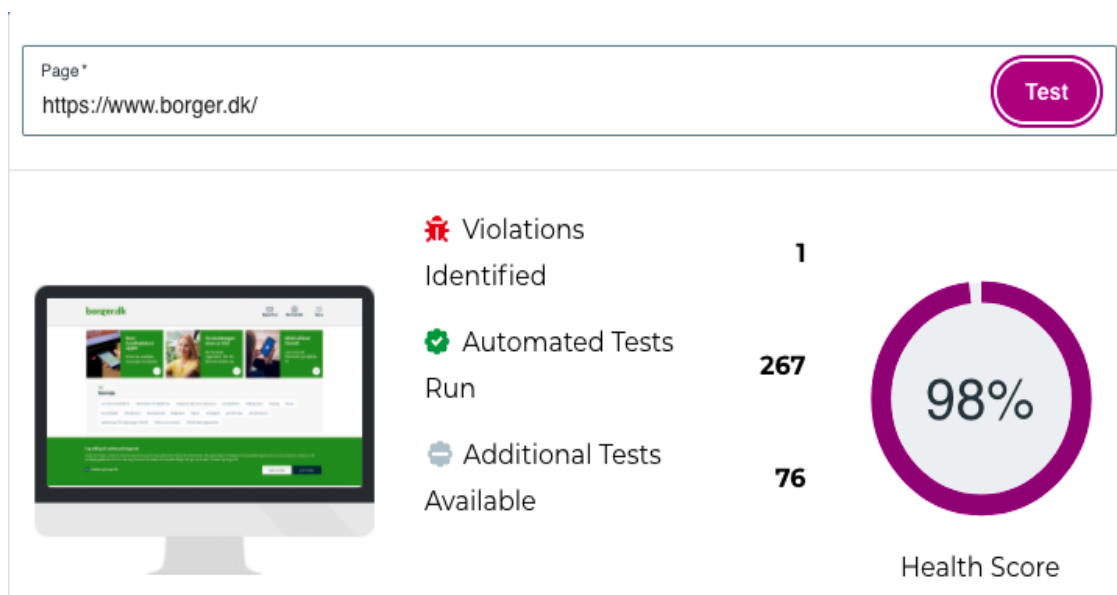


Figure 16: Web accessibility analysis of borger.dk (<https://www.webaccessibility.com/>, 2021)

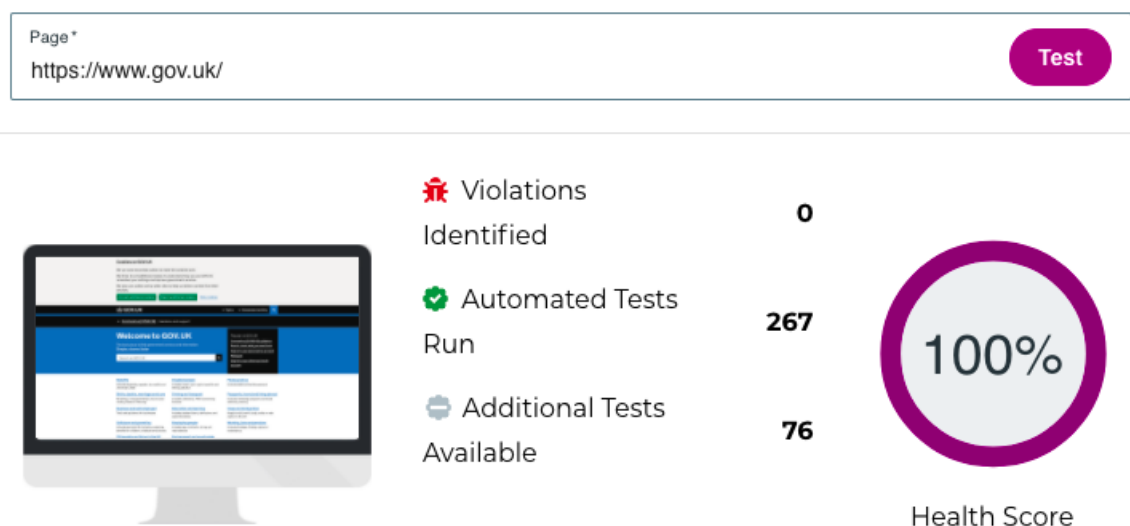


Figure 17: Web accessibility analysis of gov.uk (<https://www.webaccessibility.com/>, 2021)

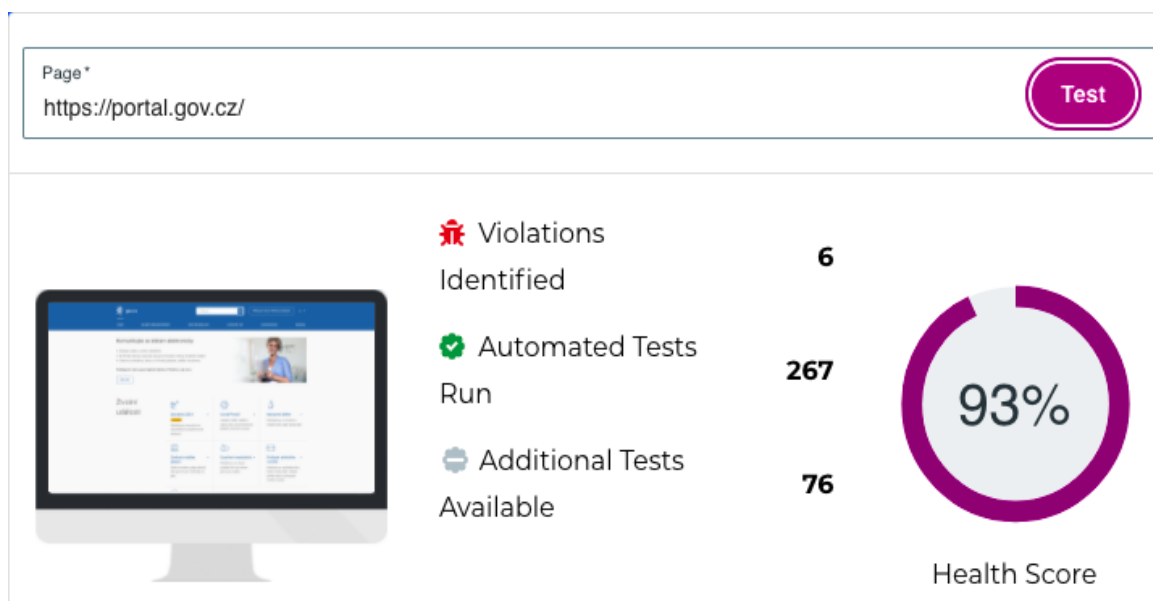


Figure 18: Web accessibility analysis of gov.cz (<https://www.webaccessibility.com/>, 2021)

Table 5: Accessibility Score

Scale: 1-5 (5=best, 1=poor)	DK	UK	CZ
Accessibility	4	5	3

### 4.3 Calculation process

Now that the scores have been evaluated, to make all the criteria more comprehensible, normalization will be applied to make sure that the data will be readable. As all the criteria are beneficial, the performance value in individual cell will be divided with the maximum value and proceed to do the same for all criteria. On solving, we will get a normalized decision matrix.

In the following table, a review of scores and their normalized values are shown.



**Table 6: Review of Criteria in One Table with Their Respective Normalized Value**

<b>Criteria</b>	<b>DK</b>	<b>UK</b>	<b>CZ</b>
<b>Quantity &amp; Quality</b>	5 (1)	4 (0.8)	3 (0.6)
<b>Presentability</b>	5 (1)	3 (0.6)	4 (0.8)
<b>Interactivity</b>	4 (0.8)	3 (0.6)	5 (1)
<b>Online Services</b>	4 (0.8)	5 (1)	3 (0.6)
<b>Accessibility</b>	4 (0.8)	5 (1)	3 (0.6)

Next step is to assign the weightage to each criterion. This process is done based on the done research and gained knowledge in the literature review. Weightage gives importance to each criterion and in this process, percentile will be applied. Quality and quantity of the provided information and accessibility for the disabled and alternative technologies have been given 25% each which is the highest percentage in this weightage because as much as quality and quantity is important to the public, the content needs to be accessible to all people with different attributes and disabilities. Furthermore, availability of online services has 20% because e-government websites should have the ability to develop towards digital interaction and practice better delivery of services to public, business and industry sectors. And lastly, presentability and interactivity have 15% each due to the fact that a more innovative and well-managed web design can make the experience between the user and the website more engaging. One important thing to note, is that sum of the weightage is always 100%. Then, the percentage will be converted into number by dividing individually to 100.

**Table 7: Weightage Score In Percentage and Numeric**

<b>Criteria</b>	<b>Weightage</b>
<b>Quality &amp; Quantity</b>	25% (0,25)
<b>Presentability</b>	15% (0,15)
<b>Interactivity</b>	15% (0,15)
<b>Online Services</b>	20% (0,2)
<b>Accessibility</b>	25% (0,25)

Afterwards, the assigned weightage will be multiplied to score assigned to each criterion with its normalized performance value.

On solving we get the weighted normalized decision matrix, which subsequently we add all the weighted normalized performance value of each alternative to get a performance score.

Table 8: Weighted Normalized Decision Matrix Calculation

<h1>Weighted Decision Matrix</h1>							
		OPTIONS					
		DK		UK		CZ	
Criteria	Weightage	Score	Total	Score	Total	Score	Total
<b>Q&amp;Q</b>	25 % (0,25)	5 (1)	0.25	4 (0.8)	0.2	3 (0.6)	0.15
<b>Presentability</b>	15 % (0,15)	5 (1)	0.15	3 (0.6)	0.09	4 (0.8)	0.12
<b>Interactivity</b>	15 % (0,15)	4 (0.8)	0.12	3 (0.6)	0.09	5 (1)	0.15
<b>Online Services</b>	20 % (0,2)	4 (0.8)	0.16	5 (1)	0.2	3 (0.6)	0.12
<b>Accessibility</b>	25 % (0,25)	4 (0.8)	0.2	5 (1)	0.25	3 (0,6)	0.15
	<b>Total:</b>		0.88		0.83		0.69

The rankings will be further discussed in results and discussions part of the thesis.

## 5 Results and Discussion

Based on the calculations that has been done precisely, we are able to identify Denmark's borger.dk as the best e-government in total according to the defined criteria, therefore it gets the rank 1 followed by United Kingdom's gov.uk at number 2 and finally Czech Republic's gov.cz at 3. However, gov.cz has scored surprisingly well considering the fact that their e-government website is the newest and most recent one out of all the participated countries in this part. Based on my opinion, that could be perceived as a great accomplishment for gov.cz and goes to show how fast an e-government can grow. Generally, Czech's are transiting towards a more electronic way of doing things nowadays with the impact that COVID 19 had in all around the world. This could be a cause for course of action to further improve all the aspects that gov.cz is lacking in. There is no question in quality and quantity of the information provided and well presented on the website but in general Czech Republic's e-government is still a bit more agency-centric which requires frequent visits to the respective offices for interaction. One of the very newest online services, that could be bear good news for the consumers and citizens, is the implementation of the "eIdentita", which could turn the people's attention towards more frequent e-government usage. It is also important to note that in order for gov.cz to be used by majority of people, they need to make that website more accessible towards people with disabilities such as visual impaired people.

## 6 Conclusion

The purpose of this thesis was to implement MCDA in e-government websites for analysis and evaluation. In this thesis, various articles, and publications especially United Public Nations surveys and factsheets were used, which are referenced by the end of this thesis. Based on the materials that were given to me, I was able to conduct research about this topic and formulate my own justified sets of criteria. MCDA has been a great method for me to approach because of its ability to assess problems from both cognitive and normative dimensions.

This thesis was divided into theoretical background and practical analysis. In theoretical part, e-government and its taxonomy is precisely described with real examples taken from various United Nation's factsheets of different countries. Furthermore, different models are presented which are used for website comparison and evaluation that helped me to understand the concept from use-end view and was the link between e-government and MCDA. Lastly, MCDA was illustrated in depth with mathematical definition.

In the practical part, MCDA is implemented with absolute attentiveness to details and table representation. For defining the criteria, I have thoroughly read the digital e-government infrastructure provided by United Nation for each country Czech Republic, Denmark and United Kingdom. Weighted sum model is my preferred choice of approach due to its objective orientated method to reach the result.

Based on both parts and provided calculations, it can be said that Denmark has risen above United Kingdom and Czech Republic due to their superior attention to ever detail that make a quality website. I cannot help but notice that after reviewing the articles, publications and calculations, Czech Republic is on the right path to a greater e-government and the future can be bright if they can keep people's focus engaged in their initiatives and projects.

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