UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

AN ANALYSIS OF THE SOCIAL MEDIA ROLE IN SMART CITIES

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EU : European Union
ICT : Information and Communication Technologies
IOT: Internet of Things

INTRODUCTION

Research Problem

The ecological balance between human settlements and their environment has broken. Town-village-settlement-systems did yet not manage to keep pace with the creation of a sustainable artificial environment and our rapid developing human society (Hall, 2000). As Chourabi and others (2012) express, excessive urbanization can have negative consequences for the environment. Cities and megacities generate new kinds of problems. The improper handling and transportation of waste can result in air and soil contamination. Besides that, the coverage of most of the surface with pavement may alter the flow and quality of rivers and groundwater. Increased traffic contributes to the accumulation of traffic wastes (Silva, Khan & Han, 2018). These difficulties in waste management, traffic congestions, energy resources, environmental pollution, and ageing infrastructures are among the more basic technical, physical, and material problems (Chourabi & others, 2012). For instance, a city with inadequate infrastructure will not be able to bear a growing population, if it does not install a process to find solutions to this challenge. On the other hand, there are social and organizational problems besides the technical, physical, or material. These types of problems are associated with multiple and diverse stakeholders, high levels of interdependence, competing objectives and values, and social and political complexity. In this sense, city problems are becoming wicked and tangled (Dawes, Cresswell and Pardo, 2009).
In the 2000s the concept of "Smart City" has become very fashionable. However, only a few know what this phenomenon is about exactly and what the areas of utilization are. The relevance of this topic is demonstrated by the United Nations report released in 2014 (United Nations, 2014). It highlights that more than half of the world's population live in urban areas today, and future projections show that population growth will rise by 66% in 2050. This will increase the proportion of the urban population on the Earth (United Nations, 2014).
The term "Smart City" defines a new urban environment. In a Smart City the "performance" is increased using information and communication technologies (hereinafter: ICT). Our expectation is: Smart Cities will provide a higher quality of life for the citizens. This is achieved in the first place by an efficient and intelligent resource management, thus improved economic conditions. As mentioned already, the majority of people in the next decades are going to live in urban areas. As a cause of that, researches, developments, and investments mainly aim to create new strategies and concepts which can keep up with the growing "smart" population.
The rapid growth of urban population requires a deeper understanding of the Smart City concept. Cities are going to face, and facing already challenges regarding their growth, performance, competitiveness, and resident's livelihoods (McKinsey&Company, 2013). The urgency around challenges and problems, such as air pollution and traffic congestions are triggering many cities worldwide to find smarter and better ways to manage them. These cities are described by the label: Smart City.
Besides the fact that there is an increased frequency in the usage of the term Smart City, the concept of Smart City embraces several definitions depending on the meanings of the word "smart". Intelligent City, Knowledge City, Ubiquitous City, Sustainable City, and Digital City are a few

examples of slightly different interpretations of a Smart City (Cocchia, 2014). Many definitions of Smart City exist, but no one has been universally acknowledged yet. The concept is evolving and not mainstreamed yet throughout the globe due to economical, technological, and governing barriers (Silva, Khan & Han, 2018) There is still no clear and consistent understanding of the concept among practitioners and academia (Ben Letaifa, 2015).

Information, communication, and data exchange can be considered as keys to the intelligent cities in the future. These are the basis for all main fields of a Smart City. For instance: power supply, mobility and public safety are based on how fast and accurate is the communication among the city.

By nature of smart city interconnectivity, data will be transferred and utilized throughout the smart city processes, with multiple parties communicating and gaining access to information. Social Media continues to play a large role in human interactions and it will most likely be used to facilitate social interactions within the smart city. (Braun, Fung, Iqbal and Shah, 2018).

The Internet of Things (hereinafter IOT) has a major role in the life of Smart Cities, it allows for automation, open data, data based decision making, real-time monitoring (Atzori, Iera and Morabito, 2010). But the installed sensors are unable to sense the opinions and emotional reactions of citizens that invariably impact smart city initiatives. Since we are living in the world of web 2.0 where every day millions of dwellers and visitors of a city share their observations, thoughts, feelings and experiences through social media updates, it is necessary to examine how "human sensors", namely the citizens, that share information about their surroundings via Social Media can supplement, complement, or even replace the information measured by physical sensors (Doran, Severin, Gokhale & Dagnino, 2015).

Use of mobile internet and for instance: travel mobile apps, Foursquare as an example, enhances the tourist-tourist relationship while during the cooperation, the social capital is getting increased (Kim & Kim, 2017).

But how could a Smart City benefit from the usage of Social Media? This field and smart phone are drawing attention from city managers of smart city initiatives that seek to improve front lines of municipal services. For instance, Social Media is broadly used to engage citizens and give them an opportunity to get feedback from them (Alawadhi and others, 2012).

It was expressed on the Smart City Expo World Congress in 2016, one of the most fast-growing field that is related to Smart Cities is the Information and Communications Technology (ICT). It indicates a new direction of urban growth – one that is not only more efficient, but also transparent and sustainable, disrupting the obsolete form and function of our cities. As the focus is on the citizens, more than ever, ICT offers a great help in moving faster toward a human centered city (Beltran, 2016).

As the trend shows: Social Media platforms are increasingly being used by governments to foster user interaction. Especially in cities with enhanced ICT infrastructures and high internet penetration rates, Social Media platforms are valuable tools for reaching high numbers of citizens (Mainka, Hartmann, Stock & Peters, 2014). The tools that are cities using for having better understanding of the citizens are changing from the traditional way, for instance phone surveys, public meetings – to digitized and data-driven.

It is clear already: There is a need to for an effective communication in Smart Cities. Social Media are hereby seen as valuable tools available for citizens, businesses. It can enhance digital literacy, skills and inclusion of separated social groups, like the young generation, lower income groups or elderly, that are often disengaged and struggle in joining the urban discourse (European Commission, 2012).

Methodology

This section responds to the question of how the problem was studied. The following chapter describes in detail how the research method is chosen for this master thesis.

In the first phase – The concept of Smart City - will be a quantitative document review of the relevant scientific literature. This method is used to cover the theoretical part of the thesis. This includes the theoretical parts about Smart Cities and Smart City frameworks, and Internet of Things. The collection of both scientific papers about them and similar concepts, and reports regarding projects in Smart Cities are considered. In addition to that, different initiatives, models, and implementations published by governmental institutions or large companies are examined. Even though some data for rankings were elaborated by field research, (by interviews and surveys), the collection of data was acquired by desk research, analyzing primary and secondary data. The focus will lay on the definitions, relevant indicators, architectures and frameworks that "make a city smart", The literature review is conducted by examining published researches from the database of ScienceDirect, and Web of Science. Keywords including: (smart OR sustainable OR digital OR knowledge OR intelligent) AND city.
The second phase – Social Media data usage in Smart Cities - is also rely on quantitative document review of the relevant scientific literature, the topic is covering the public participation in the life of a Smart City, the citizens as sensors, urban and technological challenges, and some of the methods of analyzing Social Media data. The possible fields of usage are going to be presented too, with real life examples from Europe.

In the second phase, a case study of the Social Media use in the 308 Portuguese municipalities is going to be presented. The method is: quantitative research. The data contains values regarding the Social Media use, Total Engagement and Digital Sophistication for all the municipalities of Portugal. Based on the collected data, this method emphasizes the objective measurements and the statistical, mathematical, and numerical analysis. To obtain interpretable and meaningful results, graphs and data visualizations are presented by using Tableau Public, (version: 2019.4) software. Regarding the digital sophistication, mappings of spatial correlation and hot-spot analysis are going to be creating by using ArcGIS (version: 9.3) software.

Purpose and Goals

Social Media's growth represents a unique and important civic engagement opportunity for cities which is going beyond basic advertising. It could be a relatively simple and not expensive way to maintain a two-way conversation between the local government and citizens, reach separated groups, involve more people, collect public opinion, receive more feedback, and analyze posts to make more informed decisions about city services (Bakıcı, Almirall and Wareham, 2013). Therefore, it is necessary to examine how Social Media plays a role as an information source in the life of a Smart City and how citizens' usage patterns for Social Media are changing. For this reason, this paper aims at exploring the benefits of digital communication in cities by using already widespread technology: Social Media.
There are already studies which are investigating how the Social Media changes the Smart Cities. Most of the researchers as Bertot, Jaeger and Hansen (2012), Kavanaugh and others, (2012) are focused on how the government is using Social Media, examining the challenges, issues, and the impact on the transparency. As a conclusion, they give recommendations about how it should be used in the future, based on the data that is gathered from several countries. The aim of this thesis is different, first of all the scope is narrowed to European Smart Cities, and the objective is to present not only one (the governmental Social Media use), but several projects and city management questions from different fields, where the Social Media data can add value to the projects in a Smart City.

The goals can be divided into two parts:

- The first part of this thesis aims to understand the need for a Smart City, describes the concept of it, points out the challenges, the main enablers, explores the key techniques that are used. At first, the clear understanding of the problem, that nowadays cities are facing, is required. By analyzing the background history, this paper is going to present a review of the current state of urbanization, the problems that cities have to solve, and future challenges, and the role of IOT. After understanding that what are the issues of cities, and why is there an urgent need for transforming them to Smart Cities, the concept itself is going to be examined. To close the gap in the literature about Smart Cities, this thesis presents extensive description regarding the phenomenon.
- The second part of the thesis is about the usage of Social Media in all the Portuguese municipalities. Local public administrations are increasingly interested in involving citizens in public decisions and public life. In this context, Social Media represent powerful engagement tools (Agostino, 2013).

Through the mappings and analysis of the presence and use of Social Media by the 308 Portuguese municipalities, the goal is to understand how Social Media is used. In this context, this case study seeks to answer the research question "How is the Social Media used in all the municipalities of Portugal?", with more analysis and detail about the accounts (Facebook, Instagram, Twitter), the Total Engagement – how strongly do they present themselves in the web, and examining if there

is a correlation between the digital sophistication of the region, and number of the followers of the local municipality.
The purpose of this case study is to understand how Social Media is adopted by the municipalities, how is their current presence on the web, how much they use their potential, and if the Digital Sophistication is correlated with the citizen engagement.

1 THE CONCEPT OF A SMART CITY

There is a substantial body of work investigating the concept of Smart Cities. For instance, Science Direct yields over 40,000 results, out of which we consider the top 125-150 most cited ones. The chronological order plays a big role in this section, since the phenomenon is evolving so rapidly, that the articles and papers before 2010 are obsolete due to recent technological improvements.
The smart city is like a living organism driven by a nervous system. This nervous system consists of a brain (control center) and peripheral nerves (network and sensors) that collect real-time data about the state of the city. The data is transmitted to the brain to analyze them, to make decisions, and finally to execute them. This creates a barrier-free connection between physical and digital worlds.
This chapter investigates the concept of Smart Cities. The extensive description starts with the historical background, explaining why the digital transformation in a city is required in order to keep the urban areas sustainable, how the role of the public sector changed from the old, traditional system, along with a description of the supporting projects from the European Union.
In the second part, the most widely-used definitions are presented and compared, based on the analysis of the existing literature.
In the third section, the definition and value delivery role of Internet of Things is presented, with a detailed description of its architecture, and its security concerns.
The fourth section is about Smart Cities in general. It points out the main challenges that they face nowadays.

1.1 Historical Background

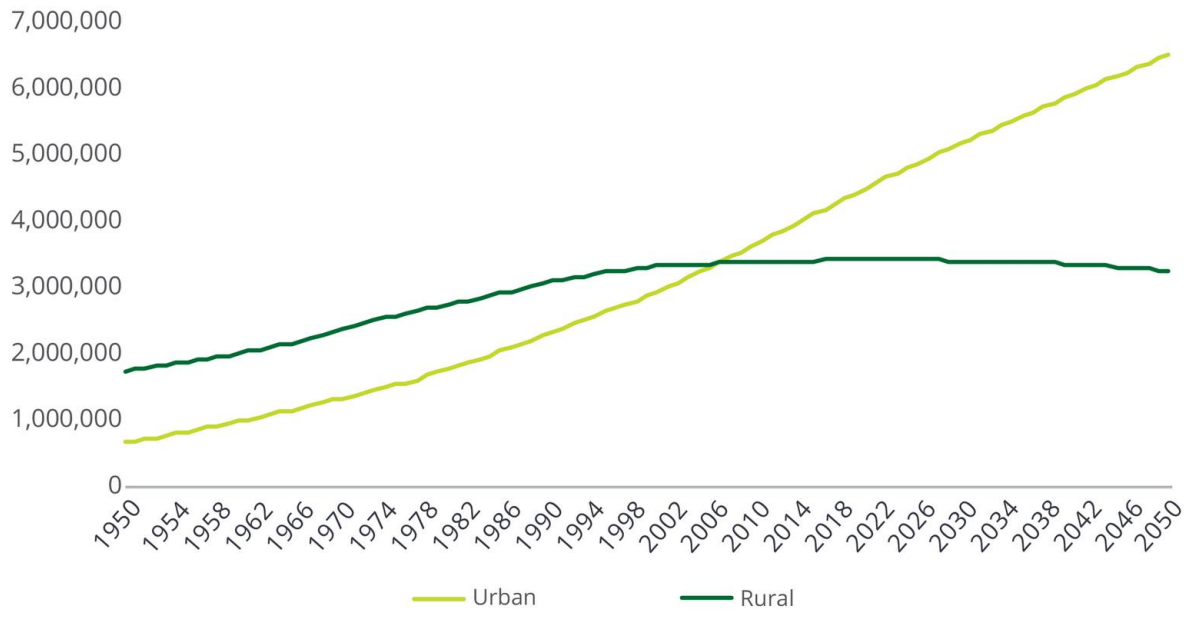
This section closely examines the urbanization trends in cities with focus on the challenges that the public sector is facing because of the need for a digital transformation. The support is coming from the European Union. Numerous projects are provided and designed to provide a possible framework, milestones and deliverables along with financial support in order to transform traditional cities to Smart Cities.

1.1.1 Urbanization Background

The concept of smart city, in the 2000s, has become very fashionable, but only a few know exactly what this phenomenon means and what the areas of the utilization are. The relevance of this topic is demonstrated by the fact that the United Nations report released in 2014 has highlighted that

more than half of the world's population (54%) live in urban areas today, and future projections show that population growth will rise by 66% in 2050, which will increase the proportion of urban population on the Earth (Figure 1). According to the report, this rapid growth could add 2.5 billion people to urban populations, with around the 90% of the increase concentrated in Asia and Africa (United Nations, 2014).

Figure 1: Urban and rural populations of the world



Source: United Nations (2014).

"*Rural populations expected to decrease as urban populations continue to grow*" (United Nations, 2014) As a result of rapid urbanization, the ecological balance of human settlements and their environment has been broken. The town-village settlement system has long been unable to create the conditions that it faces against the artificial environment of the developing human society. Excessive urbanization can have negative consequences: improper handling and transportation of waste results in air and soil contamination, and coverage of most of the surface with pavement can alters the flow and quality of rivers, groundwater. Increased traffic contributes to the accumulation of traffic wastes. A city with inadequate infrastructure is unable to bear the growing population, which creates a need for a process to find a solution to this risk.

On one hand, urbanization is quantitative change, (as the number of citizens is growing) but on the other hand, a qualitative change. Urban population want not only a bigger level of care but also require better care in all aspects of culture, health, leisure, entertainment, and living in general.

Moreover, governments are not alone in facing the challenges of urban growth; the same factors affect the business sector as they re-evaluate their growth capacity. To attract the necessary qualifications, companies need to live in cities. In addition, companies are becoming more active and motivated in being good corporate citizens, which means the participation in the urban ecosystem is growing too (Eggers & Skowron, 2018).

Urbanization requires new and innovative ways to address the complexity of urban life more efficiently. It requires a new approach and solution to the problems that are present, such as overcrowding, resource management, excessive energy consumption and environmental protection. Smart Cities provide opportunities for settlements or smaller settlements to align their existing resources, development goals, and the opportunities offered by information technology and new tools. Thus, they can be a key strategy to overcome poverty, inequality, unemployment and energy consumption. (European Parliament, 2014)
This is why cities are eager to find the way to develop better decision-making, not only the government, but also entrepreneurs and residents, grabbing the city's collective intelligence (Eggers and Skowron, 2018).
To become a Smart City, the digital transformation is the first step, that requires data-driven systems that help authorities in the city's management and enable the integration of digital and physical worlds. In addition, the city's leadership must build up all-inclusive relationships - including people and things - and connect workers, customers, partners, and service providers. City operations are often based on big data and artificial intelligence, and automated processes in real-time decision making to perform simple, efficient, and intelligent operations.

1.1.2 Supportive Projects from the European Union

The strategic goals of the European Union (hereinafter: EU) include motivating the development of smart cities, including improving urban quality of life and making city operations more sustainable. EU statistics show that more than three-quarters of citizens live in cities and the energy they consume account for 70% of EU energy consumption, most of which is linked to buildings and transport (European Innovation Partnership on Smart Cities and Communities, 2013b). As the study shows, the pollution and congestion caused by rapid urbanization has a significant impact on the quality of life in cities.
As a goal, the EU defined - almost 10 years ago - these three criteria to be reached by 2020:

- improve the EU's energy efficiency by 20 percent
- cut greenhouse gas emissions by 20 percent
- increase the share of renewable energy sources by 20 percent (European Innovation Partnership on Smart Cities and Communities, 2013b)

The EU is acting in several areas to meet the targets, the following projects are designed to give directions, instructions, and founding to succeed in the above-mentioned goals.

Horizon 2020

Horizon 2020 is the largest research and development and innovation program in the European Union, providing funding for the implementation of European innovation plans. The program will provide approximately 80 billion Euros for the creation of the program between 2014 and 2020. It is promising more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market (European Commission, 2015d).
As the European Commission declares, the objectives of the project are divided into three sections: excellent science, industrial leadership and societal challenges (European Commission, 2015d).

The smart city chapters appear in the latter as there are problems to be solved in this area that can be used to answer the use of information technology tools and services, as well as to better organize cities. While Smart Cities and Communities is basically three focus areas for the creation of smart cities, so there are three main areas of concern that are essential for achieving viable development (ICT, transport and energy), the Horizon 2020 societal challenges (such as smart, green, integrated transport, health, demographic change and prosperity, safe, clean and efficient energy use, etc.) include intelligent development plans for the specific field, the amount of funds to be invested (European Commission, 2015c).

Digital Agenda for Europe

„*The digital agenda for Europe will help Europe's citizens and businesses to get the most out of digital technologies*." (European Commission, 2014). It is designed to overcome the lags in the information and communication area for the United States and South-East Asia, which is explained by the continued reduction in the amount of money invested in Information and communication technology (hereinafter ICT) infrastructure. It provides a single framework for the development of ICT development guidelines, including a detailed guide on how to effectively achieve the 2020 targets (for every European citizen to ensure broadband internet access and to increase twice the rate of public spending on ICT developments) (European Commission, 2014).

The most important element is the definition of safer public areas, the deployment of an intelligent urban transport system, the introduction of an interactive city administration system and the adaptation to the needs of older people.

Based on the 2015 report, success rates for the general internet usage were 14% growth in those who used the Internet for at least 1 week in the first week, who did not use the internet before the program, and they have experienced a 17% increase in their number. The forms filled in on the e-government website have a growing tendency to use e-government services, and growth has been among highly educated citizens and youth (European Commission, 2015a).

European Partnership Agreement on Smart Cities and Communities

The European Commission's initiative, aimed at widening the spread of the smart city concept, has been set up. The program connects European cities, relevant industries and representatives of the civil society, and fixes the plan for the realization of smart cities, as the solutions offered by digital technologies play a major role in solving the problems arising from the increasing urbanization and population processes (European Commission, 2012)

In focus, ICT is capable of transport and energy-efficient, cost-effective, sustainable and repeatable district-level solutions. The European Union is attempting to promote the deployment of smart cities by using pilots (demonstration) projects in partner cities using the results of joint development of the three sectors concerned (transport, energy, ICT). In 2014, the "lighthouse" project was promulgated, aiming to achieve a significant increase in efficiency. The specific challenge is demonstrating solutions at district scale, which means integrating smart homes and buildings, smart grids (electricity, district heating, telecommunications, water, etc.), energy storage, electric vehicles and smart charging infrastructures as well as latest generation ICT platforms. And of course, it requires very high shares of renewable energy. The goal of the project

is to facilitate a successful transformation towards intelligent, user-driven and demand-oriented city infrastructures and services (European Commission, 2016).

Smart City Partnership

The aim of the European Union with this program is to establish a strategic partnership between cities and industry representatives in order to create urban infrastructure and its structure in accordance with the criteria of an intelligent city (European Commission, 2012). A Strategic Implementation Plan (SIT) has been set up to demonstrate how best to make the city the best use of innovative technologies, budget mechanisms, and public-private partnerships. The plan focuses on 3 specific vertical areas (European Innovation Partnership on Smart Cities and Communities, 2013b).

1. Sustainable urban mobility, combining alternative energy, public transport, efficient logistics and planning

The European Commission has identified the introduction of the Intelligent Transport System as the most important task as the system is based on an ICT solution that enables optimization of transport infrastructure, more efficient traffic coordination and more traffic safety, and real-time data traffic management and flow of information (European Commission, 2013a).

2. Sustainable neighborhoods and built environment

The focus on increasing the energy efficiency of public areas and buildings. Due to the existing ICT developments, it is possible to identify the channels with the highest level of consumption, and networking provides opportunities to optimize utilization and intelligent measurement (European Commission, 2015b).

3. Integrated infrastructure and processes between the ICT, transport and the energy sector

The purpose of this pillar is to reduce energy consumption, reduce carbon emissions, and leverage existing networks at a higher level to reduce capital and operating costs. Supported systems include: Green ICT, Intelligent Data Centers, Energy Efficient Manufacturing and Production (European Commission, 2015b).

The complement to the operational implementation plan is mentioned above, which fills the SIT structure with 11 preferred (European Innovation Partnership on Smart Cities and Communities, 2013a). The Partnership Agreement helps the project applicants in the flow of information, the implementation of cross-sectoral solutions and the establishment of strategic agreements. This strategic agreement is an appropriate meeting point for supply and demand, as the industries and actors are present, providing a single channel for cooperation

Horizontal development areas:

- Engaging citizens for development
- Policy and regulation
- Integrated planning and management

- Knowledge sharing
- Baseline data and indicators
- Management of open data
- Standardization
- Business models, procurement and financing (European Commission, 2013b).

Horizontal areas are rather a higher level of planning tasks that are needed to develop the general framework for smart city projects, so they are primarily governed by regulatory authorities, local governments and government decision-makers.

Stakeholder Platform for Smart Cities

Within the framework of the European Partnership Agreement on Smart Cities and Communities, the European Commission has created a platform that will allow communication between stakeholders interested in development (banks, researchers, cities, different industries). The platform has a dual purpose. One is to gather effective and relevant information and technology solutions that can be useful to the participants, while the other provides a point of reference for further planning and action. The site can be accessed on the internet by the actors where they can share their information and personal meetings can be made, so clever cities are cleared upwards (bottom-up).

The platform has 4200 active users, with the advantage of avoiding standard errors by sharing knowledge between players, making it easier to find the right partner for collaboration, and getting information about current and future programs (European Union, 2012).

1.2 Definitions

The purpose of this chapter is to identify the forces shaping the Smart City conception. It is conducted by examining the different definitions, tracing the Smart City concept history up to the current idea. By typing "smart city definition" in the browser of Science Direct, it results with nearly 15,000 papers. First, the existing definitions are going to be presented in chronological order, to see how it is developing and changing, and then the comparison with the similarities and differences are going to be described.

There are many researchers, studies and big companies who are trying to identify the shaper forces of the Smart City concept. But since Smart Cities are representing a multidisciplinary field, it is constantly shaped by urban development, advancements in technology. To see the exact changes, it is necessary to trace the history of Smart Cities up to the current idea, because a bigger picture might be a help to achieve a better understanding of what it means to be "smart" in a city context (Angelidou, 2015).

However, there is wide agreement about the fact that Smart Cities are characterized by a pervasive use of ICT, which in various urban domains, helps cities to make better use of their resources (Neirotti, De Marco, Cagliano, Mangano and Scorrano, 2014).

For instance, it is enough to think about Smart Cities in a different continent context. Regarding the transportation, European cities were designed first and for people; cars only came to the picture

later. American cities were largely developed to give priority to the car. As a consequence, in Europe, everyone desired and tried to live in the city center (the core of the city), but in America, it was less important, and as a result the population density of European cities is much higher than American cities. An example: New York's population density level [11.000 / km^2] is closer to Lyon [10.000 / km^2] than it does to Paris [21.000 / km^2] (World Population Review, 2018).
As a conclusion, according to the literature probably the two main forces that are influencing the Smart City definition are technology and urban development.

1.2.1 Existing Definitions

Many definitions of Smart City exist, but no one has been universally acknowledged yet (Cocchia, 2014). There is neither a general framework, nor a one-fits-all definition of it (O'Grady & O'Hare, 2012). The purpose of this section is to provide a basic understanding of the logic being the Smart City concept, and give examples of the numerous definitions of the topic in the literature. The initial review revealed a clear path of the term - evolving with the advancement of technology. Adjectives as "digital", "intelligent", and "smart" have been prefixed to "city".
This chapter is based on a literature analysis, using many definitions of this concept from diverse disciplines as urban studies, information technology and sociology.
In the published paper by Chourabi and others, (2012) that was cited over 1,000 times, one of the most important study in this topic, the authors identified eight critical factors of smart city initiatives: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure, and natural environment.

1.2.2 Comparison of the Definitions

Experts discuss a wide range of developments in Smart Cities. Some of them believes the purpose should be the widest use of the latest advances in ICT, others see the need for the implementation of people-centric smart cities.
The chronological order plays a big role in the evolution of the concept. From 2000, Hall only focused on the smartness provided by information technology for managing various city functions. The scope was widened later, as the sustainability, quality of life came into the picture with Toppeta, and services to the citizens started to be included by the authors from later.
Nowadays, there is no doubt that a Smart City is a multidisciplinary concept that embodies not only its information technology infrastructure but also its capacity to manage the information and resources to improve the quality of lives of citizens. The information technology usage is considered as a key factor in the "smartness" of a city (Caragliu, Del Bo & Nijkamp, 2011). It is able to sense, monitor, control and communicate most of the city services like transport, electricity, environment control, crime control, social, emergencies, etc.
This time the role of the government wasn't a part of the definition, but after 2010, the definition appears including the smart governance too (Chourabi & others, 2012).
The lack of a consensus has led to the comparison of the definition. Many researchers, experts or businesses are providing a definition to understand the Smart City concept, but they can differ a

lot. As the most popular and widely known provided definitions above show, some authors like Giffinger and others, Chourabi and others, Caragliu and others are focusing on the essential components, characteristic, such as the use of network infrastructure to improve economic and political efficiency and to enable social, cultural and urban development; strong emphasis on achieving the social inclusion of many urban residents in public services; the role of social and relational capital in urban development; and the important strategic element of social and environmental sustainability. While the others are aiming to understand the balance between people, technology and institutions (Fernandez-Anez, Fernández-Güell & Giffinger, 2017).
In general, the multidisciplinary nature of the topic requires a deeper knowledge in the fields of: Urban Design, Information Technology, Public Policy, and the Social Sciences.
Many papers reviewed the literature's definitions and dimensions of a smart city, and most of the authors of the definition are based on characterizing and identifying variables and elements of it. But as a conclusion, the definitions can be divided into two main groups: the information technology, focusing is on infrastructure, and the urban design with social sciences where the highlight is on the outcome: such as sustainability or quality of life.

1.2.3 Frameworks

After the understanding of the concept of Smart Cities, the assessment of the level of smartness have also become important for researchers and government officials. Considering the variables, like economy, infrastructure, innovation, quality of life, resilience, transportation, urban development, etc. rankings were developed to evaluate the level of them (Neirotti, De Marco, Cagliano, Mangano and Scorrano, 2014). This kind of frameworks can be an answer for how local governments are envisioning Smart City initiatives. For instance, it can recommend directions and agendas for Smart City research and outline practical implications for government experts (Chourabi & others, 2012).
Frameworks consist of indicators which are generally regarded as the main factors in deciding the development of the city (Yulianto, Purnomo & Madyatmadja, 2016). These factors are the basis when it comes to comparing cities envisioning their smart initiatives. There are already a lot of frameworks with the purpose of providing the most important indicators.
The most widespread ones are by Leydesdorff and Deakin (2010) who develop in their paper the Triple-Helix model, Chourabi and others (2012) create the Smart City Initiatives Framework that is mentioned already at the definition section, or the Smart City Wheel by (Cohen, 2012) where as a result of examining 62 indicators, the author highlighted the most important six: Environment, Mobility, Government, Economy, People, Living. Joshi, Saxena, Godbole and Shreya, (2016) designed the SMELTS framework, that also differs a bit from the already mentioned ones. This includes Social, Management, Economy, Legal, Technology and Sustainability factors. The Smart City Project of the European Union also provides a framework. According to them, a city can be named Smart City if it achieves specific results in all these six areas: Economy, Governance, Living, People, Environment, Mobility.

1.3 Internet of Things in Smart Cities

"*Smartness of a city is driven and enabled technologically by the emergent Internet of Things (IOT)*" (Atzori & others, 2010).

As this sentence and the discussed definitions above show, there is no Smart City without IOT. This chapter is designed to introduce the importance of the IOT, answering questions as: how the technologies of it can fit together to generate value, examining the architecture, and pointing out the biggest challenges regarding the security and safety.
The radical change in the current internet is the overwhelming network of interconnected objects that collect information from the environment by the method of sensing and interact with the physical world. Furthermore, this network also uses existing Internet standards to provide information transfer, analytics and applications (Association Instituts Carnot, 2011)
The IOT is a relatively new technology that aims at digitalizing physical objects which were not connected to the internet before. The goal is to create infrastructures of connected "smart objects" that serve different purposes (Wortmann & Flüchter, 2015). Well known and already existing examples are smart thermostats that control the temperature in private homes or smart light systems that allow energy savings by lighting up only when necessary in many cities.

As Borgia (2014) defines, the three unique steps to arise big data using smart IOT devices are the followings.

1. Collection phase: The smart objects generate data through their sensors.
2. Transmission phase: The data is transferred via wireless systems to a data collecting and processing unit. The data from different sources is collected and analyzed
3. Processing, managing and utilization phase: The comprehensive data is presented and made available for interpretation.

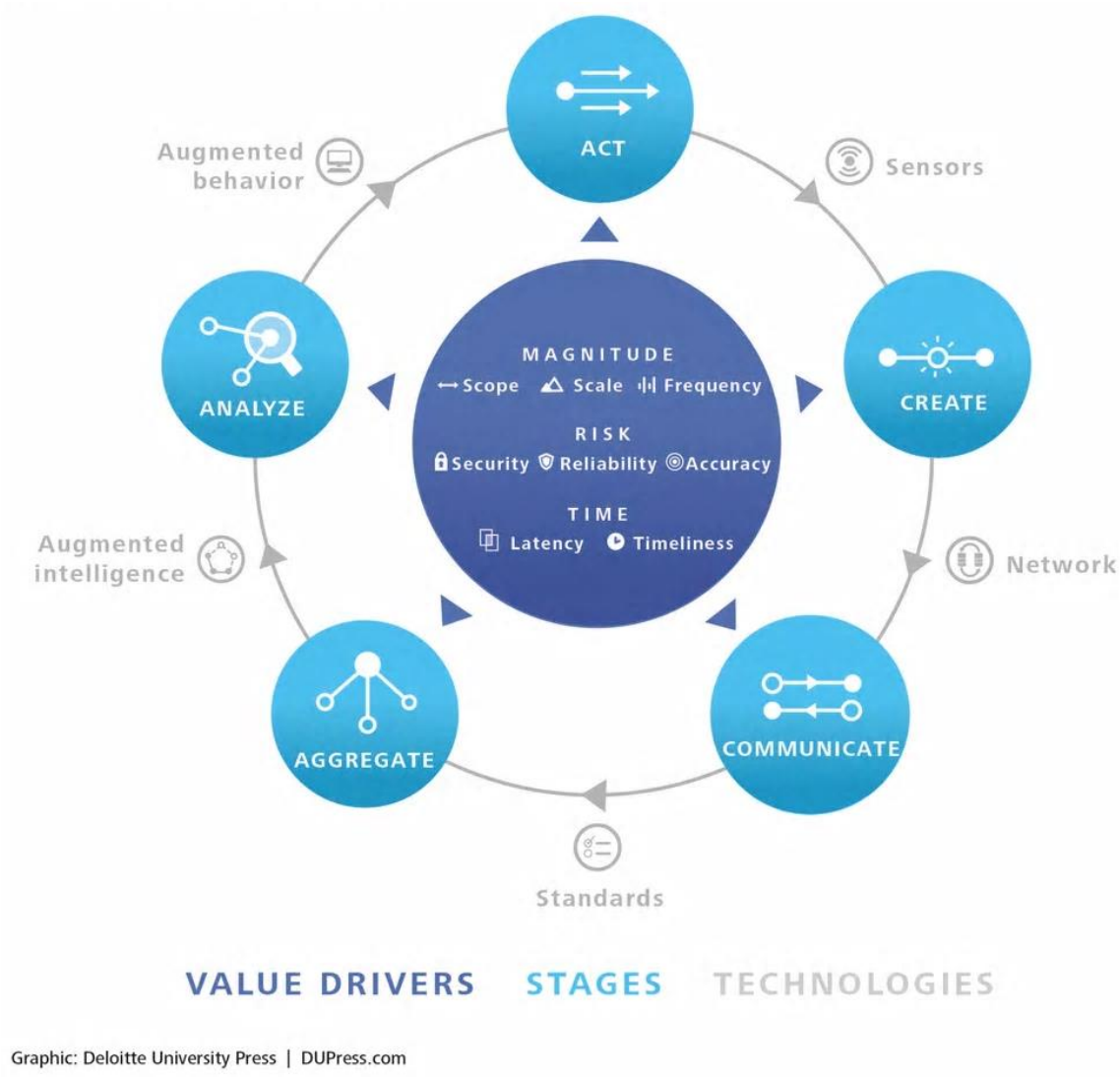
Using sensory technology and the IOT, special algorithms and data analyses can be processed, which gives us the opportunity not only to analyze the cities, but also to explore new and creative ways to reach a high level of sustainability. Being able to operate and develop our cities efficiently and innovatively.
The adaptation of the smart city concept is a complex challenge for the governments. By the implementation and support of big data applications it became possible to reach the required level of sustainability and improve the living standards. By utilizing IOT and big data analysis, the performance of health, education, energy, transportation, and water services improving, which leads to a higher level of comfort of citizens (Al Nuaimi, Al Neyadi, Mohamed & Al-Jaroodi, 2015).

1.3.1 The Value Delivery of IOT

IOT usage in Smart Cities has a lot of opportunities to improve results using technologies that provide up-to-date and accurate feedback and the data analysis drives to the better decision

making. The Information Value Loop (Figure 2) designed Odusote, Naik, Tiwari and Arora, (2016) shows the technologies of IOT combined in order to generate value.

Figure 2: Information Value Loop



Source: Odusote, Naik, Tiwari and Arora (2016).

The five most important building pillars of creating the Information Value Loop are the following stages:

1. Create: Sensors are collecting data from the physical environment — such as temperature, location, or device status.
2. Communicate: Information sharing through networks, between devices or a centralized platform.
3. Aggregate: Information, collected from multiple sources is combined.
4. Analyze: The analytical tools are helping to detect patterns or anomalies that require further investigation.

5. Act: After the insights are delivered, the user has to make a choice to respond with a real-life action or not (Meyers, Niech & Eggers, 2015).

In order to apply this value proposition regarding to the Smart Cities, here are the more general, real-life examples, how the IOT changes the urban economy and environment:

New Business Models

For the Internet of Things to be fully adopted by businesses, financial revenue is the key. Therefore, business models and ways to create value for IOT technology are needed. As the trend shows, new revenue opportunities are going to rise and the old, traditional business models will not be applicable to do so (van Dijk & Teuben, 2015). The list of business models can be seen in the Table 1, most of them are already implemented in the latest technological innovations today, this section is designed to introduce the most important ones.

As an example, one of the most popular music streaming sites, Spotify offers to listen music for free to their users. The revenue is generated in two ways, from the advertisement income and the premium service. The new business model's name is: *freemium.* The reason why this business model appeared is very simple, to offer physical things without price is way more expensive compared to the current digitized environment where the cost of increasing capacity is low. For this companies it Is worth it to offer their services for free, in order to obtain a large user base. They are benefiting either by getting revenue from the premium users (usually monthly subscription) or through the **advertisements** that are delivered to the not-payers. In some other cases, instead of advertisements, the not-paying-users are creating value through the data that they generate (van Dijk & Teuben, 2015).

Table 1: New Business Models

Advertising based	Provide content or services for free in exchange for receiving advertisements
Subscription	The user pays fixed price per month for consuming unlimited digital content and services
Pay-Per-Use	The price is based on the number of consumed items
Data monetization	The service and content is provided for free, but the business collects data of the consumer's behavior and preferences

Source: Own work.

A couple of examples for these models can be: for the advertising-based model is Facebook, for the **subscription** based are Netflix, and the above-mentioned Spotify, for the **Pay-Per-Use** it is the on-demand video from iTunes. The **data monetization** model is applied by Google for example, by tracking the online activities, they are providing better search results, connection suggestions, and better placed advertisements – Google Ads (where the revenue is coming from).

Incremental Revenue

Internet of Things is enabling to improve products with new technologies. Traditional physical products are valued by their individual performance. But IOT allows them to be connected, which creates a new key determinant in the value of the product: information. As an example: a standard light bulb. In the past, its value was based on brightness, efficiency and lifespan. Now, with the new technologies, it is more than that. It can enable automation, scheduling, remote controlling, security checks etc. (Odusote & others, 2016).

Improved Productivity

The use of IOT can increase productivity in multiple ways. Human mistakes are often influencing the manual way of work. The use of IOT provides automated machines and system that are working permanently, furthermore they can work faster and without mistakes and human presence. The usage of this IOT driven technology in manufacturing (which is an evolution of machine to machine communication) is called the industry 4.0 (Shrouf, Ordieres & Miraglota 2014). In a Smart City context for instance: by using electric public transport tickets, there is less human controller needed and people get in and out of metro more fluent without frustration of being stuck at a check point. Another example can be the public lighting, where sensors are detecting motion of people and vehicles in a street and adjust the public lighting to the required level.

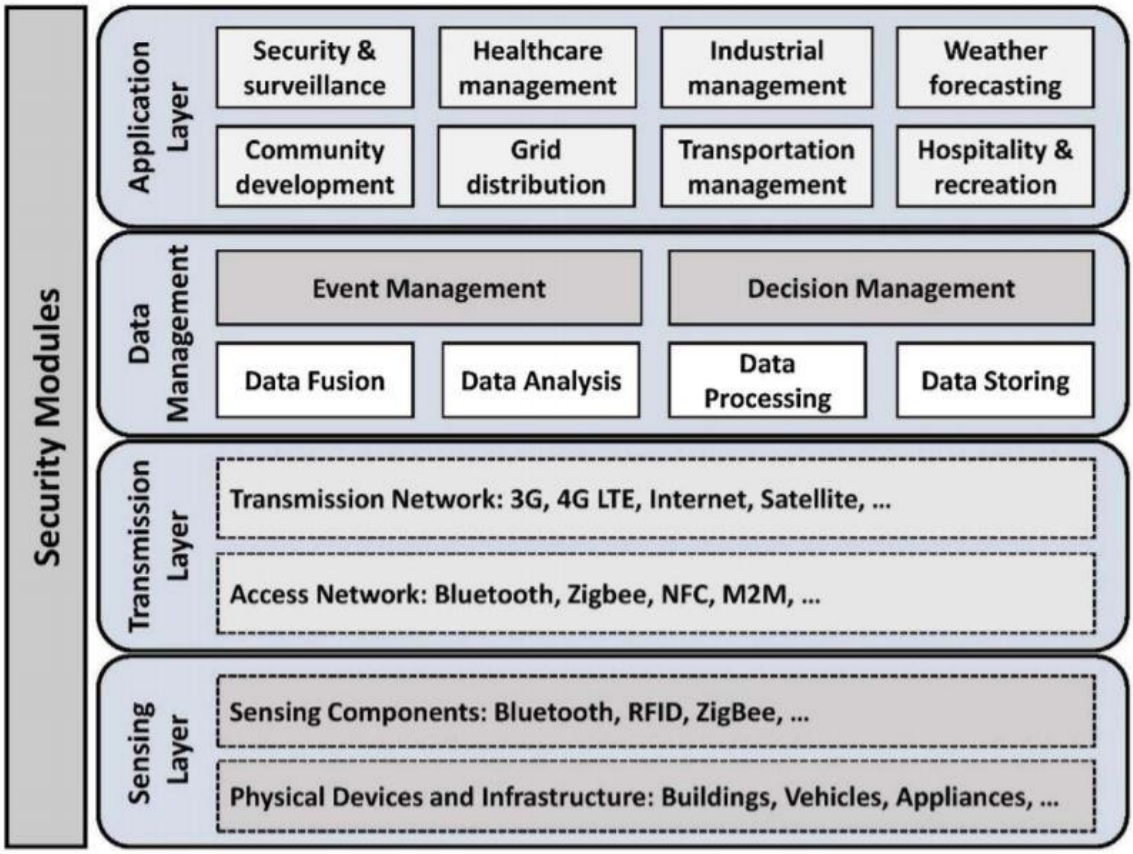
Cost Reduction

IOT is allowing us to reduce workforce and thus lower personnel costs. It enables us to measure and manipulate our processes in order to optimize the system which allows us to cut costs. Most of the IOT applications have some sort of cost reduction consequently. The above-mentioned example: smart light bulb – offers an environmentally friendly, cost effective way of lightning up only when it is necessary.

1.3.2 IOT Architecture

The IOT nowadays is more than Internet-connected consumer devices in Smart Cities. It is based on a four-layered architecture, that is fully integrated, and delivers value from the various networked “things” in order to deliver actionable business insights and support the decision-making process. The four separated layers are the following ones (Figure 3), differentiated by their technology, methods and purpose:

Figure 3: Layered architecture of a generic smart city



Source: Silva and others, (2018).

Sensing layer

As the Figure 3 presents, the bottom layer of the IOT architecture is the sensing/data collection layer. It is built of smart devices that are capturing data, and the wireless sensor network (WSN). The purpose of this layer is to collect all types of data, that the sensors and devices are capturing. The quality and quantity of data collection makes a huge role in the life of a Smart City, since this is the basis of controlling and managing every further step. The importance of it is claimed by (Kim & others, 2012) too, who expressed as: *"the smartness of a city increases with the coverage of sensor networks"*. But not only one of the most important roles, it is also considered as the most challenging task, due to the huge variety in datatypes. For all types, a different data acquisition technique is required, always based on the question of which kind of data is needed and the context. For instance: appliance control of smart home to load balancing in a smart grid, temperature and humidity data, personal health monitoring, disaster management in communities, etc. (Silva, Khan & Han 2018).

Transmission layer

Transmission layer as the Figure 3. presents, the next layer above the Sensing layer. It contains different type of wired, wireless and satellite technologies. It plays a role in advanced safes and locking mechanisms in networks and data exchanges. This layer can be easily an attack surface,

to avoid them, this layer has to has to be embedded with efficient security features. In addition, it is responsible for effective bandwidth consumption and session maintenance. The two sub layers are presented below (Silva, Khan & Han, 2018).

The **access transmission** communication types for short-range coverage.
The well-known examples are Bluetooth that uses short wavelength radio signals ZigBee (Memon, Zhang and Shaikh, 2012) that is offering a low power communication (distance of 10 m) between the enabled devices, RFID technology by using radio frequency to identify an object, a person, a vehicle, or an animal, and NFC technology which facilitates communication between two devices that are apart from each other (maximum 10 cm) (Want, 2011).

The other type is **network transmission** communication, which offers a much wider coverage than the previous. To mention a few examples starting from the most well-known, 3G and 4G represent the third and fourth generations of mobile internet. The 3G offers peak data transfer rates of at least 200 Kilobits per second, 4G network must offers the same with at least 100 Megabits per second for high mobility communication (users during motions: in cars, trains, etc.), and at least 1 Gigabit per second for low mobility communication. LTE is a leading 4G wireless service, with the main attributes: high throughput, high bit rate, and low latency (Huang & others, 2012).

Data management layer
As it can be seen in the Figure 3., the Data management layer is on the top of the transmission layer, under the application layer. It is participating as one of the main components, performing a variety of data manipulating, organizing, analyzing, storing, and decision-making tasks (Silva, Khan and Han, 2017). The process of maintaining the data can be divided to sub-tasks:

- data fusion: is to enforce accuracy and consistency. The retrieved data from multiple data sources are integrated and combined.
- data analysis: is a mechanism to reveal valuable data that is unknown and hidden in the surface. Since smart devices are generating large amount of data, experts mostly use data mining techniques.
- data processing: ensures to be able to identify and act based on the retrieved information quickly and effectively.
- data storage: gives access with reliable and scalable devices to complex and large amounts of data.

These four stages are the building blocks of event and decision management. In line with data gathered from multiple data sources and data collected from data storages, the decision management component creates appropriate decisions. It is crucial, since this is the way of implementing results of the collected, analyzed, processed and stored data into the everyday life. In different approaches, decision management components used different algorithms and techniques in order to improve the accuracy of the real-time decision-making process (Silva, Khan & Han, 2018).

Application layer

The top layer of smart city IOT architecture is the application layer, that is taking place between citizens and the data management layer. As citizens are directly interact with it, the performance of the application layer greatly influences users' perspective and user satisfaction (Silva, Khan & Han, 2018). From the aspect of an urban citizen, the layers that have the most attention are the application layer and the sensing layer. These are “physical things" that people can see, touch and understand. Data application layer can be seen for example in the case of downloading an application to schedule the best path with public transport, while the sensing layer can be recognized as the cameras, or other type of sensors are placed in the city.

1.3.3 Security Challenges of Using IOT

„*The lack of security puts smart cities at risk and creates a fear of the IOT*.” as Victoria Beltran, IOT and Smart Cities researcher expressed on the Smart City Expo World Congress in 2016 (Beltran, 2016). One of the major challenges that smart cities are facing, is the security question of using IOT. To increase the performance of a Smart City, cities need to have strong and clear management models for their cybersecurity, since the citizens must trust who provides information, products or services.

It is a complex and difficult task, since IOT architecture is dealing with billions of objects that are continuously interacting with each other, with virtual entities, and with human beings. The main challenge is to make these interactions secured somehow, by protecting the information and service provisioning of all participants in the process, and minimizing the number of incidents that affect the entire IOT. The number of attack vectors available to malicious attackers can be surprising, because the most important attributions of the IOT are global connectivity - "access anyone" - and accessibility - "access anyhow, any time". Because of the high degree of the IOT complexity, the type of attacks can be very diverse. Some examples are: targeting the communications channels, physical threats, denial of service, identity stealing.

Some of the above-mentioned challenges, in addition the security mechanisms for the IOT, have already been listed by the research community. Few of the examples are the following:

Protocol and network security: since the IOT architecture is incredibly heterogeneous, the implementation of protocol and network security services require special attention in order to be enough secure to prevent attacks. Constrained devices can interact directly with various devices (for example, other constrained devices, full-flagged web servers), or through gateways. For using this, protocols require credentials, an optimal key management system must be implemented to distribute credentials and create the necessary session keys (Roman, Zhou & Lopez, 2013).

Identity management: The existence of billions of heterogeneous objects creates a big challenge regarding to the identity management. Beyond declaring "identity" in this context (for instance: underlying identity versus real identity, core identity versus temporary identity), mechanisms for achieving universal authentication is needed. Without authentication, it cannot be guaranteed that

the data flow is produced by the right entity and contains what it is supposed to contain. Another important aspect of authentication is authorization. Without access control, everyone would have access to everything, so implementing a suitable authorization system is also required (Roman & others, 2013).

Privacy violation: Almost all aspects of our personal life are captured by digital data that is somewhere stored in the digital ecosystem. In fact, the existence of data flows that consist an enormous amount of information is a great threat to privacy. Almost every aspect of our lives creates a digital footprint. Regardless of data about purchases and payments, geographical location and movement, health records, browser history. *"Every two days, the world creates more data than in the entire human history up to the year 2003*"- said Eric Schmidt, the Executive Chairman of Google in 2010. (Siegler, 2010) Although this is a questionable statement, since it is difficult to measure the amount of data produced, but it is sure, as the User Generated Content is gaining ground, the amount of data is growing incredibly rapid. The first type of this threat is hacking, and retrieving the personal data unauthorized. In the recent years the hacked iCloud accounts of celebrities gained a lot of attention, but the other type of the privacy violation is well-known (especially from Cambridge Analytics scandals) too. Data analytics became so powerful tool, that it can combine datasets to predict someone's lifestyle, habits, political belief, and many others. Even to the point where others able to know more about a person than the person itself (van Dijk & Teuben, 2015).

Trust and governance the amount of papers and researches that can be found, is already a proof of the raised attention. It is a good way to make IOT-connected enterprises aware, that their security is needed to be a top priority. Most of the focus is concentrated on the privacy concerns. According to the amount of problems with the IOT security leaks in the literature and news, the companies are not putting enough effort in developing security solutions as fast as they do in technology innovation. But it is clear now: the old-school and obsolete approaches like VPNs and two-layered protection is not enough in the case of IOT. To develop safe IOT products, it is necessary to implement security solutions already at the development stage. It requires experienced hardware- and software engineers, and also quality assurance specialists. However, it is not easy to find experienced professionals who can adopt security technologies regarding the needs of IOT devices.

1.4 Critical points

A smart city can gain economic benefits by exploiting the potential of existing infrastructure. The environmental impact of smart energy management solutions is extremely positive, and minimizing energy use can reduce carbon emissions and reduce energy overcapacity and improve waste management. For the sake of smart urban development, the positive effects and advantages are usually emphasized, but they also have disadvantages, and challenges.
The smart city concept employs a wealth of modern technology and solutions. Cities are highly digitized cities by nature, characterized by large volumes of data stored digitally and large numbers

of physical objects with an online connection to the Internet (van Dijk & Teuben, 2015). The infrastructure has developed faster than its security, leaving a lot of space for curious researchers and cyber criminals. Since we are talking about a large and complex systems, it can be said that:

hyper connectivity + increasing complexity + tremendous amount of information
= higher vulnerability.

It is possible to abuse the possibilities for criminal purposes, in this section some of the typical crimes and security breaches of Smart Cities are going to be presented.

Huge, complex attack surface

The task of installing a whole city of buildings is intelligent electric meters, doors, HVAC systems (heating, ventilation and air conditioning) and lighting, almost inexcusable security issues. With the usage of IOT, all kinds of machines are connected to the Internet. As everything is automated, humans diminish are removed from the equation. As it is mentioned above, one of the reasons for the improved productivity is and efficiency, is the hyper connectivity. But on the other hand: connected objects are vulnerable for hacking. This goes far beyond the type of hacking resulting in embarrassing privacy leaks of celebrities, it means a real threat to life. In the case of objects that belong to the critical infrastructure and connect to each other, hacking is a huge threat. Hacking the control system of planes, energy plants, pacemakers, self-driving cars and other related machines can seriously disrupt vital systems (van Dijk & Teuben, 2015). This high level of integration brings you not only technical but also operational challenges. If the metro stops, people will not get to their workplace and this will cause further downtime. The attackers are aware of this domino effect and take advantage of it small, poorly protected systems that do not seem to be key, but stop them triggering a chain reaction.

A case study with the title of: Green Lights Forever was published, where a couple of researchers from the Electrical Engineering and Computer Science Department in University of Michigan investigated the networked traffic signal system in the US. They typically use wireless radios to communicate, and the researchers found security flaws in these connections. By controlling the traffic light, (in coordination with authorities) they successfully demonstrated this type of attack, when the hackers take advantage of the vulnerability of the interconnected infrastructure (Ghena, Beyer, Hillaker, Pevarnek & Halderman, 2014).

Uncertainties and incomplete testing

One of the biggest problems is that sensors used for smart buildings and cities can easily be broken. You can even send false signals that can cause measurements to stop, pollutants may get into the water supply, etc. Most manufacturers will issue their hardware and software without any security testing, which customers will be running without testing. Although they are tested for functionality, not cybersecurity.

Lack of organization and control

Who will be responsible when a smart city crash? Many cities have no clear cybersecurity leadership. It would be necessary to create a city-specific CERT (Computer Emergency Response Teams - team of experts handling cybersecurity incidents) and / or a security operation center, not only for sharing information, but also for vulnerability testing and incident responses. In addition, every city has emergency protocols for events like hurricanes, earthquakes, and terrorist attacks, but usually the emergency response protocols for cybersecurity attacks are still lacking. The public sector should also treat cybersecurity issues similarly to how the business sector does.

The local government should ensure that the ICT strategy is strong merge with the larger urban strategy. The system must be standardized, interoperable and open, but it must be secure to ensure that third-party information is reasonably and securely provided in order to provide general and seamless services. It is increasingly important that the IT manager of local governments take part in strategic-policy discussions. This technology allows you to integrate and deploy policies that support their change. Like other ICTs systems, the smart city's technology and communication environment (network infrastructure and the Internet of Things) have vulnerabilities that attackers can take advantage of. In fact, these systems are exposed to dangers because of their complexity and heterogeneity, so it is necessary to develop further refined defense strategies. It would be necessary to incorporate planning, construction, operation, maintenance and use of the city's services to protect it from a cyberattack at a high security level. For a smart city, it is important to consider the impact of installing IOT endpoints on urban infrastructure and service life cycles. Urban IT managers should be designed with security and functionality as well such as planning bandwidth requirements. It is impossible to defend the system and the resources from every point of view, at the same level. The city administration needs to identify which is the most critical area to be protected. These threats can be objects of attacks, the type of attacks depends on the intentions and motivations of the attackers (financial, criminal or political). As these urban IT ecosystems increasingly rely on cloud or infrastructure virtualization, social and mobile computing is the main access point platform for applications and services. To ensure an adequate level of security of the system and resilient ability, competent ICT leadership, and strong security-conscious processes and defense technology. The right cybersecurity strategy can interpret the difference between success and failure.

New types of crime

Digitization causes a paradigm shift in crime. One of the characteristics of the new types of crime is its almost unlimited scalability, since the physical barriers are not present anymore. In the traditional way, for instance in a case of a thug band, it was easy to determine where were they „working", and the number of victims was finite. In the digital world, these limitations no longer exist. one criminal organization can rob hundreds of millions of people in one attack. The most recent and the biggest until now is the WannaCry ransomware attack, which was spreading rapidly in 2017, May. Like all ransomware, it took over infected computers and encrypted the contents of their hard drives, making them impossible for users to access. For the decryption, it demanded a

payment in Bitcoin crypto currency, and as a consequence, anyone who refused to pay would eventually lose access to their files and information from the effected PCs (Ehrenfeld, 2017).

Variable policy, variable budget

Cities are changing politically, which has increased the attention. From security point of view this can be both good and bad at the end. Cybersecurity-conscious education of executives requires budget and payment. In the public sector, especially after elections, managers can often change, hence the number of budgets. Cybersecurity is much worse in the public sector as more talented professionals work in the business sector for better pay. For this reason, the cybersecurity problems of cities are real and present.

Ensuring the continuity of critical services

Inevitably, the vulnerability of the system increases as it becomes interconnected and integrated. This can be especially the case when generating large amounts of data (Big Data) on various smart devices (sensors, cameras) and all of this is processed with interconnected systems. Network infrastructure - be it broadband, Wi-Fi or satellite access points and provides security breaches and human error.

Legislation is becoming more and more preposterous in this area. The Cybersecurity Strategy of the European Union, issued in February 2013, also ensures that the critical infrastructure is properly protected against any kind of cyber-attack and that the data is protected in accordance with the requirements.

As a support, CRISALIS (CRitical Infrastructure Security AnaLysIS) was created by the EU, this project aims to protect critical infrastructures against targeted attacks by new methods. It provides new tools for intrusion detection and develops new techniques for analyzing successful penetrations (CRISALIS by the EU, 2016).

Disruption of the labor market

Due to disruptive technologies (automation and robotics), a lot of existing jobs might disappear with unemployment as result. In 2013 researchers of the Department of Engineering Science, regarding the impact of computerization, 702 jobs were analyzed by University of Oxford. For each job, the researchers estimated the change of that job being fully computerized in the next 10-20 years. The results are: 47% of total employment has a high probability of disappearing due to computerization (Frey and Osborne, 2013). As an outcome, a critical point can be increasing number of long-term unemployed citizens (van Dijk & Teuben, 2015).

And finally, as the cities are continuing to grow and becoming more and more complex, one of their biggest challenge is to truly adapt to their citizen’s needs. The next chapter is designed to investigate, which are the possibilities, motivations, technologies, and fields of Social Media, to make sure, that all the city development is first and foremost centered on our human experience, in order to build a citizen centric city.

2 SOCIAL MEDIA AND PUBLIC ADMINISTRATION

The Smart City initiatives are built on data, collected by physical sensors, however they are not able to capture opinions and emotional reactions of citizens. Every day, millions are sharing their observations, thoughts, feelings and experiences, perceptions about their city through Social Media updates (Doran and others, 2015). This is a field that is getting more and more highlighted, as the freshly published articles shows by (Witanto, Lim and Atiquzzaman, 2018) where a method was proposed for short text preprocessing with an example of Twitter tweets, that were collected to analyze topics relevant with citizen's opinions. Or another example by (Barns, 2018), who explored the topic of designing a smart governance platform, and brings an example of one that combines official, observational and Social Media data into a single interface.

In general, the interest around Smart Cities is constantly growing, regarding the fact of having over 420 experts, 16,688 visitors from more than 600 countries on the Smart City Expo World Congress in Barcelona in 2016 is already a 30% growth compared to 2015. The mission is to encourage the out-of-the-box thinking and inspire a worldwide call for action to foster more efficient, equitable and sustainable urban development. In 2017 the Smart City Expo World Congress had a 11% increase compared to 2016, which confirms the show as the benchmark event in the smart city field. In numbers: 18,754 attendees, representatives from more than 700 cities and 120 countries. Regarding the topics, after the Internet of Things and the technological and ecological aspects from the previous years, the event was advertised with the title of "Empowering Cities: The Strength of People", and as the organizers claim: "The congress was a major success where attendees learned why empowering cities means empowering people, thus building a better future." (Beltran, 2016)

In the topic of Social Media data, the citizen-centered approach got highlighted, one of the key speakers that has a lot of insight on Social Media data usage in Smart Cities, Hugo Zaragoza from Spian, the big data scientist and Social Media expert. In the next year, in the same congress, Miguel Gamiño, the CTO of the City of New York pointed out that "When you ask the community, you start building solutions to things that people themselves have prioritized." He also claimed, that the key of building successful policies, is focusing on neighborhoods and discovering what are the priorities of the community (SCEWC, 2017).

Besides the Smart City Expo World Congresses, Professor Carlo Ratti the department of Urban Studies and Planning of Massachusetts Institute of Technology (MIT) also mentioned about their latest researches regarding ubiquitous computing. Their research focuses on empowering citizens to make choices that result in a more livable urban condition. Using this methodology, they are looking at many aspects of it, one of them is the citizen engagement (Ratti, 2018).

This trend – more presentations are focused on urban topics, citizens got highlighted, on the biggest congress regarding Smart Cities - shows, that the value of Social Media data in that Smart City developments is getting discovered.

Sharing thoughts, impressions, opinions, wishes, experiences etc. became a huge part of the daily life. Using Facebook, Twitter, Instagram, Foursquare, personal blogs and many more platforms are perfect to share opinions – that is, as an interesting study from New York University and the University of Vermont shows, people are more honest in the online channels than in person.

Considering this fact, the unfiltered Social Media data can tell what citizens really think (Cody, Reagan, Dodds and M. Danforth, 2016).
As in the historical background of the Smart Cities it is mentioned already, the digital transformation marginally changes councils, public authorities, shape of businesses, by providing a new and improved method of how to deliver their services to citizens and communities. By adapting these new methods, the engagement level of public is emerging, that results in a more citizen and community-centered approach. The increased the amount and good quality data about how citizens want to live their life indispensable in order to find the best solution of how technology-enabled cities and communities can best serve the public.
It is becoming more and more common for public officials and city agencies and governmental institution to have Facebook or Twitter, sometimes even YouTube, Instagram or Snapchat accounts, for broadcasting information and gathering feedback. But the municipal use of Social Media shouldn't be narrowed to tell their daily accomplishments to the public, cities could produce value from Social Media if they would not only share, but listen their citizens. In this chapter the usage of Social Media data is going to be discovered, including the new way of data collection – citizens as sensors, its challenges regarding the urban and the technological aspects, the main methods of analyzing Social Media data in order to get valuable results to build a citizen-centered environment, and providing a current picture, about how the public administration changes, how is the communication and participation thorough their Social Media account at the moment.

2.1 Citizen Engagement

The following paragraph is a good example to compare how the world changed in the last 20 years regarding the advices of treating personal data.

> *"Do not give your phone number, social security number or address. Do not fill in questionnaires. If you must use the Internet, use someone else's computer.*
>
> *The Economist, 1 May 1999"*

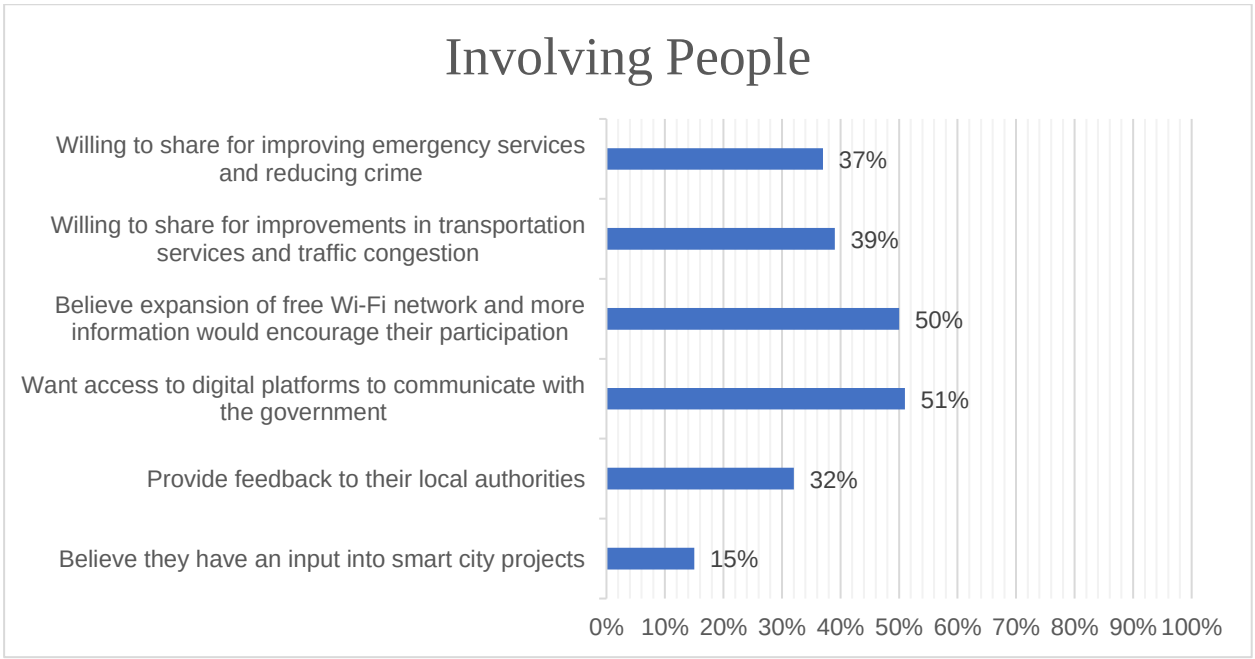
Earlier, resident meetings were held, where people could view proposed designs or talk to city government employees about the changes, their desires and concerns. It is still possible to do it today, but the new way of using digital platforms: apps, websites and Social Media is very tempting. But to be able to follow the new direction, the viewpoints of the citizens must be completely changed, since not so long ago, in 1999, the views described in The Economist magazine were widespread.
Nowadays, data-informed approaches are the building blocks of a Smart City, sharing data from waste management and public transport through to policing and emergency response. This new wave of services is bound to evolve from smart infrastructure and smart devices that will influence all aspects of our social eco-system (Al-Begain and Télécom ParisTech, 2012).
But how to convince citizens to become "sensors", and improve the willingness to share information? Recent paper shows that in the US, 60% of citizens feel like the governments and

decision makers can't hear their voices, the decisions regarding local and national societies are made without listening them. In other words: they don't feel heard and their importance, which is a simple way to lose them as a resource for the future. The first step of building engaged communities is: listening to people. To see some examples where this way worked perfectly, it is enough to think about Uber, Netflix, or Amazon, with their user centric view, where they can send direct message a service agent on their fast food delivery app, and they receive what they want. Now, an expectation of not waiting hours in a queue to talk to someone at the city hall is not so impossible, since they saw the example of the previously mentioned brands, where they could send a short message via Social Media, and got a rapid answer and actions from the companies.

And another survey shows, conducted by Philips Lighting and the Economist Intelligence Unit (EIU), the research and analysis division of The Economist Group found that, more than 50% of people would like to have wider access to digital platforms to allow them for communication with the government, and also, the same amount of people think believe that the expansion of free Wi-Fi in public spaces and more information about smart city projects would encourage them to engage further (Philips Lighting and Economist Intelligence Unit, 2016).

Unfortunately, the current number of citizens that are providing feedback to their local authorities is less than one-third, but more than a half say they would like to do so. More details presented (Figure 4) below. But the good news is: citizens are willing to share their personal data, especially for the purposes of improvements to transportation services and traffic congestion (39%), and for improving emergency services and reducing crime (37%) (Philips Lighting and Economist Intelligence Unit, 2016).

Figure 4: Social Media in Smart Cities - Involving People



Source: Own work.

As a conclusion, the citizen engagement mostly based on the results, people are willing to share information if they feel that it matters, the governments and city planning listen to them. By

showing them the results and the importance of their input is the most powerful weapon to encourage them for sharing. An example could be: if someone reports an issue, like a broken streetlight, once the problem is fixed the city worker sends a picture to prove it is fixed. Citizens need to feel part of the changes in their city (Philips Lighting and Economist Intelligence Unit, 2016).

2.1.1 Citizens as Sensors

With the exponential growth of Internet users, the possibility of having People as Sensors appeared. The first significant article in this topic was published in 2007 by (Goodchild, 2007) with defining "People as Sensors", "Citizens as Sensors". This subchapter explains the differences between the terms People as Sensors and Citizens as Sensors, and examines their willingness to share.

"*Citizens by using Social Networks, have become one of the most interesting and reliable sensor networks of any City."* As Hugo Zaragoza, the main speaker of the Smart City Expo World Congress 2016 claimed on his scientific blog (Zaragoza, 2016).

Sharing thoughts, impressions, opinions, wishes, experiences etc. became a huge part of the daily life. Using Facebook, Twitter, Instagram, Foursquare, personal blogs and many more platforms are perfect to share opinions – that is, as a study from New York University and the University of Vermont shows, more honest in the online channels than in person. Considering this fact, the unfiltered Social Media data can tell what citizens really think (Cody, Reagan, Dodds and M. Danforth, 2016).
As Goodchild (2007) declared, People as Sensors defines a measurement model, that contains new type of data compared to the "regular" sensors that was described in the first chapter (Internet of things in Smart Cities, IOT architecture subchapter: regular data is for instance: appliance control of smart home, load balancing in a smart grid, temperature and humidity data, personal health monitoring) because the human contribution includes not only the objective, but also the subjective measurements, as their individual sensations, current perceptions or personal observations.
One of the biggest benefits of acquiring data with this method, it the usage of the already existing devices, such as smartphones, PCs, laptops, or tablets, only a software or application is required, where the users can insert their observations. The citizens role is augmented with sharing real-time measurements, exploiting and elevating their expertise and their personal, local experiences. Opportunely, there is no need for the development and installation of costly new physical sensors. The clear differentiation between People as Sensors and Citizens as Sensors are essential. Both are based on voluntary motivation for instance exhibitionism, altruism, the desire to fill the gaps in data, or sharing information with acquaintances and the same time: with the public.
The main difference is: Citizens as Sensors can be considered as a part of People as Sensors, because need to have a knowledge about the specific area from where they are sharing information - ranging from bird sighting to air pollution reports or wild animal classification. Below (Table 2.), the Content row includes the type of the data which is contributed, Prior knowledge specifies

if there is any knowledge that is required regarding the environment from the user, and Reliability refers to the quality of the generated data and the contributor's trustworthiness (Resch, 2013).

Table 2: Comparison of People as Sensors and Citizens as Sensors

	People as Sensors	**Citizens as Sensors**
Content	Layman observations	Semi-professional observations
Prior knowledge	Medium	High
Reliability	Medium	Good

Source: Own work.

As a conclusion, the importance of People as Sensors is getting more and more used and highlighted, however this approach is not able to replace the current set of physical sensor networks. This approach is used to complement them, since the term "observation" is more suitable than "measurement", because highest measurement accuracy is not an absolute requirement as it is with the physical sensors (Resch, 2013).

2.2 Challenges

If the topic of Smart City development based on citizen's feedback come to focus, the legal and technological challenges are highlighted most of the times. As for instance Kitchin, (2016) the Smart City and Urbanism expert claimed regarding the legal aspect *"processing, analyzing, sharing and storing large amounts of actionable data about cities and their citizens also raise a number of concerns and challenges."*. A good example for the technological challenges is the study from (Giatsoglou, Chatzakou, Gkatziaki, Vakali and Anthopoulos, 2016) that is saying and explaining that the diverse sources of information requires a very comprehensive approach in order to exploit the various types Social Media data.
But beyond those problems and issues to solve, to gain wide acceptance for this type of data it is necessary to examine the urban challenges also, as did already (Skoric, Zhu, Goh and Pang, 2016), who published a study with a conclusions about predominantly positive relationship between the use of Social Media and citizen engagement.

2.2.1 Legal Aspects

Using Social Media based data means: dealing with personal or individually significant data, that automatically raises the privacy questions. This type of information must be always carefully protected, that makes the establishment of legal frameworks (both of national and global level) essential.

There are attempts to protect our privacy: The European Union's General Data Protection Regulation is the most sweeping recent attempt from 2016, it is giving individuals unprecedented control over information about themselves within the European Union (EU) and the European Economic Area (EEA).
The biggest limiting factor of how to treat privacy, is the differences between the interpretations. As an example, private data can be traded like an economic good by its owner in the USA, while it is against the above-mentioned privacy protect regulation in the European Union. A supra-nation legislation would be necessary, a world-wide regulation, that is a huge and complex agreement among that nations, that is incredibly hard to acquire.
The second critical question is the data ownership, in other words: Who owns the data? The people that are capturing the data – citizens or mobile operator, or institutions that are providing a system to collect data, or simply the data providers?
Moreover, if this private data is anonymized and analyzed in order to make a decision, who is responsible if decisions that are based on this information appear to be wrong?

The current available literature (Resch, 2013) mainly points out the following points,

- Raise the attention, explain, and educate decision makers and citizens about the possibilities of using Citizens as Sensors, including the nature of this new type of data and analytics that can be derived from it.
- Establish clear rules for the data collection process, take account its limits, and transparency rules

But there is no concern or general procedure about how to treat these sensitive questions. (Kitchin, 2016) has the same opinion as Resch, in his paper the declaration of the current procedure is ad-hoc, haphazard and uncoordinated. However, as both of them highlighted, this manner gives potential harms to citizens and should not be allowed to continue.

As conclusion, while dealing with the issues of privacy, data ownership, accessibility, integrity and liability, a solution should be based on covering all together and not treat them separately.

2.2.2 Technological Challenges

In the last few years, the technological development is Smart Cities has mainly focused on the issues of networking, security, sensors and sharing open data. However, the rich information base, that was developed by people at the same time, and has not yet been processed and integrated into the Smart City paradigm. The challenge is given, people’s opinions, measured in real-time through Social Networks should be considered somehow in the Smart City’s life.
In the continuous stream, that people are creating by publishing their emotions, desires, opinions, fears on the Internet, huge amount of data is created. The null step is to make sure that the correct data is processed to begin with. The biggest challenge: harnessing, requires particularly deep understanding from the data scientists’ side, and also the technology still in its infancy. Turning

this enormous amount of data into relevant, understandable insight is the biggest challenge. Step by step, this semi-advanced level technology is used regarding capture, filter, process, analyze and serve Social Media data. Algorithms must be enough intelligence to differentiate between for example a Tweet about Cambridge, England and Cambridge, Massachusetts, and, regarding the emotions, whether a Facebook user is complaining or praising the recycling service. For this, a coherent set of summaries and indicators are needed, that is enabling a set of application programming interfaces (API) and applications, from real time alert systems to periodic reporting for instance.
In the following paragraph the steps are pointed out with the short description of how the challenge could be solved:

- Capture: automatic access and querying of Social Network sites via APIs.
- Filtering: Distinguish the name of the city and find the meaningful content (e.g. there are more than 20 Barcelonas in the world). Detect and exclude “false” conversations that were generated by BOTs and other artificial methods.
- Categorization: Separate conversation about tourism, health, culture, security etc.
- Summarization: Discovering the main trends for a given topic
- Key Performance Indicators: Derive numerical indicators to have a more accurate analysis and visualization
- Visualization: Providing powerful and intuitive dashboards to read summaries and indicators and drill down to specific mentions when necessary.

As a conclusion, great technological effort is needed to develop processes and algorithms, usually connected with Big Data, in the field of Machine Learning or Natural Language processing for instance, but a high level of human intervention is also necessary before meaningful data can be derived from Social Networks (Zaragoza, 2016).

2.3 The Digital Transformation in the Public Sector

The acceleration of the urbanization processes and the increasing penetration of the information age make it necessary to incorporate processes and solutions into an everyday life based on information technology. Supporting public policy processes is also a requirement for the concept to be realized since the starting point is always a development planning decision coming from the city administration, which also requires a national, and an international environment. These environments support and provide a base for decision-making. The second important factor is the modern infrastructure, since if it is not well-developed, then the development and operation of smart processes may face many obstacles. The third important factor is the need to provide information and educate the citizens. Without the education only those groups will join the programs, projects that have already had the right knowledge and qualifications.
As Dilmegani, Korkmaz and Lundqvist (2014) expressed, nowadays, in the 21st century, citizens and business organizations expect to have information accessible, easy to find and cheap or free. Governments around the world are going a lot to get to know their citizens' demand and the benefits

of common values. This is demonstrated by the fact that the government sphere of more than 130 countries has online services already. To have a full-use of the benefits of digitalization, it is necessary to deepen digital transformation from online services to e-government portals. To do this, we have to explore the possibilities of developing productivity, collaboration, process efficiency and innovation.
The best example provided in the same study is Estonia, where 1.3 million people can use electronic identification cards to vote, pay taxes and access over 160 online services, from unemployment benefits to property registration (e-Estonia, 2019).

The digitalization processes in the public sector are present as a public value, embodied by the presence of digital techniques. It is participating in both administrative processes (compulsory services such as customer gateway, internal processes, resource management) and personal services. If the processes and the implementation of the necessary digital services (implementation of e-administrative improvements, reinforcement of the IT background) properly deployed, the increased value of public services can be achieved. A few examples can be found below:

- Resources and time can be saved by providing the service properly designed and user-friendly.
- The problem of geographic and time constraints can be solved by creating online applications, we can have access to public service availability with a relatively inexpensive. This option can be particularly favorable to those who live in a suburban or disadvantaged.
- Special benefits can be provided to those who are physically excluded from public bodies and generally have limited social relationships as they contribute to social convergence.
- The one-window system, where services are available on a single virtual platform gives equal access to services to the right-holders. The digital presence is included, which increases the level of transparency.
- Using the applications and analyzing the data provided, provides insights into user behavior and expectations. These data offer mass customization options and provide significant inputs to service development phases
- Because of the transparency, users are more comparable, and they can be easily transposed among the different public institutions. This also serves as the target of creating smart cities. Globalization is an indispensable requirement for personalization and ensures that public bodies cooperate with one another, inter-religious problems.

The biggest criticism or risk of digitizing public services is that automatic, mechanized techniques cannot provide individual solutions to situations that require personal consultation, empathy, or expert consideration. It can be a problem if services are marginalized or less-integrated by members of the group, because of the lack of physical access or lack of skills (linguistic skills, computer literacy). To overcome this, a human skills development program aimed at targeting the groups concerned (elderly, immigrants, disadvantaged people) and focusing on the application alternatives would be indispensable.

2.4 Public Administration Use

Social networking offers a lot of advantages for promote and facilitate actions such as discovering and attracting members with common interests, information exchange, decision making among, integrating individuals (Linders, 2012).
The number of public administration account on social networks is constantly increasing. Websites as Facebook, Twitter, YouTube offers a great possibility to interact with citizens. While during the one-to-many communication a post can reach millions of citizens in a second, a many-to-many communication appeared also, for information exchange between the local government and citizens (Agostino, 2013).
In this sub-chapter, as the experts Rowe and Frewer (2000) introduced the two terms for the levels of public engagement: public communication and public participation is going to be explained.

2.4.1 Public Communication

Public communication on social networks aims at providing a one-way information flow from the public administration account to citizens (Agostino, 2013). By this way, the communication becomes more effective as Bertot and others, (2012) claims, since the segment of the population that was previously inaccessible and underrepresented, can be reached. The benefits are very wide ranged, for instance to identify and respond in real time improves the effectivity of emergency management, as well as public safety level in a city. In a case of critical events like (e.g., earthquake, fire, terror attack, protests, etc.) respond could be communicated via Social Media, reaching much more people than using the authentic way – newspapers, television etc. (Kavanaugh & others, 2012).

2.4.2 Public Participation

Public participation on social networks is a dialogue between the public administration and the citizens based on a two-way information flow. While traditional media as television, radio and newspaper offers a one-way communication as it can be seen above, the case of social networking is different. A conversation can be maintained between the local governments and the citizens on the internet. Through these dialogues, the citizens can gain more information about the governments, share their opinions, ideas and feedbacks regarding the services and acts. This way municipalities have the possibility to react, gather feedback, and obtain advices, understand their citizens better and gain more trust from them (Sobaci, 2016). Also, in the emergency management, critical events can be identified as spikes in the Social Media volume. By analyzing Social Media streams, possible to detect meaningful patterns and trends: accidents, traffic, terror attack - issues of concern for public safety or general quality of life can be discovered, monitored, and solved (Kavanaugh & others, 2012).

3 CASE STUDY OF PORTUGAL

According to the framework provided by the European Union, a city can be named Smart City if it achieves specific results in all these six areas: Economy, Governance, Living, People, Environment, Mobility. This case study is focused in one of them, the Governance, and examines the presence of the Portuguese municipalities in the Social Media.
As Sobaci, (2016) declares, the popularity of using Social Media is increasing among the governments and municipalities. He claims also, that with strategic planning, effective management and realistic expectations, Social Media is a great force to drive to the e-government growth. As he says, even if the municipalities have websites, Social Media tools have been the main tool in establishing and maintaining the online communication between the local government and citizens. As an initial step in becoming Smart City, the use of Social Networks (for instance Facebook and Twitter) is one of the basics to improve communication speed services provisions, and engage citizens.

3.1 Case Study Introduction

The Social Media use of municipalities has a great potential how the governments could respond their citizen's needs. It is also a huge opportunity to improve the level of engagement in order to understand their expectations regarding the city. Since the Social Media use such as Facebook, Instagram and Twitter, became a part of the citizens every day's life, they have and express more sophisticated expectations of how the government should respond their demands.
Most of the researched has been done in local level, examining one specific government's Social Media use, strategy and possibilities, but this study is focusing on the country level, Portugal, and includes data of all the 308 municipalities.
Through the mappings and analysis of the presence and use of Social Media by the 308 Portuguese municipalities, the goal is to understand how Social Media is used currently. In this context, this case study seeks to answer the research question "How is the Social Media used in all the municipalities of Portugal?". The purpose of this study is to understand how Social Media is adopted by the municipalities, and how much they use their potential. Seeing how is the current situation can be a base for seeing the factors that are leading to E-Governance that the Smart City framework requires.

3.2 Case Study Methodology

This research design is conceived on a quantitative methodology in order to obtain a clearer view of the object of this study – Social Media use in the 308 Portuguese municipalities. The aim of this quantitative research study is to classify features, count them, and visualize them in an attempt to explain what is observed.
Quantitative research is a structured way of collecting and analyzing data retrieved from different sources. This method emphasizes the objective measurements and the statistical, mathematical, or numerical analysis of the collected data.
The particularity of this case study is: not only mathematical and statistical formulas are going to be used based on a table analysis, but the map of Portugal is examined and spatial patterns

discovered and presented – that a normal table analysis wouldn't allow. The different functions of ArcGIS software that were used in this case study can be found in the Spatial Statistics Tools suite: spatial autocorrelation, hotspot analysis, cluster and outlier analysis. They give different results as the conception of their formulation also varies.

3.3 Background

Portugal's population regarding the last official data is 10,31 million (2017), and as the published statistics show by the National Institute of Statistics (Instituto Nacional de Estatística) 77% of households in Portugal have Internet access. Regarding the density, it is the highest in the capital, Lisbon (86%), and in general it is higher than the average in the urban areas. The use of the Internet is widespread among students, people below the age of 35 years, and among those who have completed higher level of education (Instituto Nacional de Estatística, 2017).
The statistics also notes that, completing and submitting official forms over the Internet is 42% among the users in 2017, which is 6% over the value of 2010 (Instituto Nacional de Estatística, 2017).

3.3.1 Literature review

Most of the researched has been done in local level, examining one specific government's Social Media use, or in a specific topic as the paper published by (Majumdar, 2017) who conducted a case study about the Social Media use by local governments in transportation planning, or in the case of transparency as (Guillamón, Ríos, Gesuele and Metallo, 2016) where they came to the result of Social Media use by municipalities improves municipal transparency and is a great power to reach citizens with lower income.
Studies, where more municipalities were considered are also published. A paper for instance, of Italian municipalities was written by (Agostino, 2013), who had the objective of examining how Social Media contribute to public engagement by analyzing 119 Italian municipalities, and came to the interesting result of while Facebook is used to support public participation, YouTube more like a way of support public communication. A similar study was conducted by (Sandoval-Almazan, Cruz & Armas, 2015) in 8 Mexican municipalities, but the focus was based on the strategy of Social Media use, and collected data from interviews of community managers. There is some similarity with this last case by (Sandoval-Almazan and others, 2015), the Facebook likes data set, but the result is focused on people and strategy behind the page management.
More studies were published like this, in the topic of content management (Bonsón, Royo & Ratkai, 2015) also examined 75 local governments and analyzed 50 posts from each municipality. 16 content topics were separated, (e.g. environment, housing) and 5 media types (e.g. video, text). The most relevant content topics and media types were listed, based on metrics of popularity, commitment, virality and engagement. As they claim: these differentiations have a significant impact on citizens' engagement, and governments should learn what is in the interest of the locals in order to have better Social Media performance (Bonsón, Royo & Ratkai, 2015).

Discovering studies that were published with the Portuguese municipality data, one remarkable one is definitely the E-participation in Portuguese local governments : an exploratory research about emerging networks that was written by (Coelho & Neves, 2007) where the hypothesis: "*Technical modernization doesn't automatically develop citizen participation as a process of "reformation""* is confirmed, in the topic of E-participation. Their conclusion is: "*The new media are not a miraculous solution that can automatically improve citizen participation* (Coelho & Neves, 2007).
This paper differs from the mentioned ones in the sample selection – whole Portugal is considered, all 308 municipality. Not the content and managing strategies are examined, the data is collected from external factors as population, ageing index, digital sophistication, Social Media followers, and the hypotheses are based on the correlation between them. And also, important to point out again, the used technique includes the three above mentioned spatial analysis functions – while in most of the found literature regarding this topic, the results are only based on non-geographic data.

3.3.2 Social Media Statistics of Portugal

The Statista's Market Analytics team presented a forecast of social network user numbers in Portugal from 2015 to 2022, that is based on a survey in July 2017, and other relevant third-party data analysis. According to the (Statista, Inc., 2017a), the individuals who use a social network via any device at least once per month increased from 4,41 million to 6 million in 2015, and since that has a much slower rise only 0,8 million per year. As the expectations show, in 2022 the number of social network users will be around 6,6 million.

Social Media platforms

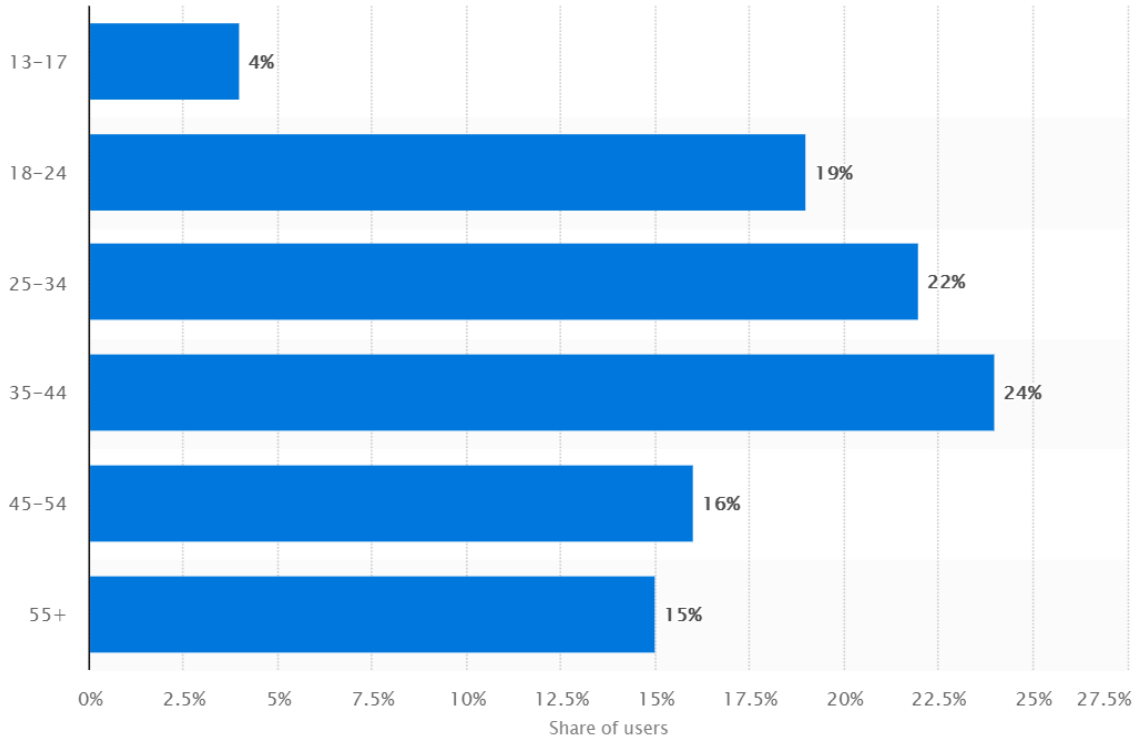
In this study, the Facebook, Instagram and Twitter accounts were examined, these are the three biggest that can be found on the official website of the municipalities. Some of them also has YouTube and Pinterest, the YouTube activity is minimal, and the Pinterest is even less since it mainly for inspiration, DIY (Do It Yourself) ideas and projects. How to make a necklace of pebbles or build a three-floor house for dogs in five minutes, and so on. Pinterest is a tool for gathering and organizing these ideas. This is not in the scope of the municipality's online presence, so it was not measured in the case study. In contrast with this, video content makes sense, as there are video tutorials already about how to deliver taxes electronically, or buying transportation tickets in Lisbon. But still, the presence of official municipality accounts is so minimal, that this factor was excluded.

Facebook users in Portugal

Facebook is now used by 25% of the world's population and is already used by 55% of all people who have access to the internet globally (Pestana Machado, 2018). According to data from the last quarter of 2017 sent to the Observer a Portuguese news agency by Facebook, there are six million people out of 10.32 million inhabitants. who use monthly Facebook in Portugal (Pestana Machado, 2018).

The great majority uses Facebook as the previous paragraph shows, this statistic (Figure 5) gives a deeper insight regarding the users in Portugal, by age. According to the source there were 5,9 million users in Portugal as of August 2017, with 19% users between 18 and 24 years. It is also mentioned, 49% them were male, and 51% were female. This data could be interesting regarding the strategic concepts of the Social Media use by municipalities, about their targeted audience (Statista, Inc., 2017b).

Figure 5: Facebook Users of Portugal



Source: Own work.

Another factor, where Facebook can be attractive for the local government is: they offer a "verified badge" for pages and profiles, which means that Facebook certificated the public figure, media company or brand. This could be an attractive factor for the audience and advantage for the page, since nowadays to come across many manipulated news, pages, and videos gives a great challenge to decide about their origin.

3.4 Data Collection

The sample consists of 308 municipalities, based on the literature review. The literature review consists of the papers that were made in the topic of e governance in connection with digital sophistication, local governments, challenges of e-participation mainly. The final selection of the variables for this paper are the followings: **Resident population** and density, that considered in almost all the papers in this topic an example can be (Dias, Gomes & Zúquete, 2016), and from the same website – Pordata - the **Ageing index** was retrieved that is a base for a Russian study -

Seniors' Inclusion into e-Governance: Social Media, e-Services, e-Petitions Usage where the authors Grigoryeva, Vidiasova and Zhuk, (2016) analyzed if elderly people are actively use e-participation tools and platforms. Social Media data: **Facebook, Instagram** and **Twitter** followers, post numbers, **Total Engagement** were used in the paper of Sandoval-Almazan, Cruz and Armas (2015) as an example from the many. The previously mentioned, Coelho and Neves (2007) conducted a research about the network usage and e-participation, according to this, a similar variable: **Digital Sophistication** was added (Table 3).

Table 3: Examined variables

Source	Acquired Data
Pordata	Resident population
Pordata	Ageing index
NOS	Digital Sophistication score
Facebook	Number of followers
Instagram	Number of followers, Number of posts
Twitter	Number of followers, Number of posts
BuzzSumo	Total Engagement number

Source: Own work.

The results are representative of the population, the whole country is considered.

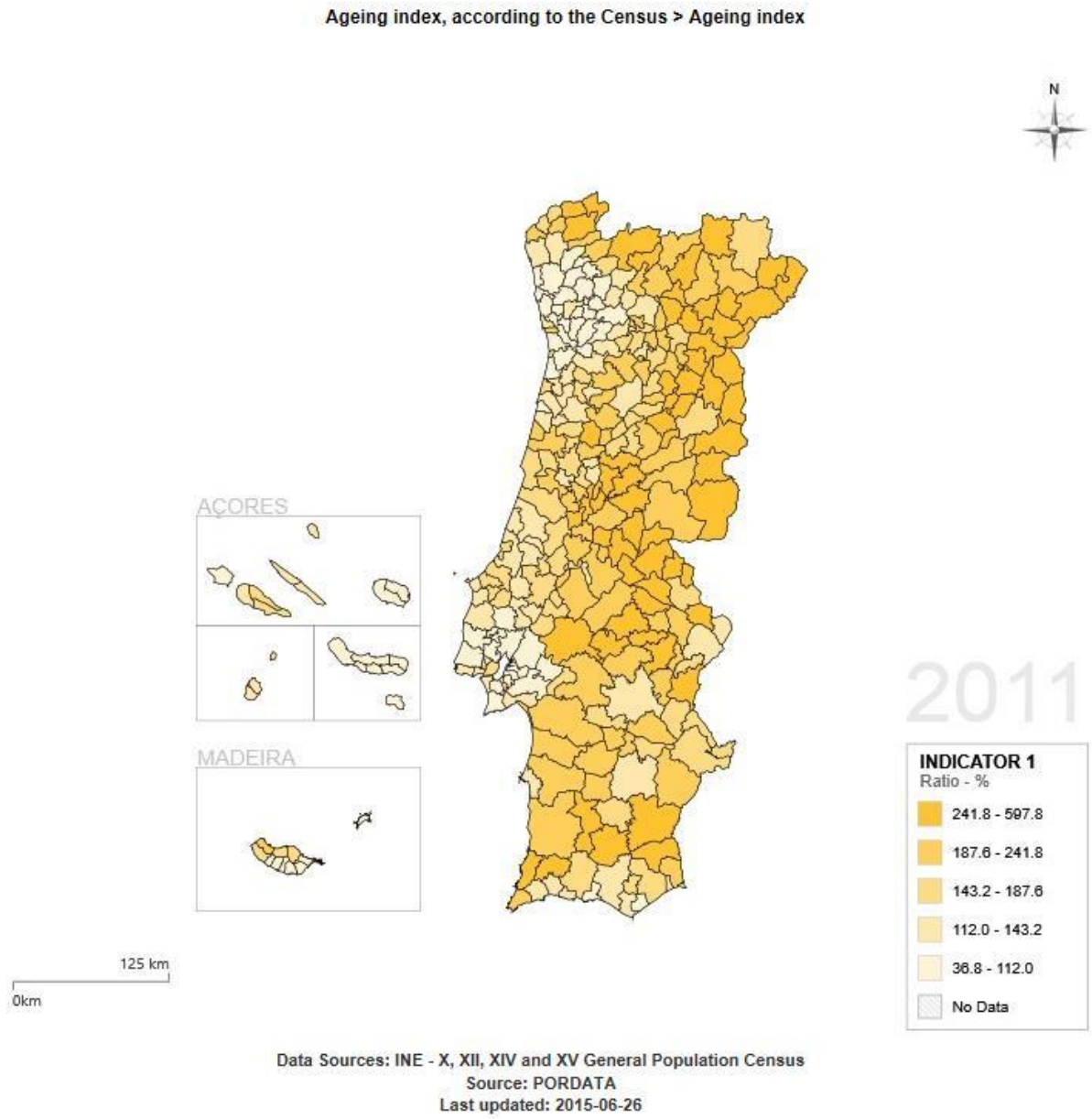
3.4.1 Resident Population

Pordata - the Database of Contemporary Portugal was created in 2009, and as it is written on the website, the presented statistics derive from official and certified sources, with data production skills in the respective areas (Pordata, 2017). As they emphasize: Over sixty official agencies, including the Statistics Portugal cooperate with them.
The number of Resident Populations and Individuals / Km² (Indivíduos por Km²) was retrieved from Pordata, the latest official dataset of the Municipalities and their resident populations is published from the year of 2017, this set was considered (Pordata, 2017).

3.4.2 Ageing index

Besides the population data, the ageing index was retrieved also from Pordata - the Database of Contemporary Portugal. The following map (Figure 6) presents the ageing index according to the Census. This indicator is the ratio of the number of elderly people of an age when they are economically inactive (65+ years) to the number of young people (0 – 14 years) (Pordata, 2017). Regarding this indicator, Portugal (153,2) is above the European average (125,8). The Census published accredited data of Portugal in 1981, 2001, 2011 until now, the last set, from 2011 is considered for the analysis.

Figure 6: Ageing index of Portugal



Source: Pordata (2011).

3.4.3 Social Media Accounts

In all the 308 municipalities the Social Media activity - Facebook, Instagram, Twitter - was considered, the period of data collection is: 2019. April 4 – 2019 April 10. As it is seen in the background chapter, the most popular Social Media websites are Facebook, Instagram and Twitter, these were considered. The data of accounts was collected based on the municipality websites, however many of them hasn't linked their Social Media pages correctly, or missing the link in general. To obtain the desired data, the search box of the Social Media pages was used, mostly

with the keywords “Municipio de *”, “Camara Municipal de *”, “Concelho de *”, “CM *”. Where “*” is replaced by the name of the municipality.
Limitation of data: If the account of the municipality didn’t appear as a result for any of these keywords, and it isn’t linked on the official website, the field received the value of “no data”.

Facebook
The collected data consists of the URL of the official Facebook page, and the number of followers (rounded up to 100) for every municipality.
The search box of Facebook was used as mentioned above, however some of the pages doesn’t include any word regarding the municipality, usually when the page is created to be attractive for touristic reasons and example is: https://www.facebook.com/TurismoPalmela/, with the page title: Turismo de Palmela Portugal. In almost all cases at least one of the categories of “City Hall”, “Government organization”, “Public and government service” was used, which is a great help in differentiating the official and the general pages, both in data collection and for the citizens. Nearly all of the pages mentioned the official website of the municipality.
Facebook allows to conquer a verification badge, which confirms that the page is an authentic rage for this public figure, media company or brand, typically pages with large follower base are using this opportunity, as an example: Câmara Municipal de Lisboa.
The limitations of Facebook data collection: The website does not share the number of posts to the public, only the page administrator and the users with managing rights can see how many posts were made since the day of the creation.

Instagram
The collected data consists of the number of posts, and the number of followers for every municipality. In some cases, more Instagram profiles were created with the same purposes, both of them linked to the official website of the municipality. When the differentiation was impossible, the account with more recent activity was considered.
Limitations of Instagram data collection: The sophistication of Instagram use was not examined, but a few accounts are using the “Stories” – sharing short videos or pictures for 24 hours, and “Highlights feature”, where they share permanent Instagram Stories for the audience. The collected data only refers to the number of regular posts on the feed, the stories and highlights were not considered.

Twitter
The collected data consists of the number of posts, and the number of followers for every municipality. Limitations are: if the account has a Twitter profile, and if the profile setting is private or public. All the profiles were public except one, the numbers were retrieved, the exception is: Municipio de Peniche’s profile, which is restricted, only confirmed followers have access to @CMPeniche's Tweets and profile.

3.4.4 Total Engagement

This number is acquired from the tool BuzzSumo that works with an API connected to the biggest Social Media platforms. The data is extracted from multiple reliable sources such as the number of followers, shares, and tweets from Facebook and Twitter, which gives a combination to review the overall presence and engagement rate on the Web.

The Total Engagement number consists of the measured interactions as posts, shares, likes, and comments within the Web. An example how it is calculated: If a Facebook user shares an article posted by the Municipality of Matosinhos for instance, that counts as 1 engagement unit, If this post received then 10 likes, 6 comments and gets 8 shares, the original link will have the value of 25 engagement units in total: (1 + 10 + 6 + 8 = 25). In the mentioned case of Matosinhos, the Total Engagement last year (2018 March – 2019 March) is 528 588. The data is collected from several blogging platforms, Facebook, Pinterest, Twitter, Reddit, YouTube, LinkedIn for instance. This number helps to measure and rank the online presence of the municipalities.
The results include the above-mentioned Social Media engagements, but besides that the number of mentions in articles were considered. This part of the web was filtered for only Portuguese domains (*.pt), where the name of the municipality is mentioned.
Limitations of this data: In some cases, the names of the municipalities have multiple meaning. For instance, Santana, who is a Mexican rock musician and guitarist, and also a municipality in Portugal. Not all the data could be filtered out this way, if a Portuguese website with a .pt domain mentioned it, the results included it.

The results of Nazaré:

As an example, Nazaré's case is presented, which is one of the most famous Portuguese cities. In the past year, the term "Nazaré" was mentioned in 1 549 Articles on the web, filtered for *.pt domains. After the analysis, is shows 367 124 Total Engagements, which means 237 Average Engagements by articles. The Average Engagements are counted by dividing the Total Engagements with the number of Articles, counted as (1) shows:

$$Average\ Engagements = \frac{Total\ Engagements}{Articles} \quad (1)$$

BuzzSumo gives a deeper analysis in every case, the domain of the published content that got shared through Social Media can be seen in a ranking, based on how many shares the article has. The most popular articles for the term "Nazaré" is coming from the website (www.beachcam.meo.pt) since it is considered as one of the best surfer place in the world, and Sapo – one of the biggest online newspaper with 2 URLs, but more important, the official website of Camara Municipal de Nazaré appears (www.cm-Nazaré.pt) ranked as the 5th most popular domain. The most popular 10 URL is presented (Table 4).

Table 4: Total Engagement of Nazaré

URL	Facebook	Twitter

1.	beachcam.meo.pt	68340	153
2.	sicnoticias.sapo.pt	47019	115
3.	cmjornal.pt	31709	86
4.	tvi24.iol.pt	21036	27
5.	cm-Nazaré.pt	17925	19
6.	regiaodeleiria.pt	12754	10
7.	publico.pt	11592	277
8.	jn.pt	11095	71
9.	sol.sapo.pt	10060	10
10.	observador.pt	9772	70

Source: Own work.

3.4.5 Digital Sophistication

Digital Sophistication of the municipalities acquired from the website of NOS that is Portuguese media holding company whose main assets include a satellite, cable operator, and known as one of the biggest mobile phone operators.
The data is a composite indicator for every municipality, standardized for a scale of 0 to 100, of smartphone ownership, intensity of data usage form 2018 October (NOS, 2018).

3.5 Data Analysis

Quantitative research is based on the use of computational, statistical, and mathematical tools and methods for having results. The acquired data is gathered in Microsoft Excel, and going to be presented by using Tableau. Tableau is now one of the most popular data visualization software, it offers business users a highly interactive and intuitive visual-based exploration experience, providing easy access, preparation, and analysis. The data visualization figures as highlight tables and packed bubbles are created by using it. All of the visualizations are published in the public directory of Tableau, and can be reached using this link below, or the link connected with each visualization. Specially interesting for the visitors to set the filter online and see how the graph changes, for this the link is provided below all the figures made by Tableau Public.

Regarding the digital sophistication, mappings of spatial correlation, hotspot analysis, and cluster and outlier analysis are created by using ArcGIS that handles all the necessary geographic information and formulas. In addition to basic tasks - managing and displaying spatial data - the software offers a complete toolkit for managing data efficiently, integrating with other IT systems, performing complex analyzes, modeling, and displaying results on professional maps and automating organization's operational processes if needed. The cartography base of Portugal was retrieved from the official site of Direção-Geral do Território which belongs to the Public Administration of Portugal. This website if a part of the open data movement, which is focused on Open Government, that combines the transparency, participation and collaboration principles. The geodetic reference system is the European Terrestrial Reference System 1989 (ETRS89) which is

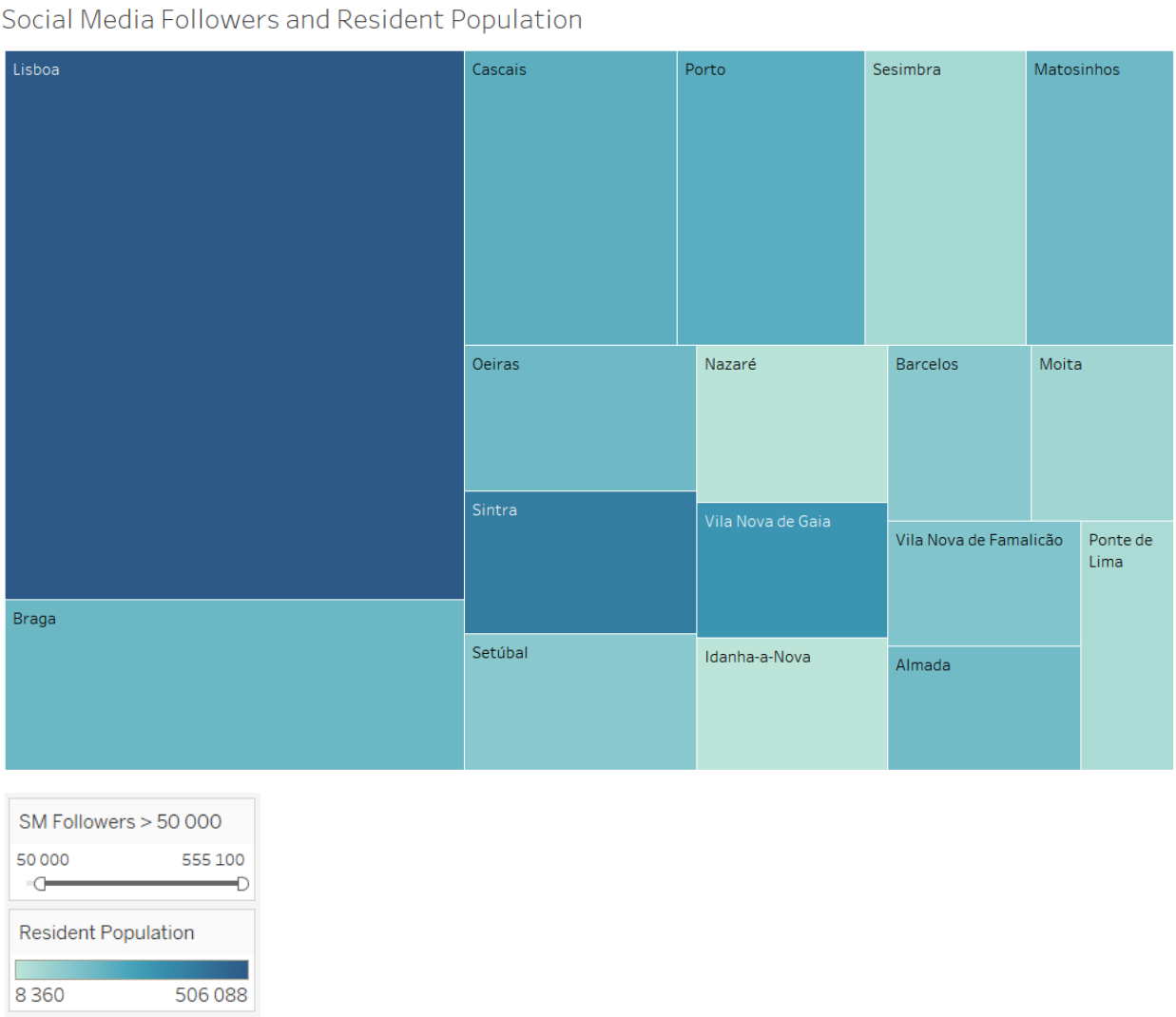
the official geodetic system in Portugal, and also on the whole Iberian Peninsula for cartographic purposes. After the retrieval, this referenced geographical dataset was implemented to ArcGIS. It includes the simple geometry elements as points, lines, and areas – to show the borders of the administrative units (municipalities) and the country.
The three chosen functions are: spatial autocorrelation, hotspot analysis and cluster and outlier analysis. Important to point out the differences between them: While hotspot analysis and spatial autocorrelation considers each entity within its surrounding area (Getis and Ord, 1992), the neighborhood is one of the key elements to establish the groupings. In other words: for a spot to be a statistically significant hotspot, requires a high value not only for itself, but also for surroundings. The local aggregated number for an entity and its surroundings is compared to the proportional aggregate for all the entities. When the local aggregate deviates significantly from what is expected, and the deviation is too large to be due to a random occurrence, it is a significant Z-score. In contrast with this, the goal of cluster and outlier analysis is to identify groupings or anomalous values according to the criterion of proximity (Sánchez-Martín, Rengifo-Gallego & Blas-Morato, 2019).

3.5.1 General Picture

How is the Social Media used in all the municipalities of Portugal? To answer this research question, the resident population and the Social Media accounts were considered. By analyzing these graphs, the commitment of the municipalities is visible.

- **Social Media Followers and Resident Population** Analyzing the demographics and Social Media Followers the ratio is counted and presented for each municipality.

Figure 7: Social Media Followers and Resident Population



Source: Own work.

The number of Social Media followers - size of the squares, (Figure 7) and resident population (color) can be seen. To have a clearer view, only municipalities that have above 50 000 followers (all numbers summarized from Facebook, Instagram, Twitter) were considered. As we can see (Figure 8) Lisbon is the winner in both categories, it has the most of Social Media account followers and resident population. Regarding the Social Media data questions, the top 10 municipality is:

Figure 8: Social Media User numbers - Top 10 Municipalities

Municipality	SM followers	Resident Population	Facebook Followers	Instagram Followers	Twitter Followers
Lisboa	555 100	506 088	384 000	85 800	85 300
Braga	173 052	181 382	96 400	13 015	63 637
Cascais	137 924	211 714	120 000	15 071	2 853
Porto	121 969	214 587	121 900	0	69
Sesimbra	104 091	51 282	18 000	1 954	84 137
Matosinhos	95 907	173 753	90 100	3 122	2 685
Oeiras	74 727	175 224	64 600	6 921	3 206
Sintra	73 121	386 038	65 300	7 309	512
Setúbal	69 854	116 330	65 500	3 365	989
Nazaré	66 281	14 268	47 400	16 460	2 421

Source: Own work.

In the further analysis, the outstanding results of Lisbon, Braga, and Sesimbra are going to be examined.

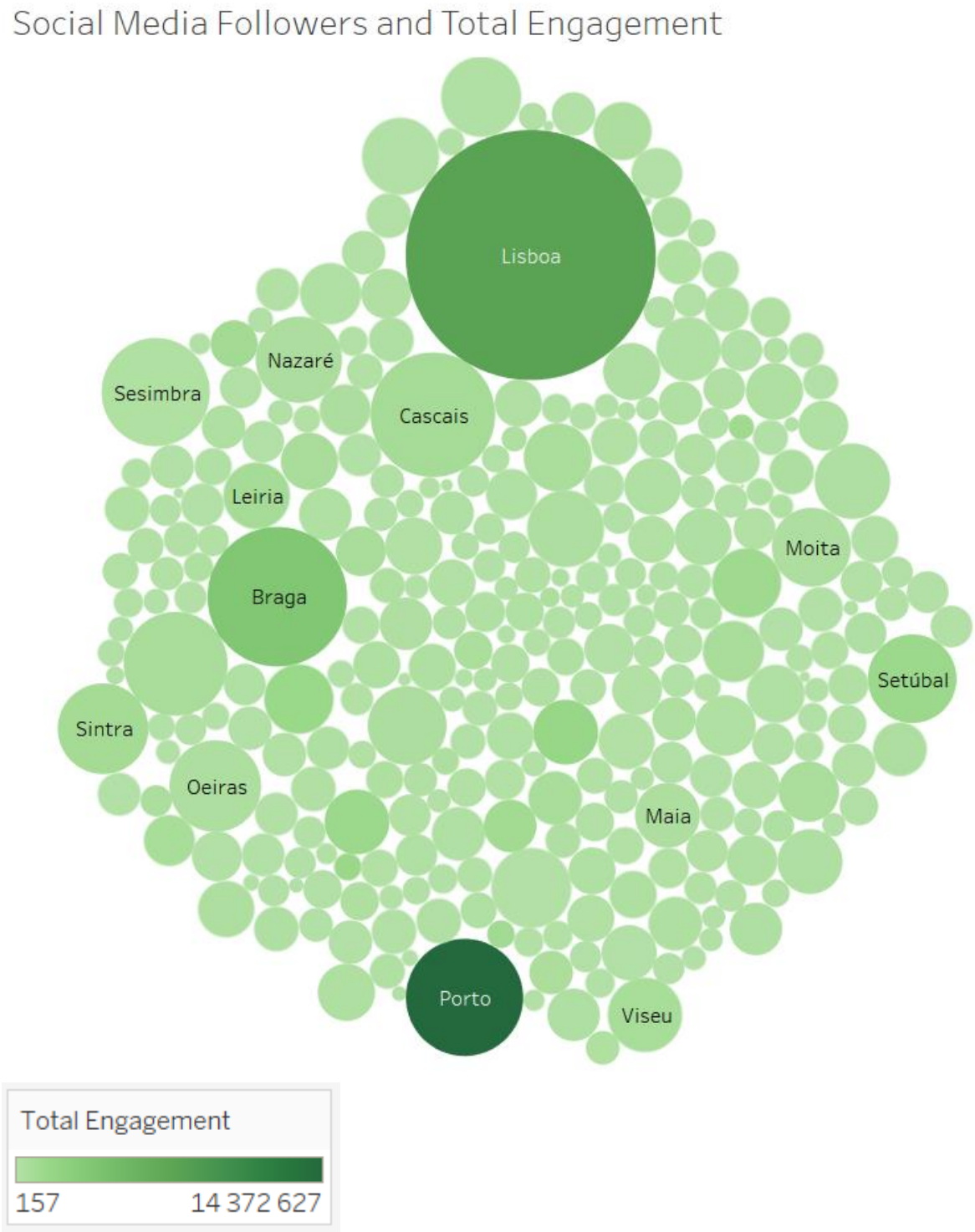
3.5.2 Social Media Presence Power

The power of Social Media is going to be examined, using the Social Media Followers and the Total Engagements values. Here the question is, if the strong Social Media follower base can indicate a big Total Engagement number though the web or not. If there is correlation, it would be worth to invest in campaigns to collect more followers and promote the Social Media account of the municipality. Facebook offers an advertisement platform for the pages, to reach and engage more people.

- **Number of followers and Total Engagements**

How strong is the Social Media presence of the municipalities? To answer this research question, the graph of Total Engagement number and the number Social Media Followers is presented. Here it can be seen, if the high number of followers indicates a big number of Total Engagement, that would be the proof of the correlation between these two variables.

Figure 9: Social Media Followers and Total Engagement



Source: Own work.

Referring to the previous values (Figure 9) Lisbon has an outstanding result regarding the number or Facebook followers, less explanation would be needed if the results were similar in this case too. Nonetheless looking at the result graph, Porto – 14 372 627 is unexpectedly the best in Total Engagement, leaving Lisbon – 7 628 422 on the second place. Only Braga and Setúbal are

performing also out of the field, but for the further analysis Porto's performance is the most interesting question.

3.5.3 Analysis of the Digital Sophistication

Digital sophistication is a composite indicator, standardized for a scale of 0 to 100, of smartphone ownership, intensity of data usage form 2018 October (NOS, 2018). This number is about the people, living in the municipalities, while the Total Engagement – BuzzSumo variable is more than that, the municipality's strength of presence through the Web. In this regard, the numbers of followers are also interesting, and if there is any connection between the numbers of the accounts following the municipality and the digital sophistication of the region or not.
In this sub-chapter, the digital sophistication itself, and the correlation between these three variables are examined, in order to see, if the investment in improving digital sophistication – offering free Wi-Fi, promoting smartphone usage, creating applications for instance - would empower citizens more to follow their municipality on Social Media, and strengthen the overall presence of the municipality on the web or not.

- **Spatial Autocorrelation**

Firstly, the digital sophistication itself is analyzed, answering the sub-research questions such as "Is digital sophistication spatially correlated?" Or they have random distribution? In ArcGIS, this function measures spatial autocorrelation based on feature locations and attribute values using the Global Moran's I statistic.
Autocorrelation is a measure of similarity between nearby observations. For measuring the degree of association over time it is possible to compute the correlation between these observation times. This is called temporal autocorrelation. Spatial autocorrelation is a bit more complicated extension of it. Spatial objects have minimum two dimensions and complex shapes. For conduction this analysis observations and location values are needed. Spatial autocorrelation describes the degree of similarity between the examined locations (that can be: points, areas, raster cells). The most commonly used statistic that describes spatial autocorrelation is Moran's I (Getis and Ord, 1992). To determine the significance of the Moran I-test, that is to say whether a given spatial distribution of the values of a variable is the result of spatial autocorrelation. The method compares the given spatial distribution values to the randomly generated spatial distributions. If the given dataset is considered extreme, compared to the random occurrence, then it is classified as significant spatial autocorrelation (eg. spatial grouping of values other than random occurrence). Of course, what qualifies as extreme is partly dependent on the probability distribution of the variable next to the null hypothesis (eg. assumption without spatial autocorrelation) and partly on the significance level chosen. The most commonly used method is based on the assumption of normal distribution of values. Then the significance of Moran's I-test is based on the value of the standardized normal distribution probability variable (Moran, 1950) as the formula (2) shows below.

$$Z_1 = [I - E(I)] / [SD/I]$$

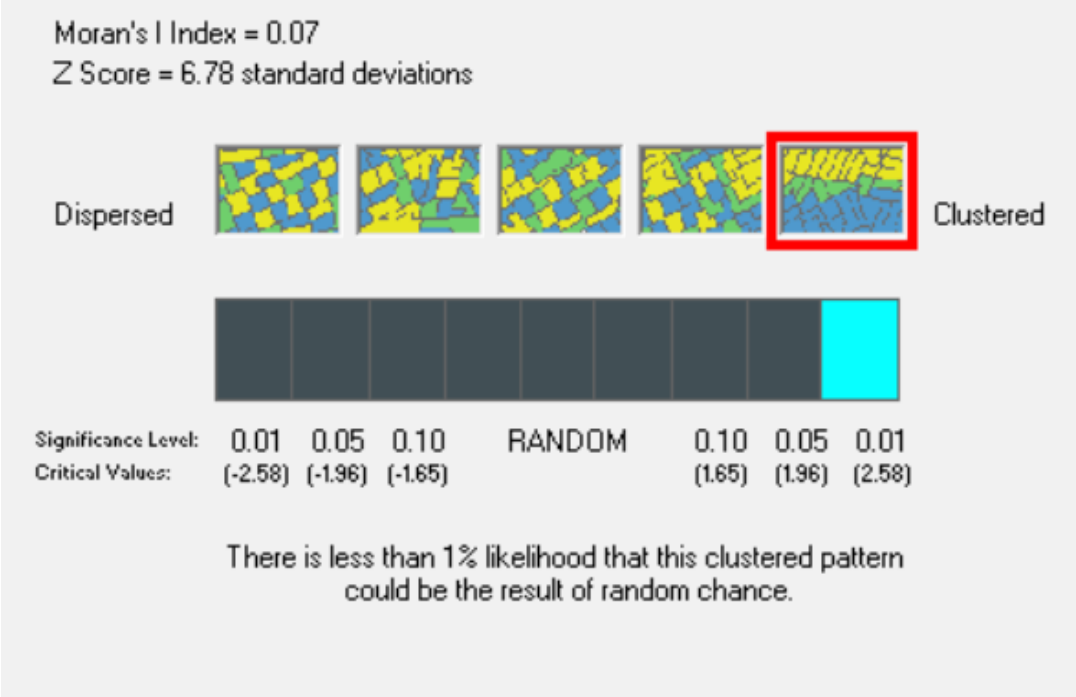
(2)

where E (I) is the expected value of I and SD (I) is the standard deviation of I. The Z value indicates statistical significance, a positive Moran's I index value indicates tendency toward clustering while a negative Moran's I index value indicates tendency toward dispersion (Goodchild, 1986).

In this case, the given a set is the Digital Sophistication values, and the boundaries of the municipalities. As a result (Figure 11), the possible result is on the scale between the fully dispersed (-1) and fully clustered (+1).

-1: perfect clustering of dissimilar values – perfect dispersion
0: no autocorrelation - perfect randomness
+1: perfect clustering of similar values

Figure 11: Spatial Autocorrelation Result



Source: Own work.

As the result shows, clustered, the Moran's Index is 0,07. Based on the analytics, the null hypothesis - stating that features are randomly distributed across the study area - is rejected. According to the ArcGIS, there is less than 1% likelihood that this clustered pattern could be the result of random chance. This means the location of the measured values do matter a lot.

- **Hotspot Analysis**

The hotspot analysis seeks to identify groupings within an area. To see where the high values located, hot-spot analysis was conducted by using Mapping Clusters tool — that is included in the Spatial Statistics Tools suite of ArcGIS.

"Is it impossible to have a high level of digital sophistication if a municipality is located in the interior?" this assumption can be interesting, regarding the fact of Portugal having a long sea-side,

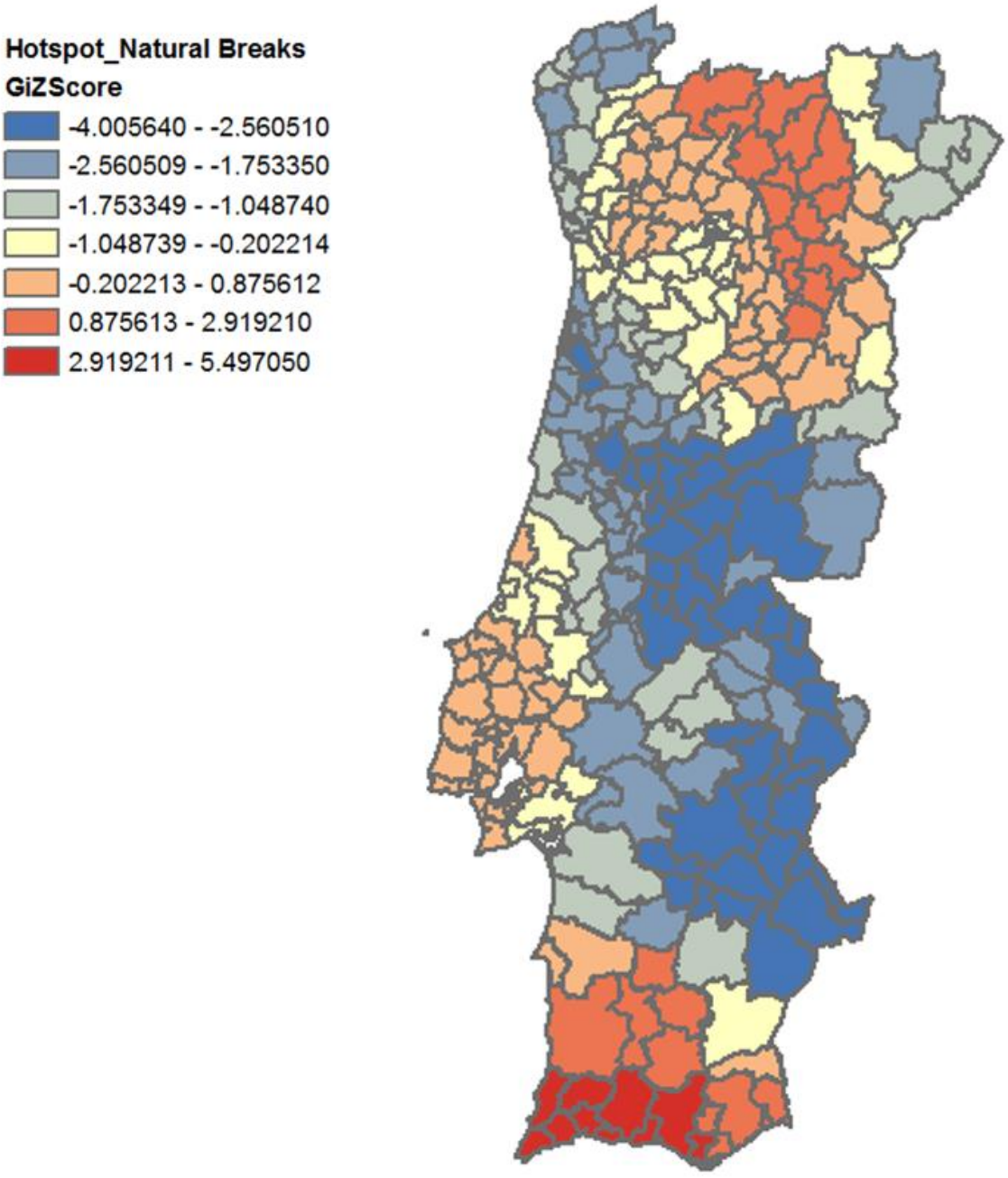
and having the two biggest cities (Lisbon and Porto) and the most popular touristic destination (Algarve) are there. Seems like the distance from the sea is a very strong factor to determine the importance of the cities and the hot-spot analysis is a tool to prove it. “Are there hot-cold spots of digital sophistication in Portugal?”, if yes then where are these located. The data set is same as in the previous case, the digital sophistication and the geographical data of the municipality are considered. This feature of ArcGIS identifies the statistically significant spatial clusters of high values (hotspots – red color) and low values (cold spots – blue color).

This hotspot analysis calculates the Getis-Ord Gi* statistic for each feature in a dataset. The result is based on the aggregation of the occurrence points, into polygons that are in proximity to one another based on a calculated distance. An area can be considered a hotspot if a higher than average occurrence of the value is found in a cluster (Getis & Ord, 1992). In the case of cold spots, is with the similar method, connected to the lower than average occurrences. As on the labels it can be seen, the Z-Scores are presented in the map. A high Z-score and small P-value for a feature indicates a significant hotspot. A low negative Z-score and small P-value indicates a significant cold spot. The higher (or lower) the Z-score, the more intense (or moderate) the digital sophistication (Getis & Ord, 1992).

For the map, Jenks natural breaks were used as classes, that based on natural groupings inherent in the data. The result is divided into classes based on boundaries where the difference between the values are relatively big (Jenks, 1967).

It is important to note - hotspot analysis and heat map is not the same. A heat map uses a raster where point data is interpolated to a surface, this occurrence shows the density or intensity value of occurrence, while hotspot uses vectors.

Figure 9: Hotspot Analysis Result



Source: Own work.

As it can be seen, the main hot-spots are in the southern coast, concentrated between Sagres and Portimão. Also, near the capital on the coast, Lisbon and its metropolitan area is having high values of digital sophistication, but in the North, interior territories as Chaves and Macedo de Cavaleiros performed better than the rest of the country.

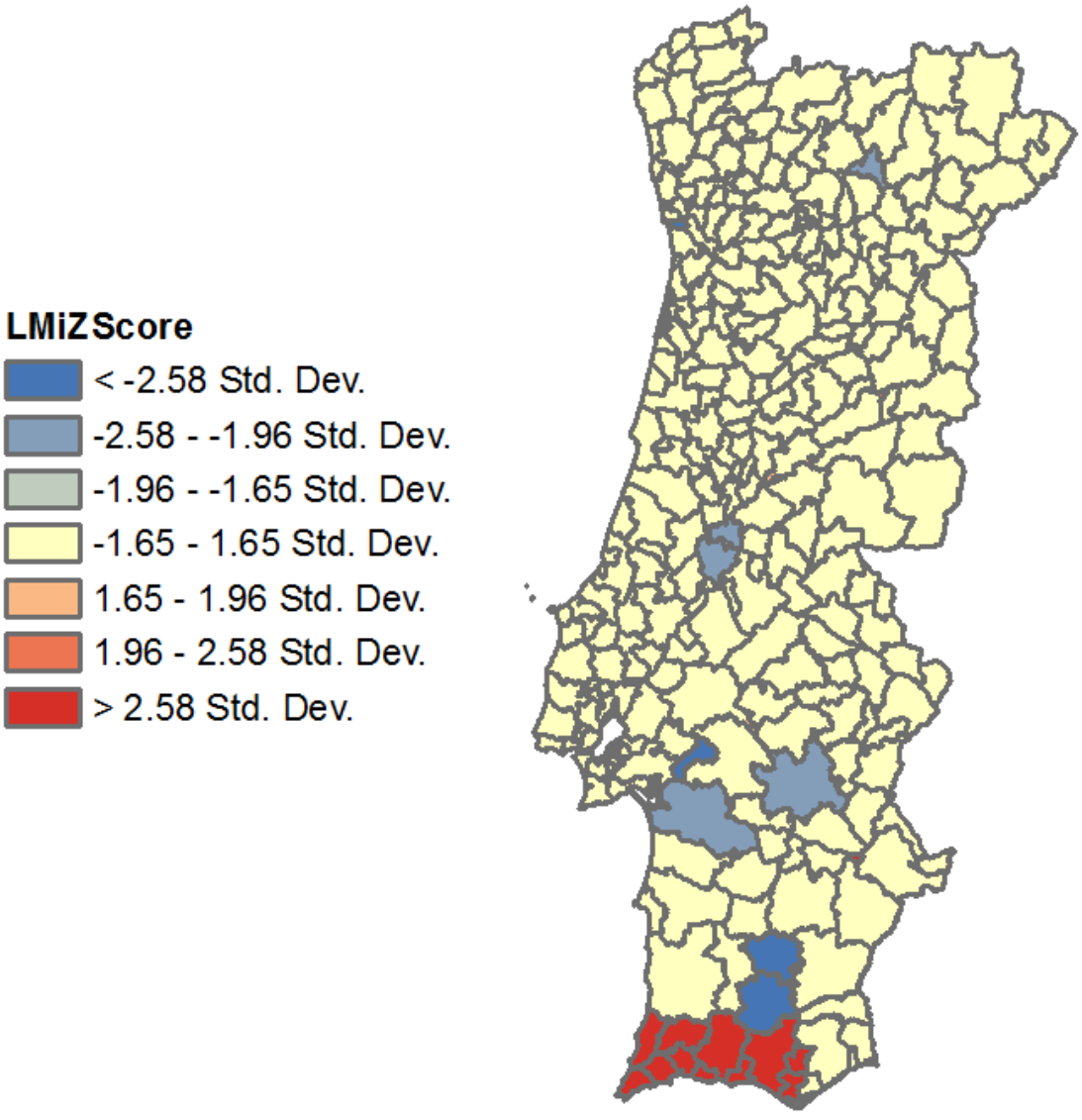
Regarding cold spots, the interior territories starting with the highest mountain Serra da Estrela – middle of Portugal, until Evora is significantly below the average.

- **Cluster and Outlier Analysis**

This analysis aims to identify groupings or anomalous values according to the criterion of proximity using Anselin Local Moran's I statistic. The function finds the spots that have either high or low values aligned with the surroundings and also, anomalous areas where a spot has a value that is relatively different from the neighboring points - much higher or lower (Moran, 1950). In this dataset, the digital sophistication, 10 outliers were found, and 48 clusters (28 high-high and 29 low-low).

Z-score was counted and evaluated by ArcGIS, a high positive z-score for a feature means that the surrounding features have similar values (either high values or low values).

Figure 10: High-high Clusters and Outliers



Source: Own work.

A high positive Z-score (more than +2.58 in this case) for a feature indicates a statistically significant spatial data outlier – colored with red in this case, while the blue color means less than -2,58. A few blue region is spotted in the interiors (Figure 10), but the red regions and blue regions are located next to each other in: southern coast, Algarve. It is a very well-known region for its touristic attractions, beaches, sea caves, surfer spots, cliffs and scalloped bays. The tourist traffic according to Algarve Association for Hotels and Resorts (AHETA) can reach 4.2 million visitors per year– of course concentrated for the summer period. Economically also very important, contributed 30% to national tourist income of the country, a total of €1.08 billion Euro (AHETA, 2017)

- **Total Engagement and Digital Sophistication**

An interesting variable to see is the Total Engagement of the terms, in connection with the digital sophistication. Digital sophistication is counted at the local level, while the BuzzSumo value is more than that, it is the presence of the municipality on the web. The assumption could be positive, that there is correlation, since if in a region more internet and smartphone user resident lives, they can improve the Total Engagement number with sharing and visiting the content of their municipalities. This question could be interesting for the governments, if there is any benefit in investing the digital infrastructure to higher the digital sophistication level, in order to reach and engage more people.

To figure out, if there is a correlation between these too variables, Correlation coefficient was counted, and the result is 0,19. This variable is on a range of -1 and +1, and since the value is very close to 0, it means that there is no correlation between them. However, it is closer to +1 than to -1, so between positive and negative correlation, the positive is the right one in this

- **Number of Social Media followers and Digital Sophistication**

After seeing the Total Engagement, the number of Social Media followers was examined, in connection with the digital sophistication. Do people follow their public administration account more if the digital sophistication is on a higher level? The correlation coefficient of these two variables answers this question. As the result is 0,19, similar to the other case, very close to 0, it means that there is no correlation between them. But also, if the question is positive or negative, the answer is positive.

Noting the similarities of one study from the presented literature is: E-participation in Portuguese local governments: an exploratory research about emerging networks that was written by (Coelho and Neves, 2007) where the hypothesis: “Technical modernization doesn’t automatically develop citizen participation as a process of "reformation"” is confirmed, in the topic of E-participation. (Coelho and Neves, 2007). Similar to this, based on the findings, there is no correlation between these variables.

3.6 Discussion

In the discussion chapter, the hypotheses are presented, and after discovering the meaning of the results better, investigating the reasons behind the data, the confirmation or rejection is

demonstrated. The purpose of this chapter is to show, how the knowledge around the field is changed, broadened with the results of my analysis. To support the understanding, data visualization methods and tools were used, as Tableau graphs and ArcGIS maps.
However, the created maps consider only the continental part of Portugal. Azores that is politically organized as an autonomous municipality and includes nine islands 1,446 km far in the Atlantic Ocean from the continental borders is presented only in all the statistic. The case is similar with Madeira, that includes two principal islands and two minor island groups 967 km away from the borders. In these cases, the distances made it beyond the bounds of possibility to present them in one-page maps. With this solution, the continental visualizations are much more understandable for the readers.

3.6.1 Findings

This chapter is based on relating the results to the issues that were raised in the introduction if this case study. The goal is to understand - how Social Media is adopted by the Portuguese municipalities, and which factors are influencing the people to interact more with their local government through Social Media. The hypotheses, different trends, and expectations (based on the data presented before) are pointed out, and the most interesting results are investigated deeper before the final confirmations or rejections.

General Picture

In general, out of 308 municipality, only 6 did not have Facebook account, 168 was without Instagram account 184 was without Twitter account during the checked period in 2019 March. 70 of the municipalities have both Facebook, Instagram and Twitter account and activity, and 115 is owning currently only a Facebook account out of the three checked platforms.

- **Social Media Followers and Resident Population**

The general picture was examined, regarding the Social Media followers and population in Portugal. Based on the ageing index, the size of the cities and digital sophistication, the hypothesis is: Lisbon will have the highest number of followers, Porto is the second, and at least one place on the southern shores will also be included in the top 5 where the local municipality account has most of the followers.
As the result was showing, the hypothesis is partly proved and disproved, Lisbon has the highest number of followers, but Porto is only on the 5th place. None of the cities from the southern shore are present in the top 5, having a deeper look on the data, the first account that appears in the list is Portimão, on the 31st place.

1. Lisbon
2. Braga
3. Cascais
4. Porto
5. Sesimbra

The values that are not surprising and the digital sophistication, the ageing index and the size of the city can explain are: Lisbon, the capital is leading the field, the city of Cascais is less than 30 km from it, and has similar values in digital sophistication and ageing index. Porto is also near its expected place.

However, Braga and Sesimbra are unexpected, the Braga is not too far from Porto, Sesimbra is near Lisbon. Among the resident population rank, Braga is only on the 8th place, Sesimbra is surprisingly the 56th highest number. In general, Braga is known from the great quality of education by its public university, and a popular touristic destination. Portugal's first king, Afonso is buried in main the Cathedral here. The religious tourism is also remarkable, one of the oldest Christian cities in Europe. After Fatima, it is the second most popular pilgrim destination, Sanctuary of Our Lady of Sameiro and the Chapel of Good Jesus of the Mountain attract thousands of pilgrims, tourists and visitors all year around. While in contrast Sesimbra is referred as a rural area in the mountains.

After a deeper look and examining the type of followers of Sesimbra (Table 5), from the detailed statistic it can be seen, that the weights between Facebook, Instagram and Twitter, the last value – Twitter followers base is the 2nd highest (84 137) – which is higher than the resident population) of all municipalities. It can be claimed that Twitter followers are the reason why it has been ranked in such a prestigious position.

This value, is suspicious. Using a prediction function, considering the whole dataset – resident population and Social Media followers is 26 935. After subtracting the number of Facebook and Instagram followers (factual numbers), the result is the forecasted number of Twitter followers, 6 981. The difference between the predicted and counted value is huge. The Twitter follower number of Sesimbra 84 137, is 1205.22 %, more than 12 times bigger, than the predicted value 6 981.

*: Calculated numbers

Table 5: Predicted values of Sesimbra's followers

Municipality	Resident population	SM followers	Facebook followers	Instagram followers	Twitter followers
Caminha	15897	28185	26400	0	1785
Reguengos de Monsaraz	10128	27188	25300	1822	66
Sesimbra	51282	***26935****	18000	1954	***6981****
Viana do Castelo	85017	25810	25100	0	710
Chaves	39500	25744	24500	0	1244

Source: Own work.

While scrolling in the followers list of Sesimbra on Twitter, many accounts seem very suspicious – possibly, but not proven: robots, and algorithm generated users. The pattern spotted; a name and 8 random number, having zero activity, no tweets, and the account is sated up in May 2019.

There is no proof in Sesimbra's case that the followers are robots or payed users. However, to buy Twitter followers is not so difficult as it should be. Easy to land on webpages offering this kind of service, a wide range of advertisements and prices can be found in the selection. In the headlines: "Buy Twitter Followers | From Only $1.59, Buy Twitter Followers 100% Active and Real $3.00" and similar offers are popping up for the search term: "buying Twitter followers".
The Twitter policy includes these cases: "*Twitter does not support paying for followers, but purchasing Twitter followers does not violate any federal laws."* (Twitter, 2019). So overall it can be said, whoever uses this technique does not commit a crime, but the result and the way how they conquered it is very questionable.
To answer Braga's case – why this city is so attractive for the Social Media users - while scanning the accounts it is obvious that their performance is much better than average. Daily 5-8 posts on Facebook, their account is verified and ranked as "Very responsive to messages", many published events, connected Instagram feed, logo and unified design. Even the selfie spot of the city has a highlighted note. The person – or people - that is responsible for managing the accounts must make serious, real effort to build the pages attractive for the Social Media content consumers.
It is also important to note, the municipality of Porto doesn't have Instagram account currently, however it would have a great potential in acquiring more Social Media followers if we are using resident population, digital sophistication and ageing index values as a base.

Social Media Presence Power

Besides the follower's number, the Total Engagement was measured too – how big is the impact of the municipalities through the web, filtered for the Portuguese websites. As a hypothesis, based on the Social Media account, - more content, more followers - Lisbon is expected for the first. Saying this - highest follower number indicates highest Total Engagement number – is from the assumption, of published articles of Social Media are indicating more publications in the media (news portal, videos, other forums).
This hypothesis is also disproved, the highest Total Engagement number is Porto. To have a deeper look, which is the most popular content that is connected to Porto and leaves Lisbon only on the second place, the use of Google Trend is a great help.
The filter was set to see the results of the last 5 years (2014.05.15-2019.05.15.), from Portugal, and the search term "Porto". The tool uses a score, as it can be seen, the score column represent search interest, relative to the highest point on the chart, where the maximum value: 100 is the most commonly searched query and a value of 50 is a query searched half as often as the most popular (Google Trends, 2019).

The TOP query (Table 6), written into the Google Search is "fc porto", the football club of Porto. Besides this, football related content appears 2 more times in the top 10 queries.

Table 6: TOP query and score in Porto

TOP query	Score
fc porto	**100**
porto portugal	96
porto tempo	84
meteorologia porto	81
benfica porto	**63**
porto lisboa	56
hotel porto	49
olx porto	48
porto editora	43
sporting porto	**41**
porto santo	38

Source: Google Trends (2019).

But this is not a scientific proof yet, that football matters so much – even is this case. To have a wider look, of which topics are having the highest interest rate, among the web, with the same filters (last 5 years, results from Portugal), the search term "porto" is compared with "lisboa". Similar as the case before, according to Google, this list includes the most popular topics. Points are given on a relative scale, where the maximum value: 100 is the most commonly searched topic and a value of 50 is a topic searched half as often as the most popular (Google Trends, 2019).
Top topics in the past 5 years (2014.05.15-2019.05.15.), Portugal (Table 7).

Table 7: Top topics of Porto and Lisboa

Porto		**Lisboa**	
TOP	score	TOP	Score
Porto	100	Lisboa	100
FC Porto	27	Rapid transit	3
Porto Editora	3	Lisbon Metro	3
O Clássico	2	Lisbon Portela Airport	1
Porto Metro	2	Lisbon	1
Francisco Sá Carneiro Airport	2	Stock exchange	1
Porto Santo Island	2	Belém	<1
Porto District	2	Estação do Oriente	<1
FC Porto–Sporting CP rivalry	2	Rossio	<1
Boavista F.C.	<1	Brunch	<1

Source: Google Trends (2019).

Here, the fist places – name of the cities - are not surprising, but FC Porto arrived to the second place with 27 points, while in Lisbon the second highest score is only 3, with the topics of public

transportation. As the related topics shows, in Lisbon the metro strike, public transport passes, metro maps are rising, while in Porto: Iker Casillas the Spanish goalkeeper, Moussa Marega a footballer, Porto – Benfica the match between the two huge Portuguese rival football teams: "O Clássico" are very popular. This makes a difference already, it is an explanation for the Total Engagement – the football club of Porto is generating a lot of content through the web, while in Lisbon there is no topic that can be compared to it. A reason behind can be the well-known greatness and fame of FC Porto, but the odds can't be balanced, there is no football club called "FC Lisbon". Benfica and Sporting, the football clubs are generating less content for Lisbon, simply because the word of "Lisbon" is not included in their name. Here important to point out, the official name of Benfica is: Sport Lisboa and Benfica (SLB) but the widely used term is simply Benfica.

Digital Sophistication

In this section, the digital sophistication values are going to be examined, the correlation between location, the ageing index, Total Engagement and Social Media followers is investigated.

- **Spatial Autocorrelation**

Analysis of spatial autocorrelation is well suited to determine the propensity of data to spatial grouping.

Based on the analytics, the null hypothesis - stating that features are randomly distributed across the study area - is rejected. The result is clustered, the correlation between the location and the digital sophistication values is strong.

- **Hot-spot Analysis**

For the hot-spot analysis, the hypothesis based on the aging index is: interior territories, in the middle of the country have lower level of digital sophistication. The hypothesis is proved, the figure presents the evidence, cold spots in the interiors refers to the low level of digital sophistication. The two figures were previously presented, Ageing index (Figure 6) and Hot-Spot Analysis (Figure 9).

As the relation can be seen clearly in the pictures, many shades of the coloring have similar borders as the region around Lisbon and the southern territories with the seaside. However, the northern region has differences. Here the area in focus is located in the interiors, as the hypothesis where the ageing index is high, and the digital sophistication level is low. The hypothesis is confirmed with numbers too, correlation value is: 0,49.

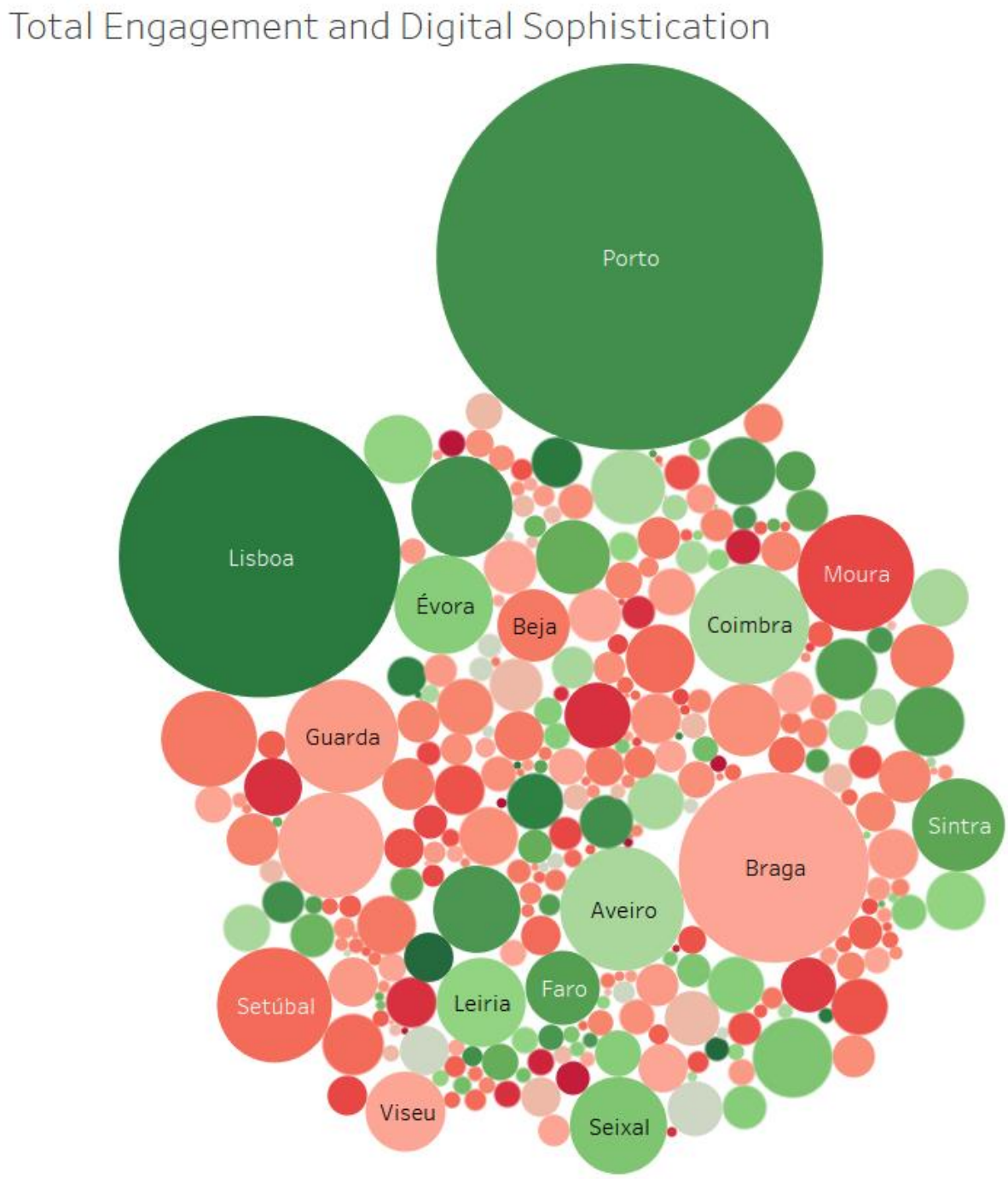
- **Total Engagement and Digital Sophistication**

The hypothesis is: There is correlation between the digital sophistication value and Total Engagement. It is based on the fact that if there is better network, more device that can connect to the internet, extensive smartphone use, then the generated content has bigger volume, and in bigger volume content, municipality related publications are more.

Correlation coefficient was counted between these two variables, and the result is 0,19 on a range of -1 and +1. The interpretation is: there is no correlation. The following figure made by Tableau

represents the result, even is Lisbon and Porto are the main big bubbles colored green (high level of digital sophistication) many other municipalities with red color (low level of digital sophistication) has also a remarkable size like Braga, Setúbal, Guarda and Moura.

Figure 11: Total Engagement and Digital Sophistication



Source: Own work.

- **Number of Social Media followers and Digital Sophistication**

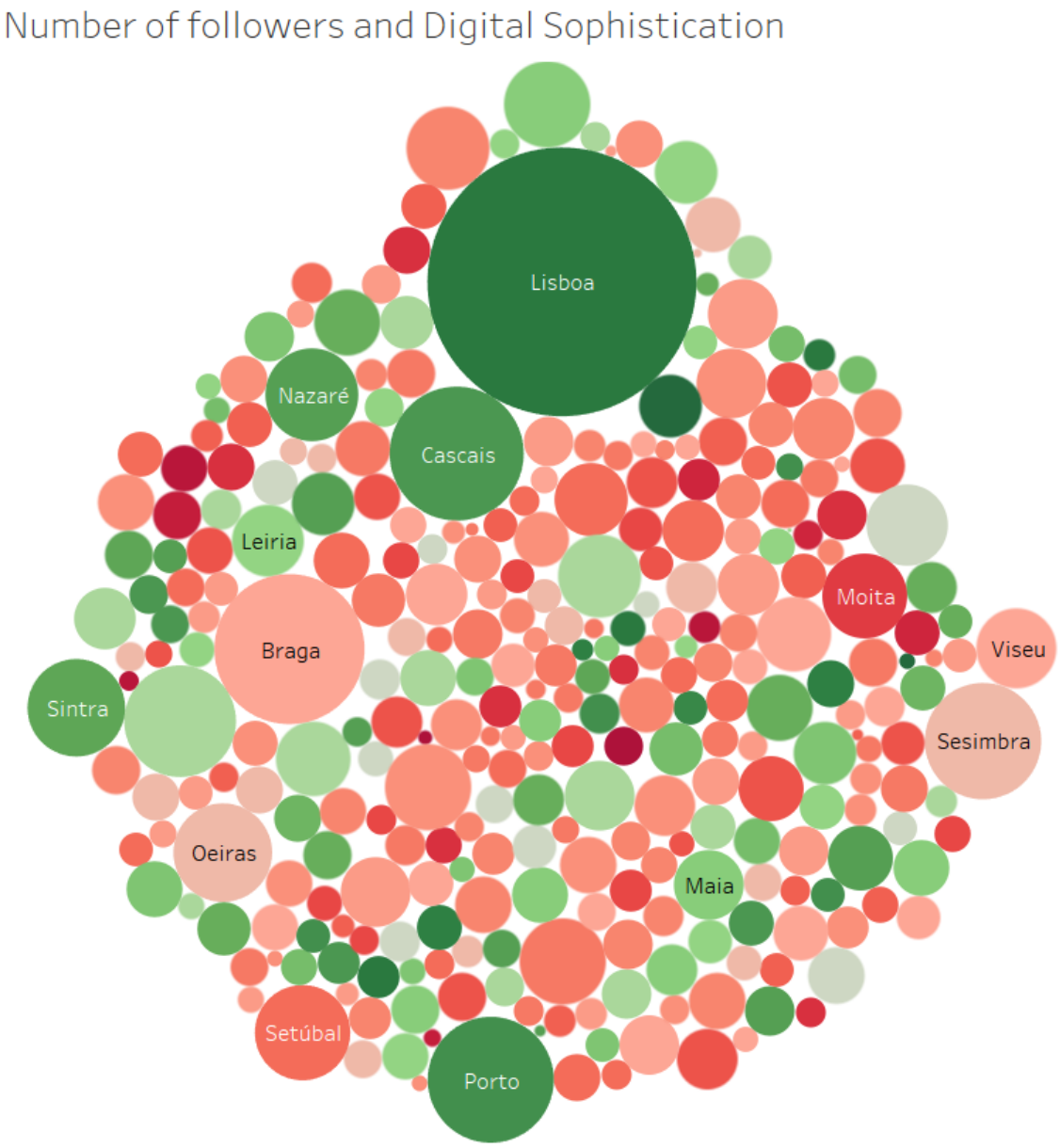
The hypothesis is: There is correlation between the digital sophistication value and Total Engagement. It is based on the fact that if there is better network, more device that can connect to

the internet, more people are willing to use and follow their municipalities on the Social Media platforms.

The result is 0,19, similar to the other case, very close to 0, it means that there is no correlation between them. The hypothesis is rejected.

The Tableau figure (Figure 12) represents this answer, the biggest bubble is Lisbon again with dark green (high digital sophistication level) but Porto is much more behind of it, smaller bubble. Many other red municipalities represent itself like Braga Sesimbra, Oeiras, Setúbal, and in the top 6 municipality regarding the Social Media followers, 3 are green (Lisbon, Porto, Cascais) and 3 are red (Braga, Sesimbra, Oeiras).

Figure 12: Number of Followers and Digital Sophistication



Source: Own work.

3.6.2 Limitations and Future Research Opportunities

This study is a single-country case study, that puts limitation to the generalizability of the results and findings. However, it is a step in figuring out and understanding the Social Media presence of the local governments as a base for engaging and empowering citizens for e-participation in a Smart City.
Regarding the ArcGIS components of the study, namely: spatial autocorrelation, hotspot analysis, cluster and outlier analysis, the limitations of the techniques the results obtained is related to the conceptualization of the neighborhood criterion which must be adapted to each study area.
Also, these techniques only allow the use of variable at one time – in this case: digital sophistication, not other parameters, which would have required other techniques
Seeing Braga's case, where the Social Media page content in both platforms was outstanding, brings up a possibility to research in the attractivity of the content itself by text mining techniques for instance. Here the next steps would possibly include both quantitative and qualitative methods, explore the determinants of content, and see which are the most powerful ways to engage citizens more for e-participation.
The touristic aspect could be interesting too, questions could be raised as how many listed touristic attraction can be found in the city, because to manage a social media account could be less complicated if there are many things to post about - important buildings, statues, attractions, festivals, churches, places of worship, and other types of touristic destinations.

3.6.3 Case Study conclusion

As it is presented, local government institutions becoming more represented and active on Social Media. Starting with the Facebook, 98% of the 308 municipality have a page already, and many of them are presented on Instagram and Twitter too.
In the Social Media usage, the capital, Lisbon has outstanding values in all the examined factors, but examples are presented to confirm the touristic attractions, football, and low aging index, in a particular case of Sesimbra: payed followers are also influencing the Social Media accounts power.
Regarding the digital sophistication, the scores are highly dependent on the location as the Spatial Autocorrelation analysis resulted. But the examined Social Media values: Total Engagement and the number of Social Media followers are not correlated with it. However, there is a relation between the ageing index values, as the hot-spot analysis confirmed it. The interior territories of Portugal have low value in both measurements.

CONCLUSION

As it is presented in the first chapter, being a Smart City is composed of many factors, and regarding the frameworks one of them is the E-Governance, how is the level of digitalization regarding the local governments and public administration. Numerous projects are designed by the European Union to possible framework, milestones and deliverables along with financial support for the local governments, helping to enhance the digital presence. Activity on Social Media is a part of it, it is no longer a question of choice for most governments to use it, since the benefits are presented, such as empowering individuals and isolated interest groups, improving transparency, public safety, and maintaining a conversation with the citizens – listening their voice. This leads to a higher level of citizen engagement, and since millions are sharing observations, thoughts, feelings and experiences, perceptions about their city through Social Media updates, the term "citizens as sensors" were introduced. This type of data unlike the traditional sensors that was described in the first chapter (lightness, temperature and humidity data, personal health monitoring) includes not only the objective, but also the subjective measurements, the citizens individual sensations, current perceptions or personal observations. As a great benefit, there is no need for new developments and installations, the existing devices, (smartphones, PCs, tablets) are ready to be used – however and input field, website or application is required.

After the literature of this field is summarized, main points are: local governments the presence in Social Media should be done in a careful and planned manner, promoting the engagement with the citizen, a case study was conducted.

In the case study questions are raised as how is the current situation among the 308 Portuguese municipalities – which platforms are used, how many followers do they have, which forces are influencing the people's empowerment and the Total Engagement in Social Media. As the study showed, most of the municipalities have Facebook account, 302 out of 308, but the picture is different regarding Instagram 140, Twitter 124 accounts during the checked period – 2019 March. To have a closer look, the resident population, ageing index, Total Engagement and digital sophistication variables were examined by using table analysis and ArcGIS, the geographical information systems 2 analysis type: Spatial Autocorrelation and Hotspot Analysis. The most interesting point of this study is the application of spatial grouping techniques, these are spatial autocorrelation, hotspot analysis and cluster and outlier analysis. The main objective of both techniques is the detection of territorial patterns of the distribution of the examined variables.

In the analysis of the Social Media, Lisbon, the capital had outstanding results almost all of the cases, however the football culture of Porto is also attracting a lot of visitors for the local websites. ArcGIS made it possible to see how the values are dependent on each other: The Spatial Autocorrelation showed, that the Digital Sophistication points are highly correlated with the locations: the interior territories of Portugal has much lower scores, while Lisbon and the coast line is performing good. The values are very similar to the Ageing Index – the inner part of the country is much "older" than the others.

However, the examined Social Media values, Total Engagement and the number of Social Media followers are not strongly correlated with Digital Sophistication and the Ageing Index. Here the example of Braga should be mentioned, that is an attractive tourist destination, with carefully

managed accounts, many posts, pictures, high response rate and big variety of content. This study is a step to understand the Social Media use by the local governments in Portugal, that would lead to the engagement and empowerment of the citizens – a base for e-participation in the Smart City context.

By now the external factors were analyzed, the next steps would possibly include both quantitative and qualitative methods, for exploring the determinants of the shared content, and see which are the most powerful ways to engage citizens better.

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APPENDIXES

Appendix 1: Summary of the thesis in Slovenian Language

ZAKLJUČEK

Kot je predstavljeno v prvem poglavju, je koncept Pametnega Mesta (‘Smart City’) sestavljen iz več faktorjev. Eden temeljnih je ‘E-Governance’, ki predstavlja stopnjo digitalizacije tako lokalne vlade, kot javne uprave. Evropska unija načrtuje številne projekte, s katerimi bi lokalni vladi lahko omogočila finančno podporo, kar bi posledično vodilo v večjo digitalno prisotnost. Prav tako pa del tega predstavlja aktivnost na socialnih omrežjih, ki ni več le pogojna, temveč obvezna izbira lokalnih samouprav. Prednosti tovrstnega pristopa so med drugim izražene preko opolnomočenja posameznikov ter netradicionalnih interesnih skupin za izražanje svojega mnenja Posledice so vidne tudi v boljši transparentnosti, povečani javni varnosti, ter nenazadnje, lažjemuvzdrževanju dialoga z občani. Vse to o vodi do večje vključenosti prebivalcev. Ker ogromno ljudi deli svoje poglede, misli, čustva, izkušnje, dojemanje sveta na socialnih omrežjiih, je bil v concept uveden izraz 'prebivalci kot senzorji'. Takšna vrsta podatkov – za razliko od tradicionalnih senzorjev, opisanih v prvem poglavju (podatki o svetlobi, temperaturi in vlagi, spremljanje osebnega zdravja) – vključuje poleg objektivnih tudi subjektivne meritve, občutke posameznih meščanov, trenutne poglede in osebna opažanja. Velika prednost je, da ne potrebujemo novih namestitev in instalacij, saj so obstoječe naprave (pametni telefoni, osebni računalniki, tablice) že na voljo za uporabo; kljub temu pa vseeno potrebujemo polje za vnos terpletno stran, oziromaaplikacijo.

Na podlagi povzete literature s tega področja je bilo zaznano da je lokalna vlada prisotna : vendar, prisotnost lokalnih vlad na socialnih omrežjih mora biti storjena skrbno in splanirano, s ciljem promoviranja vključenost prebivalcev.

Na podlagi tega je bila izvedena raziskava, kjer je bilo308 Portugalcem postavljenih več vprašanj glede trenutnih razmer – katera socialna omrežja uporabljajo, koliko sledilcev imajo, s čim vplivajo na okrepitev ljudi in celotna vključenost v socialna omrežja. Raziskava je pokazala, da ima večina anketirancev (302 od 308) odprt profil na Facebooku; veliko manj odprtih profilov je na Instagramu (140) in Twitterju (124). V ArcGIS-u so testirali naslednje spremenljivke: gostota prebivalstva, starostni indeks, celotna vključenost in digitalna kultiviranost. V raziskavi o socialnih omrežjih je imela prestolnica Lizbona izstopajoče rezultate v skoraj vseh primerih, a kljub temu tudi nogometna kultura Porta pritegne veliko obiskovalcev lokalnih spletnih strani. Na podlagi prostorske analize preko programa ArcGIS je bilo zaznano) je pokazala, da je digitalna kultiviranosti oziroma uporaba socialnih omrežij močno odvisna od lokacije: notranji del Portugalske ima nižje rezultate, medtem ko imata Lizbona in obala višje. To je lahko sklepano predvsem na podlagi demografske analize, saj je index starosti v notranjem deku države višji, kar pomeni da starejši anketiranci uporabljajo socialna omrežja manj kot mlajši.

V nasprotju pa pri testiranju spremenljivk socialnih omrežij, celostne vključenosti in števila sledilcev na socialnih omrežjih nismo ugotovili močne odvisnosti z digitalno kultiviranostjo in indeksom starosti. Potrebno je izpostaviti predvsem primer Brage, privlačne turistične destinacije, skrbno vodene s spletnimi profili, mnogimi objavami in slikami, veliko raznolikostjo vsebine

objav ter veliko stopnjo odzivnosti. Ta raziskava predstavlja pomemben korak do razumevanja uporabe socialnih omrežij v lokalni samouprava na Portugalskem, ki bi potencialno lahko vodila do boljše vključenosti in sodelovanje s lokalnimi prebivalcei –, navsezadnje je to temelj za e-sodelovanje v okviru 'Smart City'.

Ko predstavljno v tej raziskavi, so bili do sedaj analizirani zunanji faktorji, naslednji koraki pa bodo vključevali tako kvantitativne kot kvalitativne metode za raziskavo dejavnikov deljene spletne vsebine, da bi lahko ugotovilikateri so najbolj učinkoviti načini za boljše vključevanje prebivalcev.