APPLICATION OF THE ‘SMART’ TO THE CITY
A CRITICAL EVALUATION: THE CASE OF TURKEY

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ABSTRACT

APPLICATION OF THE 'SMART' TO THE CITY A CRITICAL EVALUATION: THE CASE OF TURKEY

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For decades cities have brought various concepts in order to create self-sustaining natural urban environments for future generations. Rapidly developing technologies have always been involved in this process and evolved together. Today, the world is experiencing the information age with the development of the Internet network, which allows instant data collection and quick dissemination of information. Parallel to this trend, cities have embraced latest technological developments and brought a relatively new model called the Smart City, which this thesis focuses on. The main aim of this thesis is to develop an in-depth understanding of the smart city concept with a critical approach, as it is quite a comprehensive subject with both opponent and proponents. After constituting a clear understanding of what the smart city is and what it requires to be successful, the thesis offers a new framework to critically assess the application of the smart to the city. This framework offers a triple analysis that focuses on technology, governance capability and user awareness. Turkey is the selected case study for the thesis, and smart mobility is chosen as the main area of research. The abovementioned triple analysis is used in order to first find out the extend of smart mobility technologies in use in Turkish cities, then assess governance capability,

and finally examine citizen awareness regarding smart city and smart mobility applications, with the overarching aim of evaluating the effectiveness and future viability of these applications in Turkey.

Keywords: Smart City, Smart People, Smart Governance, Smart Mobility

ÖZ

AKILLI KAVRAMININ KENTE UYGULANMASI ELEŞTİREL BİR DEĞERLENDİRME: TÜRKİYE ÖRNEĞİ

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Şehirler, yüzyılladır, gelecek nesiller için kendi kendine yeten doğal kentsel ortamlar yaratmak için çeşitli kavramlar geliştirdiler. Hızla gelişen teknolojiler her zaman bu sürece dahil olmuş ve birlikte gelişmiştir. Günümüz dünya, anlık veri toplama ve bilginin hızlı yayılmasına olanak sağlayan İnternet ağının gelişmesiyle bilgi çağını yaşıyor. Bu eğilime paralel olarak şehirler son teknolojik gelişmeleri benimsemiş ve bu tezin odaklandığı Akıllı Şehir adlı nispeten yeni bir model getirmiştir. Bu tezin temel amacı, hem rakip hem de taraftarlar için oldukça kapsamlı bir konu olduğu için akıllı şehir konseptinin eleştirel bir yaklaşımla derinlemesine anlaşılmasını sağlamaktır. Akıllı şehrin ne olduğu ve başarılı olmak için neye ihtiyaç duyduğu konusunda net bir anlayış oluşturduktan sonra, tez, akıllı uygulamaların şehre uygulanmasını eleştirel bir şekilde değerlendirmek için yeni bir çerçeve sunuyor. Bu çerçeve, teknoloji, yönetişim yeteneği ve kullanıcı farkındalığına odaklanan üçlü bir analiz sunmaktadır. Türkiye, tez için seçilen alan çalışmasıdır ve akıllı mobilite ana araştırma alanı olarak seçilmiştir. Yukarıda bahsedilen üçlü analiz, önce Türkiye şehirlerinde kullanılan akıllı mobilite teknolojilerinin kapsamını bulmak, ardından yönetişim kabiliyetini değerlendirmek ve son olarak akıllı şehir ve akıllı mobilite uygulamaları ile ilgili vatandaş

farkındalığını incelemek için kullanılmaktadır. Ayrıca, tez, bu uygulamaların Türkiye'deki etkinliğini ve gelecekteki uygulanabilirliğini değerlendirmenin kapsayıcı amacını da inceler.

Anahtar Kelimeler: Akıllı Şehir, Akıllı İnsan, Akıllı Yönetişim, Akıllı Ulaşım

To my beloved Lale.

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CHAPTER 1

INTRODUCTION

The growth process of cities has brought many concepts to help solve the problems that the world struggles with for decades as a result of industrialization, rapid urbanization, increased population, associated resource consumption and such externalities as pollution, in order to save resources and create self-sustaining natural urban environments for the future generations. Rapidly developing technologies have been involved in this process and have evolved together with the resolution studies of the cities. Today, the world is experiencing the information age with the development of the Internet network, which allows instant data collection and quick dissemination of information. Consequently, new approaches in cities embrace these latest technological developments and bring up a new city model called the Smart City as one of the most recent developments. Hence, this thesis focuses on smart cities, a very wide subject, in which numerous professions varying from economy to governance, from transportation to health is included. One of the main aims of this thesis is to develop a better understanding of the smart city concept with a critical approach as it is a very comprehensive subject, which not only has a technology dimension, but also a human and governance dimension.

While there are various criticism regarding, and opponent to, the smart city concept, it should be noted that the thesis is written on accepting the positive effects of the smart city concept and hence focusing on how this approach can be best utilized for the good of the city and its citizens. In other words, such debates as the exclusive nature of smart applications, and consequently the issues of digital divide, although acknowledged, were not placed at the centre of the field survey, which was carried out based on the assumption that majority has access to the internet and smart phones. The nature of the survey, which was conducted via the

internet, and consequently its results (illustrating that 99% of the respondents owned smart phones), required this assumption and lead to the exclusion of the analysis of digital divide, an issue which can be addressed in future studies.

In addition, the study focused on the governmental approach for the smart city practices and in Turkey smart city applications are produced by the municipalities. As a result for the e-government analysis we focused on the municipal (metropolitan municipalities) applications as a representative of the government.

1.1. Context and problematic of the study

The world now is experiencing the information age, which forms the urban, and creates an information society that is based on the productivity and competitiveness, which depends on knowledge, information and technology (Castells 2009). The most revolutionary technological medium of the Information age is the Internet (Castells 2010), which leads the world to the digital revolution age that is grounded on digitalization today, in the 21st century.

Internet history starts with the network created by the US Department of Defense in the late 1960s for communication between military units without interruption in the event of a possible nuclear war. 20 years later, UK computer scientist Tim Berners-Lee was eventually able to connect hypertext documents to an information system that can also be accessed from all nodes on the network named World Wide Web (www) during his research in CERN in Switzerland. Today, what we call Internet has a radical impact on culture, commerce and technology, which has been taking place since the mid 1990s (Berners-Lee, Cailliau and Groff 1992).

Internet is using the information communication technologies (ICT) to create better-informed and interlinked individuals and businesses. The term ICT is comprehensive, embracing all communication devices and/or applications involving radio, television, cellular and smart phones, all kinds of computers, network, hardware and software, satellite systems and even several services

correlated with such, like videoconferencing. ICT infrastructure comprises fiber optics, wireless hotspots and Wi-Fi networks, which create communication between services and the citizens. In other words, it creates hyper connectivity, also known as **Internet of Things (IoT)**[1], which means connected devices and appliances in an ecosystem. An alternative way to put it would be that it provides person-to-person or person-to-machine communication. Consequently, ICT uses sensors and cameras for monitoring the city activities and transfer to the users, producers and managers as information such as parking availability or trashcans status (whether it is empty or full), or environmental changes like humidity or CO_2 degree, or even human health by tracking heartbeat rhythm via smart watches. It generates real time information for transportation systems (for bus arrivals), detection and automation systems (for traffic congestions) and data processing centers (as connected city generates huge amount of data).

There is a complex relationship between the city and technology, ultimately, between urban society and ICT. The ICT is reshaping the world; creating a new society model depending on more information sharing and accessibility regardless of the physical distances. It changes all the traditional definitions of the geographical dimensions and the established network society. In the network society, different from the industrial society, boundaries of the states are not fixed yet still flexible within the global system. Cities now fight for their role in the global network more than ever. In this competitive world, the ICT infrastructure is essential for 'being connected' (Besselaar, Melis and Beckers 2000).

However, the rapid urbanization of the world poses various problems related to the excessive energy use, congestion, overloaded transit networks, water waste, socioeconomic inequality and insecurity and so on. In short, the dynamism of

[1] Kevin Ashton, British technology pioneer, first established the term in 1999. However, it only gained momentum in 2011, after a Gartner report, is the world's leading research and advisory company, added it to the list of new emerging technologies. Since then, IoT gained global coverage, as more companies worked on advancing and applying it.

people, building, infrastructure and resources put an immense stress on urban life in terms of operating and organizing the urban functions and the services. As a result, there is a vital need to develop and apply innovative solutions in urban planning. The ICT has thus become an ordinary argument in urban sustainability due to the massive use of ICT in urban systems (Bibri and Krogstie 2017).

Eventually, all those new technological developments created a new urban form, which is called 'Smart City'. There have been different views on smart cities since its existence. Some researchers envision the 'smartness' as a guiding principle to deliver urban sustainability (Herrschel 2013; Ahvenniemi, et al. 2017; Martin, Evans and Karvonen 2018; Yiğitcanlar and Kamruzzaman 2018). Other studies evaluate it as a utopian vision (McNeill 2016; Datta 2016; Calvillo, et al. 2016; Hollands 2016). Some studies criticise the approach as perceiving the city only as wires and cables (Hollands 2008). Some studies have concentrated only on the technological side of the smart cities (Mitchell, 2007; Yovanof and Hazapis 2009), ans some others have questioned the citizen perspective (Cardullo and Kitchin 2019; Berntzen and Johannessen 2016).

Its wide range scope encompasses many aspects of social, environmental and economic development and aims to use technology to deal with pollution, energy deficiency, poverty and social exclusion arising in large cities in order to create livable cities by providing information sharing, social communication and urban environment with higher quality of life (Hollands 2008; Nam and Pardo 2011; Dameri 2013; Cocchia 2014; Dameri 2014; Neirotti, De Marco, et al. 2014; Sanseverino 2014; Angelidou 2014; Bibri and Krogstie 2017). The vast existing literature underlines a number of main events as causes that might have had an effect on the development of the Smart City concept.

The very first step comes with the Kyoto protocol, which is the first agreement between nations to reduce greenhouse-gas emissions country-by-country. The foundation of the Kyoto protocol, where a vast majority of the world nations

agreed to sign at the Earth Summit in 1992, stems from the United Nations Framework Convention on Climate Change (UNFCCC) (Cocchia 2014).

Two other important events occurred in 2008. First of all, IBM launched the 'Smart Planet Concept' and became the first company using the word 'Smart'. IBM aims to create interconnected and intelligent planet by opening up the Big Data[2] for leaders in business, government and civil society around the world by using ICT (Palmisano 2008). The second important event is 'The Covenant of Mayors' within European cities, which aims to reduce CO_2 emission by more than 20% by the year 2020, to increase clean mobility and citizen awareness as well as preparing strategic plan for energy technologies. The main focus of the agreement, however, is to spread the smart city idea (Marlier, Natali and Dam 2010).

There are considerably numerous aspects included in the Smart city concept such as urban planning, environment, energy, economic development, technology, social participation and such. It has six characteristics based on all the urban factors called, smart government, smart economy, smart environment, smart mobility, smart people, and smart living. It has a large range of meanings linked with its different fields of applications. There were many comments, arguments, and reviews about the smart city idea, which has brought different terminologies since its existence such as, wired city, intelligent city, knowledge city, network city and digital city. Although they all have different definitions and understandings, the common concept of all those notions is the ICT use. Since it covers many areas from different disciplines, it is a subject that has been studied from a wide range of perspectives.

First of all, for a city to be smart there has to be a technology capability. Here the thesis shall define what the **capability** is. Within the smart city concept and the

[2]Big data is a field that treats ways to analyze, systematically extract information from, or otherwise deal with data sets that are too large or complex to be dealt with by traditional data-processing application software.

scope of the thesis, 'technology capability' which is used by the study refers to the city that has the smart technologies. The thesis evaluates the smart technologies first of all, as smart mobility capability, which means having the smart mobility technologies that are defined in the literature as will be seen in section 2.5. Then, smart technologies are evaluated by analyzing the e-government tools as smart governance application, which is another technology related topic within the smart city concept. As a result the thesis refers to the availability of the smart technologies when cited as capability.

For a city to be smart with the technology and applications that it produces, its people should be active users. Usage of the smart applications that smart city produces is vital for the sustainability of the smart cities as widely discussed in section 2.4. In order to be active users, first, they need to know about those applications. As a result, as presented in detail in section 2.4, a smart city requires **aware** people, that are people aware about smart practices.

Apart from this, smartness for a city requires government to be active, responsible and interactive in order to facilitate citizen-government relationship to encourage citizens to participate and to be active, as well as being innovative and entrepreneurial in terms of creating new technologies and smart applications for their city – a model referred to as bottom-up as described in the literature review. In order to allow for active citizen engagement, the government also needs to be mature to make the best use of the smart applications it produces. **Mature** here refers to being responsive to citizen actions. For example as will be seen in section 5.2, it is not enough and effective to produce applications and platforms for citizens to use smart technologies unless the governments respond to citizen actions, requests, questions, and feedback properly.

The emphasis on capability, aware and active citizenship, and maturity of the governance also forms the main analysis framework and approach of this study. Incorporating these concepts into the analysis helps adopt a more critical evaluation of the smart cities, going beyond a mere assessment of whether there are sufficient

smart tools, technologies and applications. As described below, bringing these aspects to the forefront of the analysis can also be considered as one of the contributions of this study regarding analysis approaches as well as identifying factors for an effective functioning of smart cities.

The literature of the smart city is very scattered because it is a rather comprehensive concept, encompassing various study areas as mentioned above. Moreover, in each of these study areas, various concepts and debates related to the smart city have been made, most of them taking place at the same time. Hence, it is very difficult or even impossible to deal with the subject chronologically. Furthermore, there are various application models for the implementation and governance of the smart city idea. Similar to the concept's various different definitions; those different models are also spread around in the literature.

As a result, firstly, this thesis aims to clarify the smart city literature and create a story line for an extensive smart city approach by analyzing the smart city evolution in each title. Moreover, as described briefly above, the thesis adopts a critical approach in examining smart city applications and models and eventually offers a new model as well as a new analysis framework with a view to provide a better understanding of the vital components of the smart city.

1.2. Contribution of the thesis

The structure of the thesis is not based on a common/ordinary smart city evaluation. One of the major contributions of the thesis to the literature is to achieve a clearer understanding of how the cities ended up with the 'smartness' competition. As a first in the literature, in order to create a story line, the thesis refers to various concepts including urban planning, technology, environmental data, which affect the emergence and the development of the smart city idea. Other than that, instead of addressing a single issue about the concept of smart city, this thesis presents the concept of smart city in all respects, providing both knowledge

transfer and a critical view of understanding. Furthermore the thesis re-evaluates and re-defines the most cited two characteristics of the smart city, which are smart people and smart governance. Moreover, the thesis offers a new model for the successful implementation of the smart city applications, again criticizing the current models. This critical approach also helps incorporate crucial factors and concepts, such as capability, aware and active citizenship, and maturity of the government, into the analysis of smartness. Consequently, the thesis makes comprehensive smart city analysis consisting of three different major analysis with multiple minor analysis to collect the data in Turkey, which contains all the aspects of the smart city idea, in order to understand the smart city approach from past to present and to summarize the current situation.

In addition to the introduction of a new model of analysis, as well as the debates of the abovementioned concepts and factors, a major contribution of the thesis to the smart city practices is that three different major analysis, including smart governance, smart people and smart technology with smart mobility applications, are carried out in order to find out smart city capability and awareness in Turkey. Smart city capability is the technological capability and the capability of understanding and using it. Technological capability is to have the tools that smart city requires. Capability of understanding and using it is to have the vision of smart - sustainable and acting accordingly. Correspondingly, the thesis discovers whether Turkey has the smart city technologies or not. Additionally, with the bilateral relations analysis, the thesis measures the capability of using those technologies, both from the perspective of the citizen, i.e. aware and active citizenship, and from the perspective of the government, i.e. maturity of the government, and consequently makes a proposal to assess the performance of smart city approaches as well as making recommendations on how to become a successful smart city for Turkey.

1.3. Methodological approach

In order to make a critical story line for the smart city, first of all, a comprehensive literature review was carried out in different fields including all the components of the smart city with all the debates and critics. To address the smart city approach for Turkey, which is a case study, comprehensive governmental research is vital to find out all the strategies and action plans related with the smart city development.

In order to formulize the triple analysis, three different studies were done. First of all, for the smart government analysis, all the selected governmental web sites, as an application of e-government, were examined one by one to find out how interactive they are. Afterwards, to examine citizen awareness and participation on city matters for the smart people, first, the thesis made a research on smart mobility action in Turkey. Then, a citizen survey was conducted containing both smart mobility and governmental applications. For the next step, statistical analysis was conducted to find out the factors generating awareness and effective usage. Finally, all the results and findings were interpreted and summarized with a view to make recommendations for effective implementation.

1.4. Structure of the thesis

This study is mainly composed of four parts; the first part draws a theoretical framework of the smart cities with regards to how the concept emerged and developed. The second part gives information about Turkey's smart city strategies and actions. The third part presents all the analysis conducted to answer the main questions of the thesis. The final part contains the general evaluation of the thesis findings and a critical discussion of the smart city.

Chapter 2 is a brief history of the factors (problems / solutions) affecting the emergence of the concept of the smart city, which is explained in order to make a summary of the subject and make it clearer. This section, which reviews various issues and problems that cities have experienced from the past until present, also

clarifies the relationship between cities and the Internet. The study then examines the concept of the smart city in its own context and presents related planning and design approaches, as well as governance and application methods. As a result of these analyses, this chapter, which brings a critical perspective to the subject, additionally presents a proposal for a new theoretical framework in understanding and analyzing smart city concept and implementation. Finally, after representing smart city practices around the world, the chapter concludes with a discussion in which the two most cited smart city characteristics are re-evaluated and re-defined within the scope of the thesis.

Chapter 3 is the methodology part introducing the hypothesis and main questions to be answered, as well as research, evaluation methods and data collection.

Chapter 4 delivers Turkey's smart city approach based on all the written strategies and action plans. This analysis provides an understanding of the current situation and helps discover the smart technology capability and awareness in the country. At the end smart technologies capability in Turkey is evaluated.

Chapter 5 is the smart governance capability and maturity analysis, which is composed of e-government analysis, the results of the citizen survey that is related to the municipality's responses to the citizen action and the interview with the municipalities.

Chapter 6 is the smart people analysis and includes citizen survey results that help discover the citizen awareness and usage of the smart city applications.

Chapter 7 presents an in-depth analysis based on detailed examination of the citizen survey and discusses the potential factors affecting awareness and usage.

Chapter 8 is the conclusion-containing summary and evaluation of the main findings of all the studies that are carried out. It also includes contribution of the thesis to the literature, to smart city practices and to urban planning and urban studies, also noting the limitations and making elaborations for future studies.

CHAPTER 2

SMART CITY

Cities with completely different degrees of complexity emerged in the 21st century with the digital revolution. Rapid development in hardware and software design has encouraged cities to use Information Communication Technologies (ICT)[3], and since then the cities have been labeled in different terms such as wired city, virtual city, intelligent city, digital city and finally, smart city.

Smart city is a city trying to achieve all the sustainable, ecological way of living standards and rescue the world for the future generations, and solve the problems by inventing new technologies or integrating itself into already invented ones with entrepreneurial and active citizens.

In order to better understand the concept, there has to be a broad understanding of when and how it started. In order to find an answer, this study tries to create a chronological development by making a vast literature research in different concepts that are related to the emergence of the smart city and brings them together to clarify/filter how the smart city idea has emerged.

2.1. Understanding emergence of the smart city

What has been discussed among the economists, environmentalist, academics and politics over the centuries can be summarized with the following statement by

[3] ICT is an umbrella term that includes any communication device or application contains radio, television, cellular phones, smart phones, any kind of computers, network, hardware, software, satellite systems and also the various services and applications associated with them like videoconferencing.

Brown et. al (1987, p. 713) in their work titled Global Sustainability - Toward Definition:

'... Indefinite human survival on a global scale requires certain basic support systems, which can be maintained only with a healthy environment and stable human population.'

The world's population increases steadily. Today, there are 7.7 billion people worldwide in 2019, and it continues to grow every day. According to the World Population Prospect 2019, it is expected that the world population will be around 8.5 billion in 2030, 9.7 billion in 2050, and 10.9 billion in 2100 (United Nations 2019).

Manuel Castells (Castells 2002, cited in Evans, 2002), by introducing the book called 'Livable Cities?' in 2000, claimed that 'probably around the time you are reading this book, we will be crossing the threshold of 50 percent of the world's population living in urban areas' (Evans 2002). Today, according to the World Urbanization Prospect 2018, literally more than half of total population (55%) is living in the urban areas while it was 30% in 1950 (United Nations 2018). It is estimated that this ratio will rise to around 70% (68% according to United Nations (2018); 70% according to Dameri (2014); 75% according to Burdett and Rode (2006) and Brenner and Schmid (2014)) by 2050.

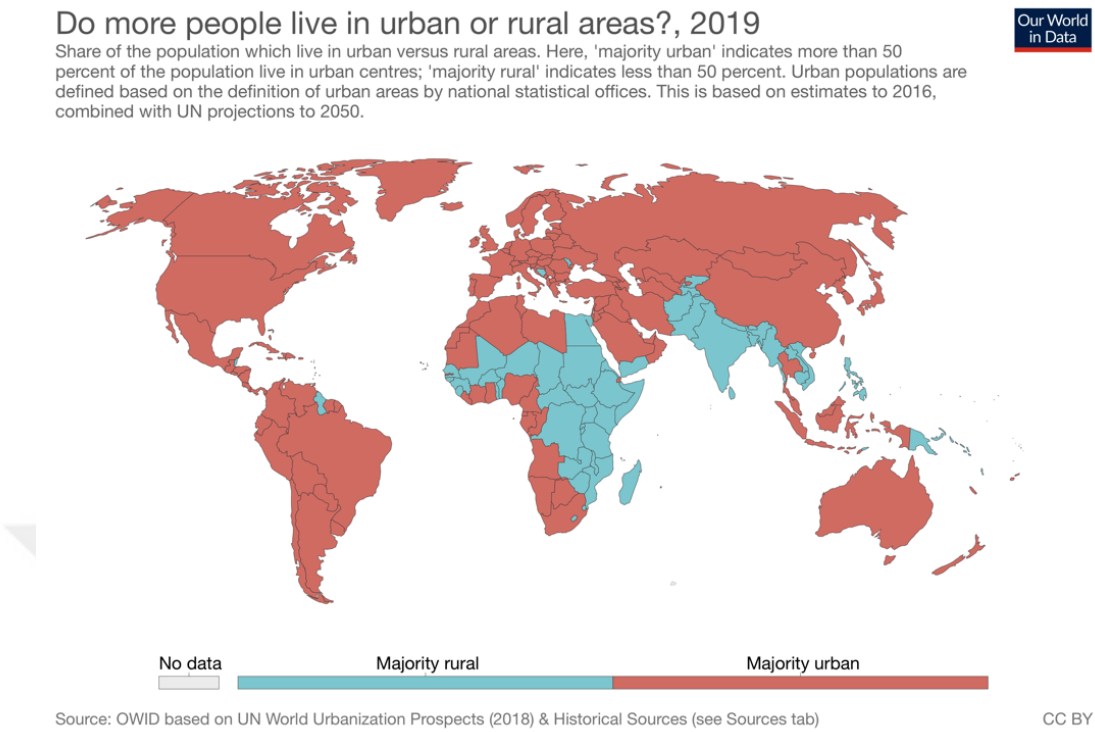


Figure 2.1: Urban vs. Rural Majority (United Nations 2018).

Within 125 major cities, there are almost 2.5 million cities and towns in the world and according to Demographic World Urban Areas & Population Projections, cities where over one million people reside are expected to increase in number at a proportion of less than 2%, whereas those with less than one million residents show a growth rate of 4.19% (WWF 2015). There will be 43 megacities with more than 10 million inhabitants by 2030 (United Nations 2018). In spite of all these huge populations, cities occupy only 2% of the Earth's surface (Revi 2016; Dameri 2014). However, they consume about 75% of the world's natural resources and 80% of global energy supply (Revi 2016;Bibri and Krogstie 2017; Mitchell and Casalegno 2008) while being responsible for 70% of global CO_2 emissions (WWF).

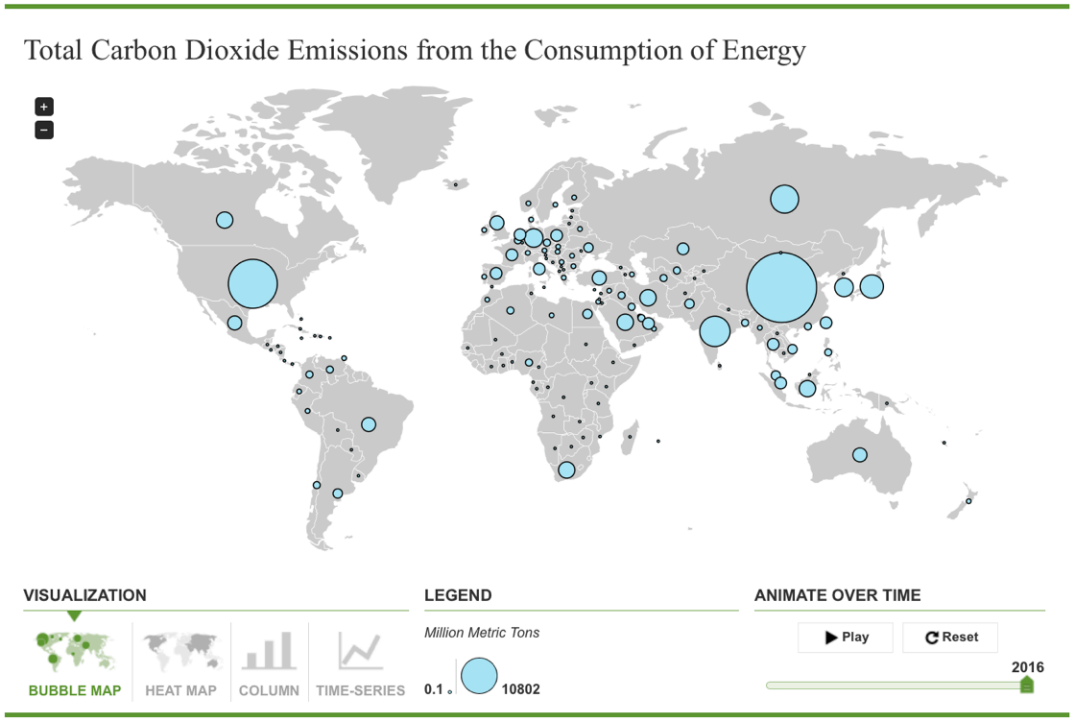


Figure 2.2: An Atlas of Pollution (US Energy Information Administration 2016)

According to the US Energy Information Administration (International Energy Statistics 2016), United States is responsible for 5,172 million tons of CO_2 emission while China is responsible for 10,593 million tons. As said by the World Health Organization (WHO), 748 million people do not have access to clean water and over 80% of residents are exposed to unhealthy air (Revi 2016) due to the massive growth of urban population and inadequacy of the built environment (Bibri and Krogstie 2017). With respect to the Global Health Observatory data, published by World Health Organization, 12.6 million people died, which is 23% of all deaths, because of living or working in an unhealthy environment (Ustün, et al. 2016).

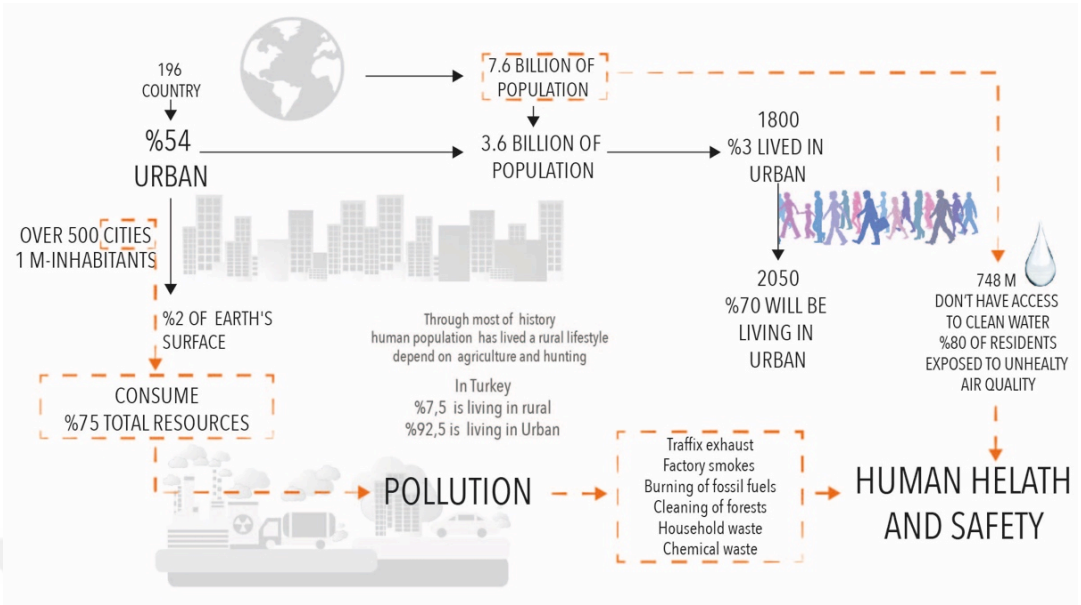


Figure 2.3: Earth's Facts (author's elaboration)

Those uncontrollable matters mentioned above and as seen in Figure 2.3 clearly require a worldwide change to overcome the environmental problems and provide a clean survival to the humankind. In 1971, when Canada created the Department of the Environment (Sustainability Report 2011), the aim was to attract the attention of the world to the environmental issues that humans have created, mainly, since the industrialization. The well-known term Sustainability was first used in a British book published in 1972, published with the title of 'Blueprint for Survival' (Kidd 1992). So the first sustainability term is used for 'survival'. Since then, there have been many conferences and meetings organized, reports published, and policies written in order to attract the attention of the world to the environmental issues (Robert, Parris and Leiserowitz 2005) and to discuss the phrase 'Sustainable Development' (Newman and Kenworthy 1999). As one of the most recent activities, in 2015 at the UN Summit, the world's heads of states and governments adopted 17 Global Goals as seen in Figure 2.4 to protect the planet and ensure wealth for all (United Nations). Known as Sustainable Development Goals (SDGs), they cover a wide range of issues; and it is worth noting that one of the SDGs is named 'sustainable cities and communities' also referred as the urban SDG.



Figure 2.4: Sustainable Development Goals (Source: *https://sustainabledevelopment.un.org)*

Although there is a clear focus on cities and communities due to the urban SDG mentioned above, it should be noted that at first, sustainability was a common discussion topic for the environmental policy and environmental scientific research arena. The relationship between humans and global environment became a matter for institutions and individuals, who became increasingly concerned with the management of global natural resources and designed multinational and multidisciplinary research and monitoring programs (B. Brown, et al. 1987). However, this positioning in environmental policy and studies started to change, and the issue became a concern for urban policy too. As stated by Newman and Kenworthy (1999):

'It is probably true to say that the major environmental battles of the past were fought outside the cities, but that an awareness of the need to come back to cities is now universally recognized by environmentalists, governments and industry.'

It is inevitable to look at the issue of sustainability through urban cities perspective because the physical form of a city has an effect on the human activities (Banerjee and Southworth 1995). As a result, sustainability became a topic not only for environmental policies but also for urban policies.

The motto of sustainability struggles to create self-sustaining social environments and conditions for the existence of human (L. Brown 1982). It also seeks to maximize the continuity of renewable resources stocks (Conway 1985; Joy and Greg 1981). It aims to achieve an environment where renewable and unlimited energy resources are present (Lovins 1977). Rapid global urbanization created many challenges, including congested traffic grids, social inequality and weakness, decreases in public health and so forth. Urbanization with the complex distribution of residents, houses, infrastructures and systems places a tremendous burden on urban systems (Bibri and Krogstie 2017). Hence, innovative solutions in the field of urban planning and development were required, to be applied and to overcome urbanization challenges (European Commission 2014; United Nations 2016).

What is meant by innovation? According to the Oxford Dictionary innovation means the introduction of new things, ideas or ways of doing something. In the area of city planning, we can state that when Ebenezer Howard proposed his 'Garden City' idea in 1899, he did something 'innovative'.

Garden City idea suggested an amazing industrial innovation with glass arcade surrounding the park at the center of the city called crystal palace. Here, manufactured goods would be displayed for sale and joy. At the outer ring, in the façade of the main railway line, there would be factories, warehouses, dairies markets, coal yards and timber yards. Smoke is kept minimum and all machinery is driven by electric energy. It would be a new planned town placed in countryside. Jobs would be provided by light, worker friendly industries and services. The town would have circular form, with radius of a little more than kilometer so that people could walk to their work. At the center of the city would be a park, ringed by impressive public buildings This innovation arise because of the phenomenal growth of cities with its crowding population, poverty, disease and crime when the total population of earth was only 1,5-2 billion (Ward 1992; Beevers 1992; Kargon and Molella 2008).

Industrial revolution itself, of course, is the biggest innovation of 18th and 19th centuries and it led many innovations to emerge in different areas, such as the advent of the steam engine in transportation and inventions of the telegraph in communication. Today, what is described in the garden city idea or the things industrialization gave to the world is not considered as a technological innovation from our time of perspective, but in its own timeline, it was very much considered as innovative and technological solutions. So the important thing is to create something that has not been created before or provide a solution that has not been done yet by using the newly discovered technologies.

After almost three centuries with benefits (and of course damages) of the industrial revolution, the world now is experiencing the information age (Yovanof and Hazapis 2009). The information technology, emerging just as an archetype in 1970s, redefined the era of competition among the countries and societies by prioritizing knowledge, information and technology (Castells 2009), and the most revolutionary technological medium of the Information age is the Internet (Castells 2010).

Internet history starts with the invention of computer technology in the 1950s. A variety of input science laboratories in the United States, United Kingdom and France have developed the first principles of wide area networking. The US Defense Department focused onto creating a network called ARPANET (Advanced Research Projects Agency Network) in the beginning of the 1960s to ensure that communication between military units continues without interruption in the event of a possible nuclear war. The first message through ARPANET was sent to The Stanford Research Institute in 1969 from the Computer Science Laboratory of Professor Leonard Kleinrock in California, Los Angeles (Leiner, et al. 2009). Due to its success, all US universities joined the network in the 1980s when UK computer scientist Tim Berners-Lee was eventually able to connect hypertext documents to an information system that can also be accessed from all nodes on the network named World Wide Web (www) during his research in CERN in Switzerland. In the 1990s, it started to become widespread with its inclusion in

commercial organizations. Today, what we call Internet has had a radical impact on culture, commerce and technology since the mid 1990s (Berners-Lee, Cailliau and Groff 1992).

Sustainable development now uses the potential of the Internet which creates the better informed and interlinked individuals and businesses by using the information communication technologies (ICT) in order to create an environment enabling the civic participation in the policy debate, offering higher education and quality of life (Dameri 2014).

The term ICT is comprehensive in which all communication devices and/or applications involving radio, television, cellular and smart phones, all kinds of computers, network, hardware and software, satellite systems and even several services correlated with such, like videoconferencing. Consequently, ICT has recently become part of a common debate on urban development because of the ubiquity of digitalization as mentioned in previous sub-chapter in chapter 1.

In order to be able to offer new innovative solutions to various problems of the world, a new phenomenon influencing research institutes, universities, governments, policy makers and ICT companies (Bibri and Krogstie 2017) which is named Smart City (SC) has surfaced after various trials of different concepts, which will be explained in the next section and seen in Table 2.1.

The concept of smart cities is now common throughout the world. Taking the major problems of urban life including traffic, noise, urban crowding, crime and etc., cities are now meant to produce smarter urban spaces by making use of high technology (Dameri 2013).

By the end of 2010, while the ‘Sustainable City’ was a common concept, the word ‘Smart City’ has progressively evolved and resulted as the most popular phrase. In Figure 2.5, it can be seen how high the smart city settled above the sustainability in the hierarchy graphics although it arose after the sustainability.

There are considerably numerous aspects included in the Smart city concept such as urban planning, environment, energy, economic development, technology, social participation and such. Also the word smart assumes a large range of meanings linked with its different field of applications (Cocchia 2014; Hollands 2008) which is explained in the next section in order to understand how smart city concept is taking place through its development.

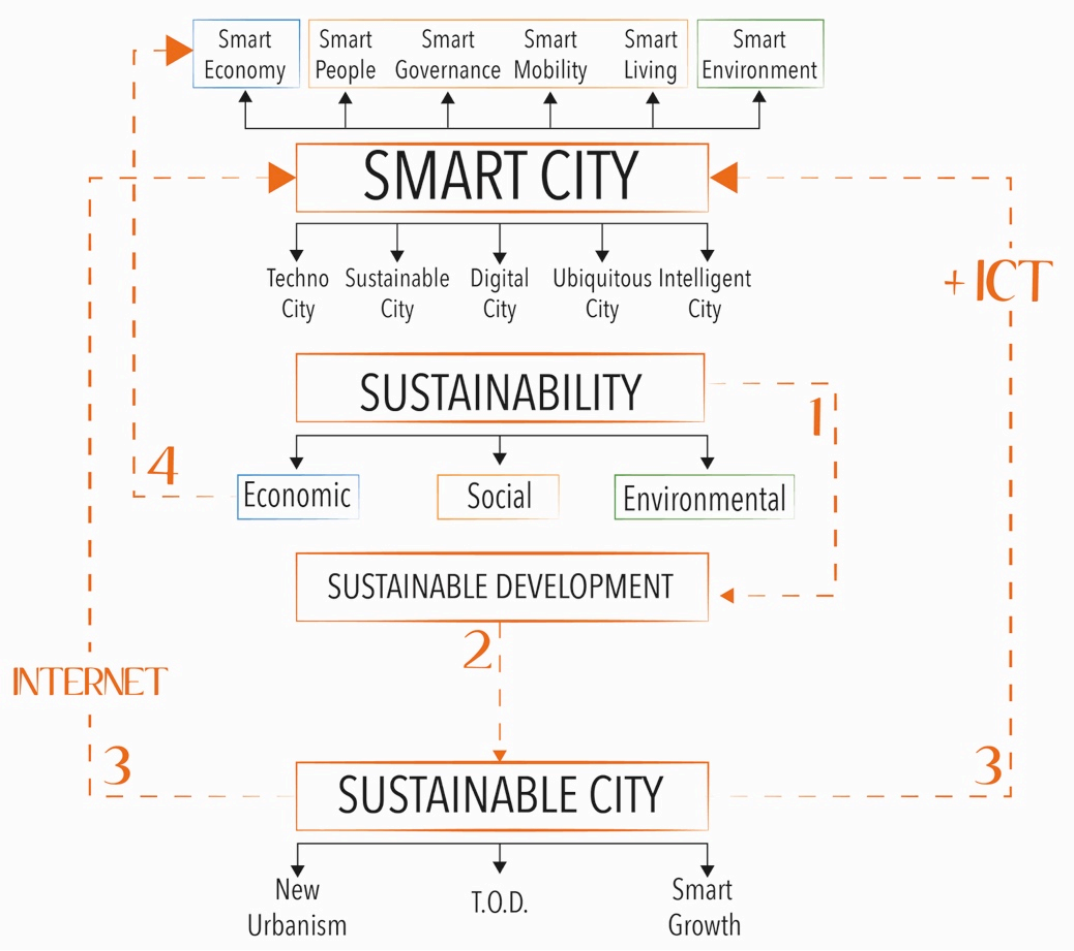


Figure 2.5: Smart City merging with Sustainability (author's elaboration)

2.2. Understanding smart city context: smart city evolution

After the revolution of the Internet and the rising developments of the technological events like computers, a new form of a city has started to be discussed among the scientific area. There were many comments, arguments, and

reviews about the smart city idea, which has brought different terminologies with it like, wired city, intelligent city, knowledge city, network city, digital city and etc. With its many different descriptions, there are also many different approaches like technological view of perspective, economical, environmental, human perspective, and governmental perspective and so on. It is very hard to identify which one was discussed before; indeed, there is no order because smart city idea is a topic that all of its various contexts are discussed at the same time while it is developing. In these complex circumstances, it would be hard to analyze and discuss the literature in a chronological order. Therefore, without attempting to present such a chronological description, Table 2.1 brings together leading concepts related to the smart city paradigm together with the leading scholars who discuss these concepts.

One of the first sources on the concept of 'smart city' is a book named 'The Technopolis Phenomenon: Smart Cities, Fast Systems, Global Networks' written by Gibson, Kozmetsky and Smilor (1992). The authors examine the Smart cities as 'The Technopolis Phenomenon', and in 18 essays, organized in five parts, discuss the relationship between industry, universities, authorities and institutions. They also concentrate on the ability of integrating the Technopolis in which they are living into worldwide network according to the 'intelligence' of their representatives. Here, we have the very first idea of smart people to achieve some sort of smart living standard. After they use the term 'intelligent' for people, the idea of 'intelligent city' comes as a metaphor, which is about using information communication technologies and wired systems.

Table 2.1: The different smart city concepts and definitions (Cocchia 2014)

CONCEPT	DEFINITION	REFERENCE
Wired city	"Wired cities refer literally to the laying down of *cable and connectivity* not itself necessary smart"	(Hollands 2008)
Virtual city	"Virtual City concentrates on *digital representations* and manifestations of cities"	(Schuler 2002)
Ubiquitous city	"Ubiquitous city (U-City) is a further extension of digital city concept. This definition evolved to the ubiquitous city: a city or region with *ubiquitous information technology*"	(Anthopoulos ve Fitsilis 2010)
Intelligent city	"Intelligent cities are territories with high capability for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their *digital infrastructure* for communication and knowledge management"	(N. Komninos 2006)
Information city	"Digital environments collecting official and unofficial information from local communities and delivering it to the public via *web portals* are called information cities"	(Anthopoulos ve Fitsilis 2010)
Digital city	"The digital city is as a comprehensive, *web-based representation*, or reproduction, of several aspects or functions of a specific real city, open to non-experts. The digital city has several dimensions: social, cultural, political, ideological, and also theoretical"	(Couclelis 2004)
Smart community	"A geographical area ranging in size from neighborhood to a multi-county region whose residents, organizations, and governing institutions are using *information technology* to transform their region in significant ways. Co-operation among government, industry, educators, and the citizenry, instead of individual groups acting in isolation, is preferred"	(California Institute 2001)
Knowledge city	"A Knowledge City is a city that aims at a knowledge-based development, by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge. This can be achieved through the continuous interaction between its citizens themselves and at the same time between them and other cities' citizens. The citizens' knowledge-sharing culture as well as the city's appropriate design, *IT networks and infrastructures* support these interactions"	(Ergazakis, Metaxiotis ve Psarras 2004)
Learning city	"The term 'learning' in 'learning cities' covers both individual and institutional learning. Individual learning refers to the acquisition of knowledge, skills and understanding by individual people, whether formally or informally. It often refers to lifelong learning, not just initial schooling and training. By learning, individuals gain through improved wages and employment opportunities, while society benefits by having a more flexible and technological up-to-date workforce"	(OECD Observed 1999)

They assume these cities run with the knowledge processors, which enables rapid information exchanges. Another terminology that is considered within this Technopolis age is 'multimedia city' which is interestingly offered to the people at the bottom of the social pyramid so that they will be provided with the information. The book also concludes that technological developments should be linked to, and supports, the political struggle to create order in a dispersed world of power.

In 1995, Carter and Brine (1995) discussed the 'The Multifunction Polis', which aims to improve the cities (in Australia) to meet the challenges of the 21st century. The idea was to create business investment and employment in the growing industries, which were environmental management, education and most importantly information technologies and telecommunications. And now, they called this as 'smart city' and they believe that it will balance economic and social development and it will be technologically and environmentally sustainable. The Multifunction Polis project aims to find out solutions to existing environmental problems with a view to create sustainable growth by developing new technologies and products. It could be said that from the 1990s onwards, many researchers started to investigate new technologies to support and develop sustainable solutions.

In 1997, Graham (1997) stated that the technological changes would affect urban changes. Doing anything, anywhere, at any time, universal access to the information, ubiquitous online links and technology itself would change the urban. Although this was seen as a futuristic myth, they saw telecommunication as a solution to insufficient commuting and pollution in physical space. Dr. James Martin, the guru of the information age (Martin 2014; Winston 1981), predicted in his book named The Wired Society (Martin 1978), that congestion and pollution in the cities would be overcome with the growth of 'virtual cities'. He claimed that the use of telecommunications would suppress the need of physical transportation.

In light of that statement, today, according to the state of remote working reports published in 2019, 70% of professionals work remotely at least one day a week.

Also, two-thirds of managers report that employees who work from home are more productive. As 84% of remote workers primarily prefer to work at home, physical transportation certainly is affected and reduced by telecommuting. In fact, today, in 2020, after a pandemic, officially declared by the World Health Organization as Covid-19, the world is experiencing this futuristic myth. According to the statistic published by slack[4], an estimated 16 million U.S. knowledge workers started working remotely due to Covid-19 as of March 27; that number is likely much higher now. In Turkey, all forms of education from elementary school to universities are performed as online education. Except for defense industry and production related works, almost every profession such as engineers, architects, managers, and bank officers are now working at home via Internet. Online applications like Zoom or any kind of application provide audio conferences allowing education, businesses, and meetings, even birthday parties to be run at home. Even health appointments are run from home.

While the 1990s were dominated by discussions on how telecommunications will change the cities and how to deal with the growth and development of computers and communications, long before these discussions, in 1982 the Government of Singapore created National Computer Board (NCB) to audit the computerization and to increase the information technology (IT) professionals. In 1987, with many different applications of IT, they published seven-point National IT Plan aiming to create a climate for creativity and entrepreneurship by developing IT capability, producing a range of applications to improve productivity, and build an efficient information communication infrastructure. Once they had applied all those extremely ambitious goals, Singapore began to advertise itself as 'The Intelligent Island' (Batty 1990).

[4]Slack is the collaboration hub that brings the right people, information, and tools together to get work done. From Fortune 100 companies to corner markets, millions of people around the world use Slack to connect their teams, unify their systems, and drive their business forward.

In 1992, Tatsuno came with a new term named multimedia city and described it with this paragraph (Tatsuno 1992):

'It is September 2007. Your six-year-old daughter has returned home from school and persuaded you take her on a quick study tour of the Louvre for a class assignment. You put on your virtual reality TV helmet and skim through the museum's visual catalogue. Her assignment is 17th century French artists. You say '17th century – Georges de la tour' into the speaker. Immediately, you are on a 3-D simulated tour of the Louvre…' As you both gaze at a painting, your daughter calls her friend on the videophone and they edit the picture and swap the ideas for their joint school project'.

Today, in 2020, video calls are very common not only in business but also in daily life. Virtual reality glasses, indeed, are used as what Tatsuno described 27 years ago. For example, lots of museums[5] around the world are available online so that visitors can connect to the website that the museum provide and have a 360 degree tour inside the museum. Even open-air museums and archeological sites have that opportunity. Additionally, some museums offer visitors the experience of literally being there, if they participate with virtual reality glasses, via special video broadcasts. You may even find mobile application provided by Google (Google art and culture) where you might visit top exhibits, iconic sites, famous buildings and natural wonders on your screen or in VR.

Tatsuno also introduces globally networked cities and intelligent cities as a new metaphor. He describes the network cities as personal computers, which are interactive, flexible and rapid. These cities are developing on networking and

[5] From Turkey: Cappadocia-Göreme Open Air Museum, Nevşehir; Chasm of Heaven and Hell, Mersin; Dolmabahçe Palace, Istanbul; Efes Museum, Izmir; Fish Lake (Balıklı Göl), Şanlıurfa; Göbekli Tepe, Şanlıurfa; Hagia Sophia Museum, Istanbul; Museum of Anatolian Civilizations, Ankara; Topkapı Palace, Istanbul; Zeugma Museum, Gaziantep are some of the examples. From Abroad: American Museum of Natural History, New York-USA; British Museum, London-ENGLAND; Galleria Degli Uffizi, Florence-ITALY; Louvre Museum, Paris-FRANCE; Metropolitan Museum of Arts, New York-USA; The National Art Museum of China, Beijing-CHINA; Indian National Museum-New Delhi-INDIA; The State Hermitage Museum, Saint Petersburg-RUSSIA; Van Gogh Museum, Amsterdam-The NETHERLANDS; Vatican Museums, Rome-ITALY are some of the examples.

concerned about linkages rather than being the only technology oriented technopolis. Their value originated from the rapid exchange and transformation of raw information into highly valuable knowledge. Intelligent city, on the other hand, according to Tatsuno, uses information communication technologies to make everyday urban activities more valuable; however, they are closed systems unlike global network cities. Intelligent city uses closed circuit systems to protect their licensed know-how.

As mentioned earlier, while searching about the smart cities, one can meet various terms like wired city, virtual city, information city, intelligent city, digital city, knowledge city and learning city. Not all these terms have a wide-ranging literature. These are just the names used as a trial in the development process of a smart city idea, like the draft titles of an unfinished book. When examined in detail, all the definitions are about connectivity and knowledge sharing via digitalization and ICT. The smart city issue is a very large and complex subject, as it affects many areas of the city and life. It is not possible to follow the subject chronologically as all versions are discussed at the same time. In order to fully master the subject, it is necessary to go back and forth in literature. Therefore, while working on the definitions of the different smart city concepts shown in Table 2.1, it is also necessary to look at the definition of the smart city at the same time. Although there are lots of discussions about what smart city is, there is no real accepted definition of it.

Hitachi, Japanese multinational conglomerate company, defines smart city as *'an environmentally conscious city that uses information technology to utilize energy and other resources efficiently'*.

IDC International Data Corporation defines it a *'finite unity or entity with its own governing authority that is more local than the federal or national level and uses a specific set of technologies to achieve the explicit goal of improving the lives of its citizens through sustainable development'*.

According to the study for the European 2020 strategy goals *'smart city is a city seeking to address public issues via ICT based solutions on the basis of multi stakeholder, Municipalities based partnership'.*

Dr. Boyd Cohen[6] expresses that *'Smart sustainable cities use information and communication technologies (ICT) to be more intelligent and efficient in the use of resources, resulting in cost and energy savings, improved service delivery and quality of life, and reduced environmental footprint – all supporting innovation and the low-carbon economy'.*

Prof. Dr. Ruddolf Giffinger[7] outlines that *'a Smart City is a city well performing in these 6 characteristics, (Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living, and Smart Governance) built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens'.*

Assoc. Prof. Andrea Caragliu[8] states that *'A city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance'*

Assoc. Prof. Dameri, Renata Paola[9] defines smart city *'a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and*

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[6] Boyd Cohen is an urban and climate strategist working in the area of sustainable development and smart cities. Currently he is Dean of Research at EADA Business School and co-founder of IoMob.

[7] Professor Dr. Rudolf Giffinger is an expert in analytical research of urban and regional development. His research mainly concentrates on intra-urban development, urban decay, and segregation/integration as well as on urban/metropolitan competitiveness of selected cities and respective strategic issues.

[8] Associate Professor of Regional and Urban Economics in Politecnico di Milano and Executive Director at Regional Science Association International

[9] Renata Paola Dameri is Associate Professor in Business Administration and Information Systems at the University of Genoa, Italy. She is at present Advisor to the mayor for Territorial development, innovation and smart city.

participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development'

However, as shown in Table 2.2, when most cited smart city definitions are examined, it can be seen that there are three most mentioned concepts, which are digital city, intelligent city and ubiquitous city. As a result, this study continues with detailed clarifications of these three concepts.

Table 2.2: Most cited definitions of smart city (Cocchia 2014)

DEFINITION	**REFERENCE**
"A Smart City is a city well performing built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens"	(Giffinger 2007)
"A city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance"	(Caragliu, Del Bo ve Nijkamp 2011)
"Smart city is defined by IBM as the use of information and communication technology to sense, analyze and integrate the key information of core systems in running cities"	IBM
"Smart City is the product of **Digital City** combined with the Internet of Things"	(Su, Li ve Fu 2011)
"Concept of a Smart City where citizens, objects, utilities, etc., connect in a seamless manner using **ubiquitous technologies**, so as to significantly enhance the living experience in 21st century urban environments"	(Cocchia 2014)
"A smart city is a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, **intelligent development**; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development"	(Dameri 2013)

2.2.1. Digital city

While these various new terms were being discussed in the literature by the end of the 20th century, a new terminology emerged as one of the most discussed terms related to the smart city phenomenon: 'Digital City'.

From that point onwards, apart from the availability and accessibility of the technology, immediate satisfaction of the citizen's need and a new model of management have started to be discussed. Digital cities have begun to merge urban information and build public spaces for urban residents. The question of what a Digital City is cannot find an accurate answer as there is no single agreed definition for it as in Smart city concept. Yet the most cited definitons can be seen in Table 2.3.

Nevertheless, when all the definitions are analyzed, it can be understood that it is something about the digitalization of a city to create an environment for information sharing and virtual digital space aiming to provide better services to the citizens.

Although the term is being discussed in the literature by the end of the 20th century, it is assumed that AOL in the US was the first example as a digital city application founded in 1985 as largest and the most popular local information service that provided shopping information, advertising opportunities and etc. By 2000, AOL had more than 17 million members, which was constantly growing (Ishida 2000).

The Copenhagen, Denmark is another example, which started with citizen demand that was asking for public information mainly in the city libraries. It was initiated in the late 1980s as an information database, then with the development of the Internet; it was revised with a newer version in 1996, which was accessible through Internet (Jaeger 1998).

Craig Millar, Edinburgh is another example aiming to link the community groups, who are receiving social allocation, to share information and create online

community. After the technological developments on the web, in 1996, Craig Millar Community Information Service (CCIS) adopted the Internet and created a European hub as a One Net network (Slack 1998).

Table 2.3: Most cited digital city definitions (Cocchia 2014)

Definition	**Reference**
'A digital city is substantively an open, complex and adaptive system based on computer network and urban information resources, which forms a ***virtual digital space*** for a city. It creates an information service marketplace and information resource deployment center'	(Qi ve Shaofu 2001)
'A Digital City has at least two plausible meanings: (1) a city that is being transformed or re-oriented through digital technology and (2) a ***digital representation*** or reflection of some aspects of an actual or imagined city'	(Schuler 2002)
'The concept of Digital City is to build an arena in which people in regional communities can interact and share knowledge, experiences, and mutual interests. Digital City integrates ***urban information*** (both achievable and real time) and create public spaces in the Internet for people living/visiting the city'	(Ishida 2000)
'Digital city denotes an area that combines broadband communication infrastructure with flexible, service-oriented computing systems. These new digital infrastructures seek to ensure better ***services for citizens***, consumers and business in a specific area'	(N. Komninos 2008)
'The term Digital City (a.k.a., digital community, information city and e-city) refers to: a connected community that combines broadband communications infrastructure; a flexible, service oriented computing infrastructure based on open industry standards; and, innovative services to meet the needs of governments and their employees, citizens and businesses. The goal of a Digital City is to create an ***environment for information sharing***, collaboration, interoperability & seamless experience for all its inhabitants anywhere in the city'	(Yovanof ve Hazapis 2009)

Digital Amsterdam, Netherland, is yet another example born in 1994 and started as an experiment during the local elections in order to support citizen participation (Dameri 2014). Antwerp, Belgium also tried to create a link between local authorities and citizens (Pierson 1998). Helsinki Arena is another example that started in 1996, which aimed to create a network for the citizens to allow them to communicate with each other (Ishida 2000).

All the examples of the digital city approach are to provide information of daily life matters. It uses ICT systems that simplify public operations, minimize

telecommunication costs, and provide a wide range of services that meet the daily needs of urban residents. The people living in the digital/virtual network will communicate with each other and share knowledge, experience and mutual interests anywhere in the city (Yovanof and Hazapis 2009). It has a huge impact on easing people's daily life as it allows everyone to access[10] the information they need.

2.2.2. Intelligent city

During the digital city discussions, there have been some studies focusing on the intelligent cities as a second phase of the digital cities. In addition to what Tatsuno described above for intelligent cities (he sees them as users of ICT to make everyday urban activities), Komninos, the researcher and the author among the founders of the intelligent city paradigm, enlarged the definition and the meaning of the intelligent cities with these words:

"It is a space with a high capacity for learning and innovation, which is built in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management" (N. Komninos 2006).

The foundation of intelligent cities builds on a digital-city infrastructure. In the global effort, intelligent cities will play a role to create environmentally sustainable urban environments (Yovanof and Hazapis 2009). Architect and urban designer

[10] Does everyone has an access to the Internet, that is to say information, is another topic named digital divide. 'The phrase digital divide has become the accepted manner for referring to "the social implication of unequal access of community to Information and Communication Technology and the acquisition of necessary skills. The term has been derived from the commonly held belief that access to Information and Communication Technology (ICT) such as the Internet, and the ability to use this technology is necessary for members of community if they are to fully participate in economic, political and social life' (Partridge, 2004). There are 4 types of divide; Access divide, Skill divide, Economic opportunity divide, Democratic divide. Users whether can or cannot have access to the ICTs, can access but may or may not to know how to use it, physically can access, to a smart phone store for example, but may not have economic conditions to buy it, can access and have the knowledge but because of the political issues may not use it to participate. Hence, there are studies shows that smart cities are not for everyone.

William John Mitchell claims that in order to build up intelligence cities, they need to be merged with software and digital telecommunications networks, ubiquitously embedded intelligence, sensors and identifiers. The main idea is to create some sort of systems (mechanical and electrical as he says), which are able to respond intelligently to the surrounding environments they are integrated to (Mitchell 2007).

2.2.3. Ubiquitous city

Another term that is widely used in the smart city discussions is 'Ubiquitous'. Ubiquitous means being everywhere at once. It is a term used in computer science to define that computing could occur using any device in any location in any format. Ubiquitous city, for companies, means to build industry-wide partnerships among high-tech sectors. It is transparent governance in the course of public service delivery to their communities since it creates a society where people can connect to the digital services anytime anywhere (Shin 2009). It is a city that provides information, knowledge and service anytime, anywhere, and to anybody (Anthopoulos and Fitsilis 2010).

The Ubiquitous City idea was born in South Korea, which has been a pioneer in the information technologies (IT). The city of Songdo shares all the data it has like in the cloud computing. Whole city is designed with sensors, as Mitchell described above, these can notify the individual in certain cases like transportation not arriving timely or reporting any incident to local authorities by reading data regarding weather conditions, rate of energy consumption and the flow of traffic. There is also an idea of creating a chip for every individual like a fingerprint, and each person will be followed by the computers and will be provided personalized services.

Amazon Go, the grocery that the website Amazon built, can be another example of ubiquitous and intelligent idea. Here a person, with a QR code in his/her

smartphone, scans the QR code at the entrance and starts to be followed by cameras. Every item that s/he has in his/her hand is added to the chart like in the online shopping. When they finish and exit from the store, the barcode reader double check the barcodes of the items to see whether they are the same with the ones in the chart or not. Once the check is done, it charges the buyer online without waiting any line.

So, what is seen as a futuristic myth once as stated in chapter 1.2, doing anything anywhere and universal access to the information has come true. To conclude, smart city is a city, which uses all the high tech solutions in order to create self-sustaining urban environments via gathering everything alive in a common network and being accessible for all by means of time and place.

To further the understanding of smart city idea, the planning and design approaches should be examined too. As mentioned before in the previous chapters several times, smart city idea has six characteristics. Each characteristic has its own planning and design approaches. This study examines three of them as a scope of the study. Smart Governance, Smart People and Smart Mobility will be examined in detail in the following sections, but the next section will give the general information about all the six characteristics and criticize it in terms of the most important component of it.

2.3. Characteristics of the smart city

Smart city idea has been present for almost 20 years and as it uses technology - which is updating itself everyday - to survive, it infiltrates every sector in a city that makes it live. The literature categorizes the smart city idea with six characteristics that are defined by the numbers of factors, which are described with numbers of indicators. Giffinger listed 33 factors and 74 indicators in total seen in Table 2.4 (Negre and Rosenthal-Sabroux 2014; Giffinger 2007; Benamrou, et al.

2016; Gupta, Mustafa and Kumar 2017; Raj and Dwivedi 2017; Agarwal and Dixit 2017; Wall, et al. 2015; Sanseverino and Orlando 2014).

Table 2.4: Characteristic, factors and indicators of a smart city

SMART ECONOMY (Competitiveness)	**SMART PEOPLE (Social and Human Capital)**	**SMART GOVERNANCE (Participation)**
Innovative spirit Entrepreneurship Economic image & trademarks Productivity Flexibility of labour market International embeddedness Ability to transform	Level of qualification Affinity to life long learning Social and ethnic plurality Flexibility Creativity Cosmopolitanism/Open-mindedness Participation in public life	Participation in decision-making Public and social services Transparent governance Political strategies & perspectives
SMART MOBILITY (Transport and ICT)	**SMART ENVIRONMENT (Natural resources)**	**SMART LIVING (Quality of life)**
Local accessibility (Inter-) national accessibility Availability of ICT-infrastructure Sustainable, innovative and safe transport systems	Attractivity of natural conditions Pollution Environmental protection Sustainable resource management	Cultural facilities Health conditions Individual safety Housing quality Education facilities Touristic attractivity Social cohesion

Smart Economy represents economic competitiveness, such as innovation entrepreneurship, productivity and flexibility of national and international business. **Smart People** are not only for education quality but also for ability of social interaction. **Smart Governance** requires being transparent and offering participation in decision-making. The most important aspect for **Smart Mobility** is the availability of the ICT infrastructure. **Smart Environment** is related with the environmental protection. Finally, **Smart Living** involves all the aspects of quality of life such as safety, health, cultural facilities and etc.

When examined in detail, the prerequisite for the smart cities is to use of technology and ICT Infrastructure. However, a smart city cannot be evaluated only based on the technological capabilities of the city, as all those features are human related. The concept of ‘smart people’ mentioned here is a fact that has

always been necessary for cities even since the sustainability discussions have been held. The only thing that is different regarding the smartness of people mentioned in the smart cities is mostly about the people's ability to understand and use the technology. All the smart solutions that smart city produces is depended on the people's usage. Consequently, as Paskaleva (2011) states; smart cities require 'smart citizens' and they need to be truly inclusive, innovative and sustainable. Hence, smart city needs to generate civic engagement to create a partnership between the city and its stakeholders and to ensure that people are active, dedicated and view their city as their own project not only for acting as a user but also identifying needs and developing solutions as we see in Amsterdam smart city example which has started as a citizen attempt. In 1993 Amsterdam, few people met to set up an experiment for a virtual public domain to share their opinion before the local elections and launch a product (Besselaar and Dennis 2003). The smart citizen kit is a civic undertaking revolving around the idea of environmental monitoring and so, it technically defines as an open-source platform with mainly 3 layers: means of hardware access like a device, a website, and a mobile application. The ultimate intention is providing collection, visualization and share of environmental data by anyone.

Therefore, smart people are the most important component for the smart cities. What do smart people mean and why it is important for the smart city idea is examined in detail in the next section.

2.4. Smart people for the success of the smart cities

While participatory democracy discussions continue from past to present, it is not possible to talk about smart city phenomenon without considering the citizen

involvement. Most of the current literature focuses on a political[11] participation of the citizen and neglect the non-political participation (Berntzen and Johannessen 2016). Citizens are able to affect the way their city is governed, developed and maintained through participation[12] (Held 2006; Cardullo and Kitchin 2019; Mora, Deakin and Reid 2019). Citizen involvement, however, is far more than a symbolic role in governance. Increasing the use of ICT, especially mobile-based tools, will enable the participation of smart people as decision makers but most importantly as users. The success of the smart city tools and applications is highly dependent on engagement of citizens. The IT infrastructure and benefits offered a wonderful addition to the Smart City but the citizens must contribute too (Rawat and Rawat 2017). As Ishida (2000) said 'even if we build a beautiful 3D space, if no one lives in the city, the city cannot be very attractive'.

Professor Dr. Rudolf Giffinger, an expert in analytical research of urban and regional development, defines smart cities as 'a city built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens' (Giffinger 2007).

A study held by Gupta, Mustafa and Kumar (2017) about smart people for smart cities concluded that '*the concept of the smart city varies from city to city and country to country. However, one thing that remains common …… is citizen engagement. Hence, human factors and human development in smart cities is a very important domain to analyze*'.

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[11] Here the participation models are discussed within the direct and indirect democracy practices. Direct democracy implies that citizens have the power to make political decisions by themselves. In an indirect democracy elected representatives make political decisions (Pitkin, 1967). However, in their book Stealth Democracy, Hibbing and Theiss-Morse (2002) argues that citizens are satisfied with indirect democracy. They say that citizens should not be bothered with problems that elected politicians should solve. "The last thing people want is to be involved in more decision making: They do not want to make political decisions themselves; they do not want to provide much input to those who are assigned to make these decisions; and they would rather not know all the details of the decision-making process." But participation is more than exercising political influence. Citizens can also help the city solve their problems and improve their services by offering help.

[12] There are lots of articles that I read within this research that examine the smart city and citizen examples in that manner. This study did not cover them all but you may find a lot of study.

Another study, which is Evaluating the Performance of Smart Cities in the Global Economic Network (Wall, et al. 2015), prove that in explaining external investment, only the smart people characteristic is important. The other five characteristics that are mentioned in the literature are not as imperative. They concluded that to compete with the world's powerful cities, local governments improve and maintain their citizen's power.

Hence, in order to ensure the success of smart cities, citizens must have the knowledge about smart city, its tools and applications as well as the ability to understand in order to participate as users since the entire smart city applications are designed to serve them.

Dameri (2014) in her study of Comparing Smart and Digital City compares the Amsterdam and Genoa Smart cities. Amsterdam is the first Digital City example in Europe and it is considered the most successful project in this area (Lieshout 1998; Dameri 2014). Also, it is an example of evolution from digital to smart city. The potentials of development in economy as well as how quality of life improvements for citizens via practical accessibility of technological innovation are presented in emphasis (Merli and Bonollo 2014). Genoa is on the other hand the leading city in winning European awards for smart cities. It started as a best practice in smart governance perspective. It was the first city to establish a governing authority from scratch to adopt smart policies and initiatives (Dameri 2014).

The main goals of Amsterdam Smart City projects are economic development and quality of life with the improvement of environmental quality, digitalization of public and private communication and services, and offering more public services and facilities. According to Dameri (2014), sustainable responsibility, technical awareness and strong democracy traditionally define the cultural profile of the Netherlands; and therefore, it is simple to share an idea of a smart city with Dutch people based on these drivers. Genoa on the other hand, is one of Europe's oldest cities where 27% of the population is over 65 years of age. This means a possibly lower awareness of the smart city concept and a low level of ICT education.

However, elder people are the main stakeholders of smart city initiatives and services; for example, e-health systems, better public transport services, cheaper heating and cooling plants. Therefore, they should be educated and adequately informed and involved in the smart city projects (Dameri 2014).

Dameri concluded that the smart city could only create and produce a higher public, economic and social value for all with the strong active participation of all citizens. As a result, Amsterdam and Genoa examples also show that successful smart / digital initiatives depend on the capacity of its citizens to understand the use of the technology it produces.

Smart parking service, used to improve traffic congestion and pollution within cities, was completed in 2012 in London and potentially saves £183.6 million worth of petrol per year and reduces its annual CO2 emissions by 642,978 tons. However, according to the study held after 5 years later showed that public awareness, actual usage, and user satisfaction of this smart service was very low and as a result, did not save the expected benefits (Peng, Nunes and Zheng 2017).

Shin also shows in his research that the reason of South Korean u-cities have concentrated on the digital technologies is the fact that common social groups predominantly have a technology background (Shin 2009).

Helsinki example also showed that citizen participation in smart city practices is an important factor for successful implementation. In this example the government of Helsinki opens its data to the citizens and organizes a competition to encourage citizens to develop smart applications for the city (Hielkema and Hongisto, 2012).

Barcelona smart city is generally accepted as a leading smart city example since it has the collaboration between government, universities and private companies (Capdevila and Zarlenga, 2015). However, there are critics about the case of Barcelona arguing that smart applications produced for the Barcelona Smart city did not include ordinary citizens, and 'no smart city can involve its citizens only as recipients of its interventions but include them as partners deciding the type of city

they want to live in when designing, implementing, and evaluating related projects' (Gascó-Hernandez, 2018, pg 57).

As a summary of this section it can be concluded that smart city and its ICT tools provide services to the citizens in order to create safe and independent social environments and for better conditions. As evaluated in previous section, the citizen factor is the main issue in the smart city notion. Especially London example showed that while advanced information technologies drive smart city services, their efficiency depends heavily on user participation. The study on the smart parking project concluded that local authorities and service providers, in addition to the technological activities, should make more efforts to increase the public participation and user satisfaction in smart cities to achieve success of their claims (Peng, Nunes and Zheng 2017).

Amsterdam and Genoa examples also showed that the success of the smart city applications depend on the citizen's ability to understand and get engaged in those applications. The example of Korea u-city also shows that even designers produce according to users' technology awareness. **According to the Lytras and Visvizi (2018), the awareness of the end users and their ability to use applications are considered 'smart' within the smart city context.** The case study given in chapter 6, which was conducted to argue citizens' awareness and their ability to use smart applications, showed that even the most educated individuals have some doubts to use these services so citizen awareness on smart city applications and their attitude to use those applications are carrying great importance for the success and the sustainability of the smart city notion. **As a result, citizen awareness is crucial for the success of the smart city applications.**

However, according to the 'bee smart city', which is the leading global smart city network and community with more than 14,200 members from 170 countries, featuring 670+ smart city solutions implemented in over 1,000 cities and communities across the globe. According to data they have among the 670+ smart city solutions the top three smart city applications are based on smart government,

smart environment, and smart mobility.

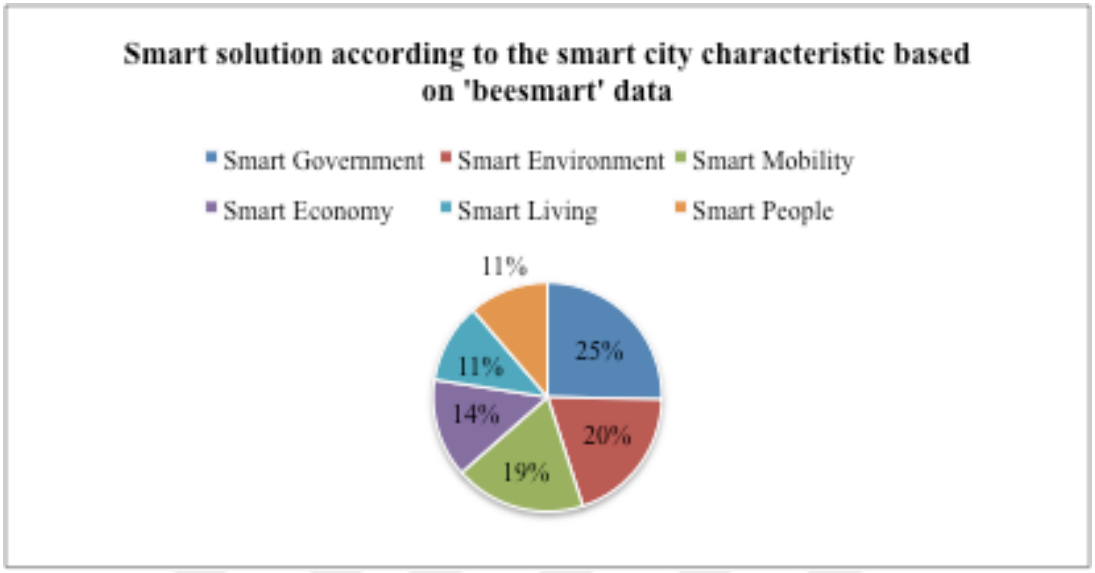


Figure 2.6: Smart solutions distribution according to the smart city characteristics

Also, smart mobility is the most citizen centric smart city application as all smart solutions and applications are designed for the use of citizens and it is the most effective characteristic on quality of life as it is related with the transportation.

2.5. Smart mobility as the most citizen centric characteristic of smart city

Smart Mobility can be considered as a component of sustainable Mobility. Sustainable mobility is about transport, which is sustainable in terms of economic, social and environment impacts, which are the three pillars of sustainability. In order to achieve sustainable transport, there has to be three levels of urban strategies that are macro, mezzo and micro level planning on compactness of the urban form, existence of sub-centers, extensive public transport infrastructure, mixed-land use, pedestrian friendly development, high density area grid system plan, intensity of street network to ensure high connectivity, interface with parking and care free public places. As sustainable transport is crucial for the goal of sustainability, Smart Mobility is also crucial for this goal; and at the same time it is a crucial topic for smart cities as it has an impact on several dimensions of smart

city idea such as increasing citizens' quality of life by reducing air and noise pollution, traffic congestion, transfer costs, increasing people's safety, and improving transfer speed (Benevolo, Dameri and D' Auria 2016; Kalogirou, et al. 2018). Both sustainable transport and smart mobility support public transport, bicycle sharing, carsharing and carpooling, sustainable fuels and electrical cars (Orlowski and Romanowska 2019; Papa, Gargiulo and Russo 2017).

Achieving sustainable transport through urban design strategies and planning would reduce the CO_2 emission and traffic congestion or encourage people to use more public transportation. However, if passengers do not know the shortest route of their commute, available parking lots or the time of the public transportation arrivals, there will be waste of time and energy while commuters spend lots of time in the traffic both in order to reach the destination point and to find a parking lot or while waiting for a bus. As Kalogirou et. al. (2018, pg 1271) defines, 'Commuters would like to travel using a mixture of available transport types considering also the most comfortable and fastest solutions for their destinations. On the other hand, many drivers travelling to regular destinations would like to save petrol and cost'.

To help solve these problems, Smart Mobility, of course, uses ICT, which, as mentioned before, encompasses technologies capable of collecting, analyzing, and transmitting the data as information via Internet, mobile phones, wireless networks and applications or intelligent transportation systems (ITS) (Orlowski and Romanowska 2019). Moreover, as Kalogirou, et al. (2018) and most of the sustainabilty literature stated, reduction of CO_2 emission and traffic congestion can also be achieved by sharing a ride in private vehicle commutes. As a result, smart mobility also offers various applicaitons to enable the more sustainable means of transportation such as car sharing or bike sharing.

Garau et al. (2016) uses six variables to evaluate smart mobility which also focuses on sharing a ride by including bike sharing, respectively cycle lanes and car sharing. He also includes private mobility support system such as variable message signs, SMS service for traffic alerts, electronic payment park systems and

applications for mobile devices. Moreover, there are public transport support systems, such as electronic bus stop signs, electronic ticket payment system, information on routes, schedules and waiting times, travel planner for the route calculation, travel tickets online. Garau et al. (2016) also refers to public transport focusing on the demand for public transport and bus network density.

Orlowski and Romanowska (2019) refers to the ITS, municipal public transport, bicycle systems and car sharing when speaking about the smart mobility.

Boyd Cohen defines the indicators of smart mobility as efficient transport based on clean energy transport, multi modal access based on public transprot and technoloy infrastructure based on access to real time information.

Papa and Lauwers (2015) evaluate smart mobility with two apporaches as technocentric smart mobility and consumer centric smart mobility. Technocentric smart mobility focuses on the ICT infrastructure such as traffic controller systems (cameras, sensors, traffic management centers, intelligent junctions etc.), smart road network for operating the autonomous cars and some mobility applications for developing sustainable commute behaviour by route navigators kind of applications. The techno centric smart mobility, as Papa and Lauwers stated, focuses on the supply side; however, the consumer centric smart mobility focuses on consumer side monitoring the behaviour of the users to optimizing consumer's mobility behaviour through the ICTs. Within this category, numerous mobility applications developed for users information could be cited, which are spreading the data and sharing information among the mobility system users. Route navigator applications are also counted in this category in order to collect the data for the drivers behaviours.

In short, the first purpose of the smart mobility is to collect the everyday commute data by using intelligent transportation systems (ITS) and deliver it to the citizens as information via ICT, mostly through smart phones and computers. As a result, the survey conducted in this thesis to measure the citizen awarenes on smart city applications are based on the smart mobility applications. The next question is what

is ITS and what are the components of it?

2.5.1. Intelligent transportation systems

The most leading smart city based on smart mobility is considered as Singapore with its Smart Mobility 2030 approach. Singapore's ITS vision is to create a more connected and interactive transport community based on four main approaches, which are informative, interactive, assistive and green mobility. The ITS includes transport data collection technologies with sensors, dynamic processing of big data and analytics centers, transport information delivery through smart devices, intelligent fleet management systems, integration of public transport and road operations, advanced road usage demand management, smart junction management, safety at traffic junctions with the traffic light control via wireless communication technologies, connected vehicles infrastructure, autonomous vehicles, promoting higher usage of public transport, green vehicles like electric cars.

Intelligent Transportation Sytems is a worldwide phenomenon, attracting the interest of transportation industry and decision makers in order to solve transport problems, such as congestion, safety, transport efficiency and conservation, and ITS employs advanced communications, information and electronics technology (Figueiredo, et al. 2001). There are eight ITS indicators according to the extensive study based on United States and European regions (Yaman, et al. 2018) as listed below:

1. Incident detection and management
2. Automatic speed control
3. Traffic and travel information
4. Adaptive traffic control or prioritization
5. Dynamic public transit passenger information
6. Smart services in line with ITS directive's regulations

7.Traffic information, management and coordinated ITS coverage

8.Smart vehicles

However, within the smart city discussions, studies focused on only four major categories of the ITS (Figueiredo, et al. 2001; Zhang, et al. 2011; Sarkar and Jain 2018; Vanderschuren and McKune 2011) in the smart city literature, which are listed below:

1. **Advanced Traffic Management Systems (ATMS);** cameras, sensors, smart junction and electronic displays which help system operators manage and control real time traffic.
2. **Advanced Travellers Information Systems (ATIS);** information about the transport systems and traffic conditions, travel planner offering the most advantageous road to reach the destiny, the most favourable transportation service and the most appropriate schedule to adopt.
3. **Commercial/Business Vehicles Operation (CVO);** management of all the fleet vehicles, while controlling speed and stopping-place times, increase safety and efficiency of commercial vehicles and fleets.
4. **Advanced Public Transportations Systems (APTS);** real time information about changes in transport systems, real time information of the buses' location, automatic payment systems, multiple usage smart cards, cameras (inside and outside of the public transportations to increase safety).

Smart Mobilty 2030 in Singapore also accepts the ITS vision to achieve smarter urban mobility with four key principals; informative, interactive, assistive and green mobility which summarizes the four major categories of ITS described above.

Of course, smart mobilty has a wide range of purposes besides its technology part since the main aim of the smart cities is to achieve the self-sustaining greener urban environments. Orlowski and Romanowska (2019) defines the smart mobility indicatiors as follows:

1. **Technical infrastructure;** Roads and intersections, Bicycle routes, Car parks/parking spaces, Infrastructure allowing travel beyond the city limits
2. **Information infrastructure;** Mobile devices and internet access, Applications, Information collection, Traffic management systems, Information systems for people traveling.
3. **Mobility methods and vehicles used for this purpose;** Public transport, Private carriers, Travel by private car, Travel by bike, Travel on foot.
4. **Legislation;** Assessment of various vehicle types, Assessment of various forms of transport.

Technical infrastructure, mobility methods and legislations are the key indicators for achieving any kind of sustainable city. However, the information infrastructure is related with the ITS which makes the mobility smarter. As a result, focusing on smart city and smart mobility, this study deals with the ITS capability when making the analysis of selected cities.

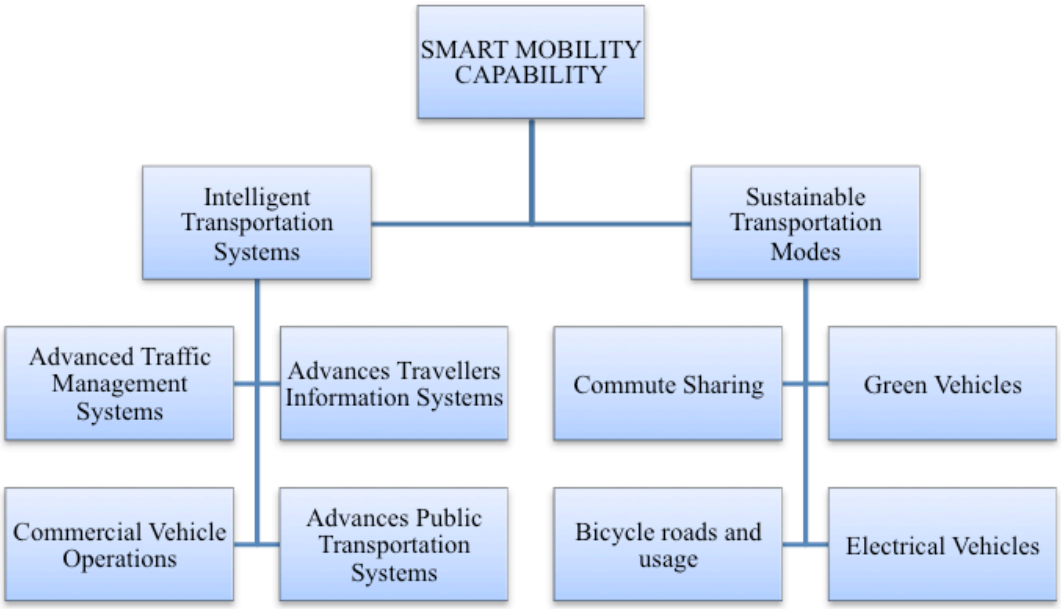


Figure 2.7: Smart mobility indicators within the thesis context in order to evaluate smart technologies capability in Turkey

So far it has been seen that smart cities are an effort to create a self-sufficient world through digitalization. A smart person is an essential element for the concept of a smart city among the six characteristics and the smart mobility is the most implemented version. After all this information, another issue arises about the implementation and management of it. In countries where state permit is required to build a detached house in the city, individuals cannot act to make a city smart for themselves. Consequently, smart cities need government approval and initiative. Otherwise, the entire smart city act remains as just an individual attempt like in the Amsterdam Digital city, as mentioned in Chapter 2, which is a private project for citizens to share their opinions before the local elections via a virtual public domain. As they did not get the funding they needed from the government, the project failed even though they had 140.000 subscribers in few months.

Hence, the next section tries to find out how smart city strategies and applications are managed and implemented and the following section presents a critical approach to the implementation of the smart cities and questions whether it is enough only to govern or not, which will be discussed in the following chapter.

2.6. Deploying smart to the city

There are two well-known management styles in business, which are top-down and bottom-up management styles. Employer in top-down gives their employees specific tasks to complete and employees fulfill them. Most organizations across all industries still pursue this approach. Nonetheless, several companies have started moving in a different direction as workers work harder to keep up with the rapidly shifting economy. As a result, those businesses adopt bottom-up management styles that focus more on feedback from workers (Harper 2015).

Like in the business model, Smart City development also has two primary strategies: Top-down (government-led) and Bottom-up (community-driven) approaches (Mora, Deakin and Reid 2019; Breuer, Walravens and Ballon 2014;

Dameri 2013; Cocchia 2014; Ojo, et al. 2015; Wall, et al. 2015). However, unlike the business model, the smart city model carries various different understandings regarding these notions.

For example, according to the Dameri (2013), top-down strategies emerge from a well-defined smart city strategic vision and the execution of government rules and policies, which are designed to achieve smart city goals. On the other hand, Harper (2015) defines it as a technologically deterministic 'control room' for the city which is designed to provide the ICT-based architecture for an analysis of urban activities and tools that are automatically interacting with infrastructure and adapting parameters to predefined criteria. In its most extreme manifestation, Harper claims that a top-down approach refers to ex novo cities (Sanseverino, 2014) that are planned, designed and built from scratch with the optimization of urban processes through technology, and that Songdo and Masdar can be seen as peak examples for the smart city vision.

Bottom-up strategies on the other hand are about the Smart Citizen: those who live, work, and engage in all kind of activities in the city (Harper 2015). According to Ojo et al. (2015) people or city inhabitants serve as agents to build smart cities. Unlike business, bottom-up approach in smart city vision does not work like drawing up the strategies by taking feedback from the people. In that kind of an approach, top management still has the control, as they might not consider the feedbacks. However, in smart city vision, people are taking initiative to solve the urban problems. It is the independent free use of ICT and other technological innovation to improve urban quality of life (Cocchia 2014). This is like the case in 1993 in Amsterdam where few people met to set up an experiment for a virtual public domain to share their opinion before the local elections (Besselaar and Dennis 2003). Here, the citizens have launched a product and even though it was neither accepted nor supported by the government, people still had the control and could manage to run their projects.

According to the Nesta[13]'s bottom-up and top-down approach, in top-down smart cities, IT infrastructure is a key element utilized by urban planners and corporations for creating optimal people and goods flow as well as delivering public services in an effective manner. However in bottom-up data is collected and distributed in order to develop the city functionalities. This is done by enabling a common connection and sharing resources. In the city where both are working together the data from the governing organs as well as the companies are utilized by the people for the purposes of enabling services, which allows authorities to further collect data from the citizens to develop and improve upon their services.

There are many discussions about these two particular styles in the literature. Some studies argue that the concept of smart city depends on the top-down approach, while others argue that it depends on the bottom-up approach.

Aurigi (2000) discusses that Digital city approach is designed to offer a set of services, which are seen as expected opportunities to citizens who do not know about them. Therefore, the vast majority of the projects are still developed in a top-down structure that sees citizens as "unaware customers".

It was mentioned above that there has not been a clear definition for the concept of smart city yet. Dameri (2013) clarifies this dispute with the argument that the smart city is a bottom-up phenomenon not a top-down one since it emerges from technology. Aurigi (2000) also argues the same point by stating that smart (digital) city idea emerges as a result of technological initiatives/expansions instead of a response to any public or urban demand (Aurigi 2000). However, in another study in which she compared smart and digital city concepts, Dameri (2014) stated that there is no need to have technology in smart city approaches unlike the case in digital cities. So it may be discussed that her earlier comment may not be relevant for the smart city case.

[13] Nesta is an innovation foundation to turn bold ideas into reality

Crali et al. (2013) supports the same argument with another assumption that today the urban planning approaches emerge mainly by a top-down principle; but that ubiquitous development of the technology creates alternative views based on more decentralized bottom-up frameworks.

Shin (2009) in his study of criticizing the Ubiquitous City (U-City)[14] in South Korea claims that to create effective urban systems, a mix of actors, which refers to the bottom-up approach, is needed in order to increase public participation and involvement in smart city architecture. He is criticizing the absence of the bottom-up approach, which is the lack of public participation as a problem in the development of the U-city, which was planned and implemented entirely through top-down principles. According to Shin's evaluation, the smart city should include bottom-up approaches as well as top-down policies.

Paskaleva (2011) makes another argument and states that the potential of the information society by accessing innovative Internet-enabled infrastructure is a big challenge because not everyone has equal access to the resources that it promises. This brings the topic into the discussion of the digital divide. EU programs have addressed the 'digital divide' to avoid existing inequalities toward citizens in the information society. This requires a new approach in creating smart city paradigm that focuses on citizen empowerment as an important catalyst. What she mentioned is again bottom-up approach based on user-generated content. So her new innovation service model depends upon both the top-down and the bottom-up approaches based on the new knowledge and creativity of the citizens and their context.

As Shin (2009) stated in his study, information architecture of cities works more like the human brain and less like an electronic computer, and it would be unfair to

[14] The u-city initiative in South Korea is a national urban development project that focuses on strengthening the role of information and communication technologies in civic planning and management.

embrace only one way of management style to achieve the success of the smart city.

It can be best observed in the examples of Amsterdam and Genoa smart cities that being supported by government – top-down approach – does not mean absolute success. Both Amsterdam and Genoa smart cities are top-down initiatives where the municipalities have the leading role to implement smart initiatives. While Amsterdam Smart city had a great success with the high awareness of the citizens (Cocchia 2014; Besselaar and Dennis 2003; Dameri 2014), Genoa Smart City did not share the same success due to lower level of awareness of its citizens (Dameri 2014).

The literature shows that the smart cities that emerge from a top-down strategy are more oriented to satisfying market expectations and the needs of major companies competing on the smart city market than the needs of the society (Mora, Deakin and Reid 2019; Shin 2009). Also, bottom-up supporters often join the claim by Mora et al. (2019) that 'top-down strategies disregard the enormous and innovative potential of grassroots efforts'.

Breuer et al. (2014) claim that 'a purely top-down view on the Smart City carries a danger of authoritarianism with it, while a bottom-up-only approach leans towards chaos and lack of long-term vision' and that therefore they need to be combined. Paskaleva (2011) also suggests that for the success of the smart city activities, a balance between 'top-down' and 'bottom-up' strategies has to be attained.

In their research based on the most successful smart cities in Europe, which are chosen according to the prizes they have been awarded for their smart city development strategies and the smart city rankings, Moora et al. (2019) showed that those cities, which are Amsterdam, Barcelona, Helsinki and Vienna, maintain a balance between top-down and bottom-up approaches. Those cities also preserve university, industry, government (triple helix model) and civil society organization cooperation (quadruple helix model) in order to design and deploy smart city strategies and products.

In the next section the helix models that occurred against the bottom-up and top-down approaches are discussed. Moreover, this study approaches those models from a critical perspective and offers a new model for the successful implementation of the smart city strategies and applications.

2.7. Is it enough to only govern and produce for smart city

There is a growing interest in smart cities for almost three decades. Yet the literature is still unable to define what needs to be done to be successful in planning and implementing smart city strategies (Mora, Deakin and Reid 2019).

As a result of the acceptance that bottom-up and top-down approaches should cooperate, literature gives us different types of collaborations for the design and implementation process of the smart city development, and also as a sociological paradigm, like, as most cited in the literature, quadruple and triple helix models. Thanks to their collaboration, they enable innovation process to be faster, deeper and higher in value (Dameri 2014). According to these models, various urban stakeholders (public, private and civic) need to participate and innovate together in order for smart city development strategies to be successful (Mora, Deakin and Reid 2019).

The triple helix model refers to collaborations between government, university and industry in order to encourage economic and social development. However, Triple helix model has its weakness as an innovation policy framework. The very crucial weakness is that the civil society is not included in the triple helix model. However, smart city idea as we discussed above should accept citizen as a main stakeholder as seen in the Amsterdam and Genoa examples in order to create successful smart city strategies (Leydesdorff and Deakin 2011; Etzkowitz and Leydesdorff 2000, Arnkil, et al. 2010).

In this understanding, citizens and civil societies have more roles than being stakeholders alone, being important factors for forming a smart-awareness behavior

and for the creation of innovation in people's culture, knowledge and mentality (Dameri 2014; Arnkil, et al. 2010).

As a result, quadruple helix model embedded citizen as the fourth element of these collaborative ecosystems (Baccarne, Mechant and Schuurman 2014; Arnkil, et al. 2010; Carayannis and Campbell 2014; Cavallini, Soldi and Margherita 2016). Another alternative, however, proposed by recent literature, identifies the fourth aspect of the quadruple helix model as user-oriented / centered innovation which is a key factor for the success of industry and public sector (Arnkil, et al. 2010; Cavallini, Soldi and Margherita 2016).

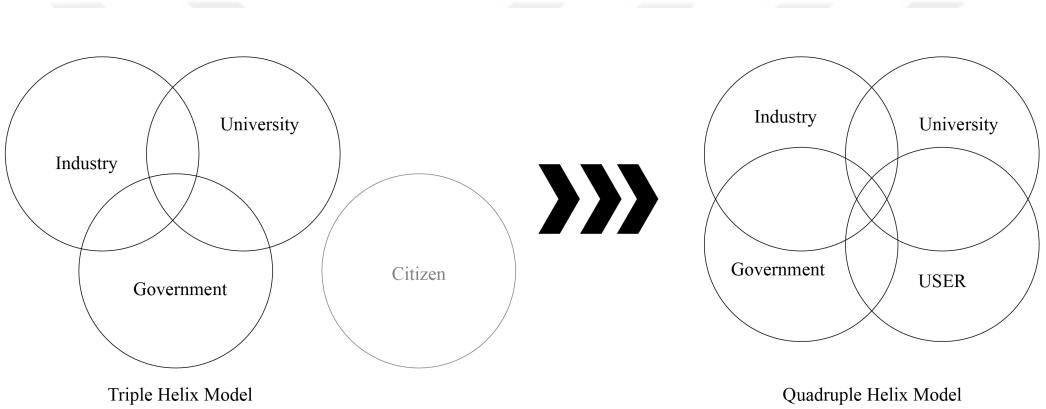


Figure 2.8: Triple and quadruple helix models

Here, the important point is that the user, unlike citizen, can be identified in different ways. Based on the context, users can be ordinary or amateur users, non-users, lead users, professional users, scientific experts, consumers, employees, residents, citizens, hobbyists, businesses, designers, researchers, organizations, firms, civil society (Arnkil, et al. 2010; Carayannis and Campbell 2014; Cavallini, Soldi and Margherita 2016), in short, any person with any qualification.

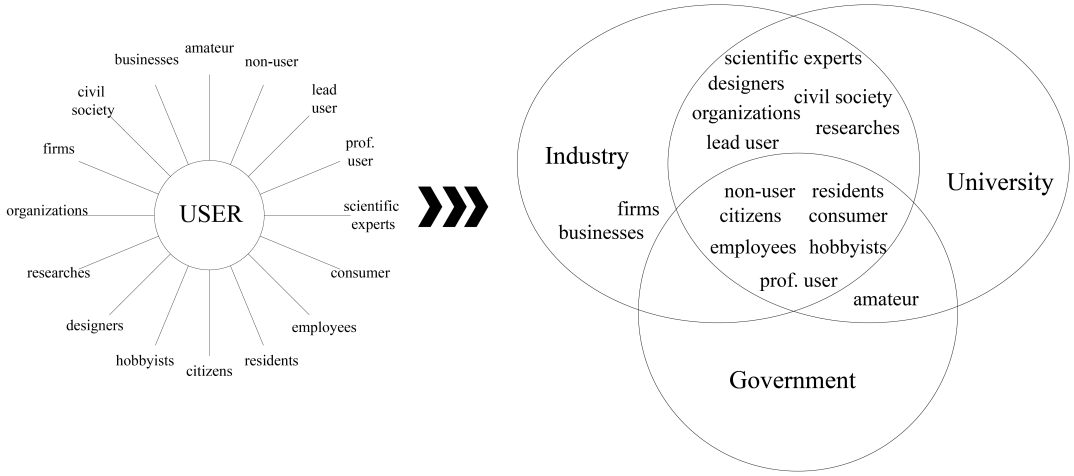


Figure 2.9: User as university, industry and government

Lead users, for example, are the ones who are experiencing the needs before ordinary users and create solutions and innovate (von Hippel 1986; 2001). With these innovative lead users commercially important products, smart city applications in our context, are prototyped or even deployed by the users rather than the manufacturers/industry (Arnkil, et al. 2010).

Even involving ordinary users has expected outcomes that should be seen in smart city ideology. According to Magnusson, Matthing and Kristensson (2003) ordinary user involvement has four stages; start-up phase, idea creation phase, delivery phase and evaluation phase. During this process, after all users are informed about the scope of the projects they are expected to create an idea for a new product that was planned to produce for the users/citizens as a smart city solution, for example. In order to design a product, the users that are mentioned here, should be people who have high level of insights. The expected designer/manufacturer user could be anyone from the university or industry or even from public organizations. So here, we have the user as an alternative to the industry and university within the helix models collaboration ecosystem. In the information society that we live in, in which we move from Fordist production to flexible production, this is an expected result.

A consumer, as a user, is the person who both pays for and uses the product (Arnkil, et al. 2010). So the consumer again, could be the university, industry or even the government itself. Because in the end, all information communication technologies are for the people and, when we leave our professional qualifications aside, we are all consumers.

So in these helix models mentioned above, university and the industry can be replaced with 'aware people'.

However, another important point is that the user can also be the non-users who personally choose not to use or to limit the use of the products or services in their private lives (Selwyn 2003). The main idea of the smart city is to produce smart solutions for the citizens to ease their life, most importantly, for them to use. In this context, a smart city cannot exist with people who choose not to use the information communication technologies and smart city applications. Hence, it is not enough to only govern and produce to achieve success in smart city movement. A citizen in a smart city is required to use the smart applications that are produced for them for that city to achieve the goal of being smart.

To conclude, when all the smart city ideas and all these collaboration models are to be re-evaluated, one can see that there are three crucial elements of a smart city and for these collaborative ecosystems. First of all, since a smart city without technology cannot be considered, the first element of the smarts city and for the collaborative environment is the technology. The second element is the aware people in order to produce and use. However, even if it is a city full of aware people who are producing lots of smart city applications, there must be a mature government too, as a professional qualification, in order to respond to citizen actions. Consequently, lastly, the third element should be the government. Hence this study presents a new triple helix model, as seen in Figure 2.10, as a proposal for the successful implementation of smart cities, which suggests a new type of a collaboration method between government, people and technology.

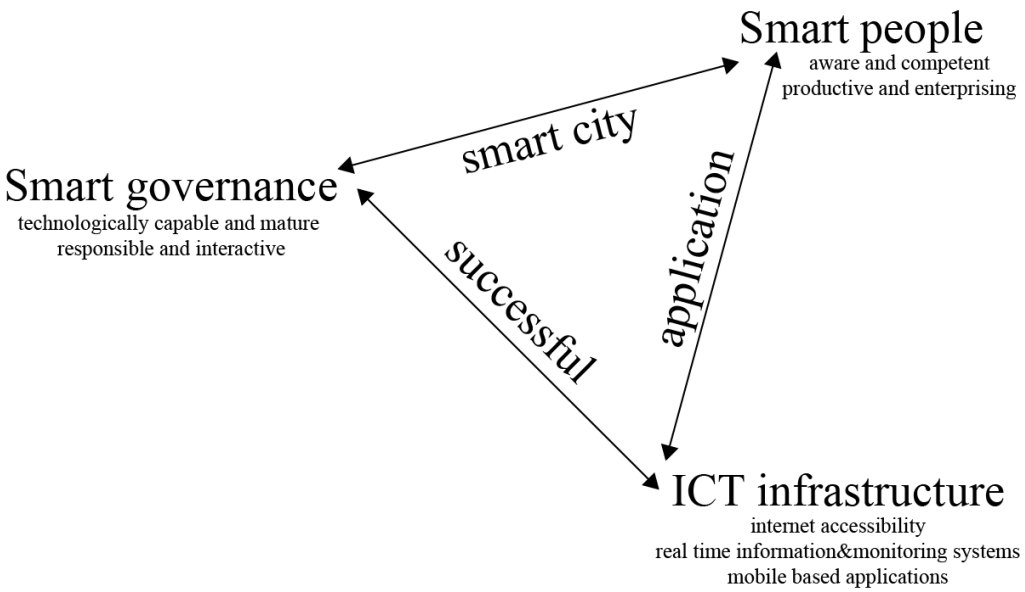


Figure 2.10: A new proposed triple helix model for successful implementation of the smart to the city

This study examines the Turkey case according to the new triple helix model via triple analysis. Detailed information about how new triple helix model is evaluated and applied for the case study is explained in the next chapter. However, before that, the question of what is the smartness of the governance is explained in the next section.

2.8. Smart governance

The core elements of good governance have been stressed as transparency and responsibility (Bonsón, et al. 2012; Bertot, Jaeger and Grimes 2010) for providing services. While the services that governments provide are increasing, meaning more employees serving seven days a week and more physical spaces to locate, the costs are increasing too. In a traditional way one should spend hours to have these services, for example for a bill payment as they have to travel to the responsible

department. However, in a rapidly developing information society, in the context of the smart city understanding, this is not acceptable as citizen will not prefer to take time off their jobs and wait long lines for the government services (Evans and Yen 2005).

In a democratic society, in the meantime, with 'good governance' it is expected that there is an environment for the 'meaningful citizen involvement' (Conroy and Evans-Cowley 2006) in cultural, economic, political and social life as a citizenship duty (Benn 2000). It has been challenging to look for methods to achieve effective citizen participation. Traditional platforms such as public meetings are accepted inefficient and ineffective as for the timing issues and most importantly political reservations (Conroy and Evans-Cowley 2006).

The information and communication technology (ICT) offers flexible times and reduces the other limitations faced by citizens who want to participate. Governments, who control the e-government tools as ICT, increase opportunities for citizen participation (Evans-Cowley and Conroy, 2010). Also, technology enables governments to provide more efficient and cost-effective services to the citizens (Evans and Yen 2005).

Almost every modernization program in Western democracies has e-government initiatives. Throughout the 21st century, governments all over the world are under pressure to change and innovate their relationship with the citizens. E-Government has been defined as 'the use of ICTs, and particularly the internet, as a tool to achieve better government' (Bonsón, et al. 2012; Bertot, Jaeger and Grimes 2010). ICT has the potential to increase operational efficiency by reducing costs and productivity and to provide better quality services (Gil-Garcia and Pardo 2005).

However, as Yiğitcanlar et al. stated (2019) what is missing in the smart city concept is the integration of the concept of smartness with the technology rather than human. As smart city existence depends on the smart technology, it is vital for the conceptualization of this notion; technology alone cannot create smart cities.

What is needed to done is that making the city smart with its residents and respectively creates a smart community.

Hence, like smartness of the people as mentioned before, which is related to the awareness of the individuals regarding smart city concept, smart governance also requires the maturity of the government on smart city vision. In addition to having smart city technologies, the ability and awareness of using these technologies correctly is also important to achieve the smart city goal. In fact, this is always the case, for example, if no one goes to vote during the governmental elections, we cannot talk about a democratic election or an opening. For this reason, it is as important for city managers to be sufficiently mature regarding the smart city concept as they have the smart technologies.

Therefore, the thesis, first of all, examines whether Turkey has the smart governance technologies, which include both smart applications and the e-government as governmental websites. The presence of these technologies are important, but the analysis should also examine how informative and interactive they are. Hence, secondly, and most importantly, the thesis inspects the governmental response, i.e. maturity of the government, regarding the interaction tools they have. Through the citizen survey, which is in fact made to analyze how aware and active the citizens are, the study also asked to the citizens whether they have a response from the government or not when using these interaction tools. Hence, this part of the citizen survey also helps analyze government maturity.

Following this general understanding regarding what the smart city idea is, the next section provides some examples of what the smart city looks like in order to help reinforce our knowledge.

2.9. Smart city practices around the World

There are various ranking systems on the smart city competition. Each has its own criteria to choose the best smart city. The earliest index for the Smart City, Smart

City Index 2019, was developed by The Institute for Management Development (IMD)[15] under World Competitiveness Center's Smart City Observatory and has listed a total number 102 cities globally. This effort was carried out with the cooperation of Singapore University of Technology and Design (SUTD). This Index, abbreviated as the IMD-STUDY SCI (Smart City Index), included a number of scopes under perspectives by the residents; readily available applications regarding technology and structures.

The two key factors that are fundamental in the perceptions are structure and technology pillars; former being the condition and the status of infrastructure of cities and the latter being the technological availability and services for the residents. Both of which consisted 5 decisive fiels, namely, health and safety, mobility, activities, opportunities, and governance. Based on such, the rankings for the top 5 smart cities of that year were Singapore, Zurich, Oslo, Geneva and Copenhagen, from top to low respectively.

Another list has come up by the Eden Strategy Institute and OXD (ONG&ONG Experience Design), ranking 50 smart cities within the years of 2018-2019. The list is stated to be unique and original by the Eden Strategy Institute in a way that the cities and the roles of their governments had in a smart city concept were evaluated as well. Initially, 140 smart cities were taken into account for study, defined under a list of criteria of 10 items. The result was the 50 cities which were ranked under these guidelines.

The aforementioned items are as follows: Clarity of vision, leadership, budget, provision of financial incentives, support programs, talent-readiness, people-driven approach, development of an innovative ecosystem, implementation of smart city

[15] Institute for Management Development (IMD) is an independent academic institution with Swiss roots and global reach, founded almost 75 years ago by business leaders for business leaders. Since its creation, IMD has been a pioneering force in developing leaders who transform organizations and contribute to society.

policies and track record of past initiatives and projects. In this ranking, the top 5 smart cities were determined to be, from first to fifth, London, Singapore, Seoul, New York and Helsinki.

A pioneer in its field, the ‘bee smart city’ encompasses a vast reach, over 14,200 members from 170 countries. Globally, more than 670 smart city solutions were realized encompassing over 1,000 communities and cities. Their criteria for ranking involves the total amount of smart city solutions implemented per continent, country and city, all which have been present on bee smart city. Their top ranking cities are Amsterdam, Moscow, Lublin, Winnipeg and London.

However, according to the literature, Barcelona is considered as the leading smart city) based on its sucessfull implementation. Additionally, the rankings vary according to the the smart city characteristics. For example, Singapore is considered as the leading smart city based on smart mobility strategies.

Boyd Cohen itself is ranking the top 5 in 2012 as Vienna, Toronto, Paris, New York and London. After 2 years, in 2014, the list changed as Barcelona, Copenhagen, Helsinki, Singapore and Vancouver with the leading smart cities title.

Respectively, in this section, instead of selecting the top smart cities to describe what a smart city looks like, the thesis uses Boyd Cohen’s three phased smart city evaluation, namely smart city 1.0, smart city 2.0 and smart city 3.0.

He describes smart city 1.0 as technology driven cities which are distinguished by technology companies, encouraging integration of their technologies to the communities without considering the effects on the people who are not sufficiently prepared for it. City of Songdo in South Korea, built from scratch, is an example.

The Songdo city, being a landmark of evidently proving South Korea's dedication for innovation in technology and sustainable growth, sits atop a 6000km^2 sized land that was initially part of the Yellow Sea before being completed in 2015. Despite having residents, the development is still undergoing.

In addition to the financial aid by the municipal and governmental organs, it upholds an open and privatized development model, which heavily contributed to the design, building and project operation with countless agents involved in the building of the city. In terms of infrastructure, the city is essentially a marvel of data collection where numerous aspects of the city are monitored and regulated, these are namely, but not limited to, traffic condition, temperature values and consumed energy data. What is more is that the services are, in fact, part of the infrastructure system as well, where the trash is carried via tubes to a central waste plant or recycling the water with careful filtering for the whole complex.

This system can be easily accessible by using digital services designed for individuals, making it technically the first ever u-city at this scale that allows real-time information sharing. This is further enhanced by the preinstalled computers into many parts of the city like streets, buildings and even houses themselves. In spite of its vision, the target values have not been met in terms of growth since the values fell short in 2018. The initial prediction was 300,000 yet the population only ever reached 130,000 within the year (Kuecker and Hartley 2019; Rugkhapan and Murray 2019; Yiğitcanlar, et al. 2019).

Across the city, rows of retails, complex canals resembling Venice, a central green are inspired by the Central Park in NYC and small parks dotted around, similar to those found in Savannah, Georgia, can be seen. These create perfect housing options in different styles for the skyscraper office buildings. The city claimed that all was built according to the LEED (Leadership in Energy and Environmental Design) and Sustainability criteria, but matching skyscrapers and ‘luxury’ with the sustainability is not an easy task.

While the smart city 1.0 version ignores the dynamism of the cities interacting with the citizens, smart city 2.0 which has the technology enabled city-led approach, is characterised by the city administrators instead of technology companies.

Barcelona is considered to be the most leading smart city in the literature and in 2014, Barcelona was awarded the European Capital of Innovation. This is mainly

due to having high number of active smart city projects, over 100, ranging from Wi-Fi access in public spaces to smart lighting systems and promotion of electric vehicle iniative. However, it is not only their active efforts of utilizing the infrastructure at its disposal, but also becoming a role model and a factor of guidance by organising several initiatives to support smart city industry and networks, such as Smart City Expo and City Protocol Initiative. It has proven to be an effective pioneer in facilitating quality-of-life improvements for all residents and tourists alike.

Barcelona's urban governance is original in concept. The public structure is heavily tightened, companies and political figures are in close cooperation, creating the need for the Smart City initiave due to issues with environment, transportation and energy and requiring the utilization of ICT in a step to solve these. City hall agreed upon the need and deemed a mutual effort was to be held, binding the active elements from the city to collaborate. Thus occasion resulted in the organization of the Smart City strategic plan by both local authorities and other institutions in the 1990s, which eventually put Barcelona in the leading position today among Smart Cities in Europe.

For Barcelona, the term Smart City is comprehensive in which the state of the city is advanced and developed with high-tech and actively allows and persuades connection among the people and other city elements. Another crucial point is the inclusion of corporations from private sector, academic sector and governmental authorities as well as the residents. In addition to conventional means of information gathering like maps and information kiosks, renovative initiatives like Open Data are also involved within the scope of Smart Governance though the common aim to create an ease of access to government information. Triple helix is a central piece for innovation and its clusters, therefore the Smart Economy focuses on many organisations, from faculties to companies, to allow exchanging information, feedback and collaboration. Only through such an interaction, can innovation be realized via networks. Smart Living initiatives however, focus primarily on embracing new technological applications and tools, some of which

are regulated under the municipal police force. Projects and policies regarding training for litereacy in the digital medium are placed under the Smart People initiaves. There are several efforts made in this field such as, new infrastures or utilization of present ones, 22@Barcelona innovation district and network developments for Wi-Fi mesh, sensors, fibre optical and public Wi-Fi (Bakıcı, Almirall and Wareham 2013; Capdevila and Zarlenga 2015).

Stated by Cohen, the most current version of smart cities is 3.0 which, unlike 1.0, where technology emphasis is prevalent, or 2.0, where emphasis on a city itself enabled by technology is present, focuses on integrating the citizens in the creation of the city in order to aid the development of smarter cities in following generations. Several examples of this can be seen across the globe, such as Vienna including its citizens as investors for solar plants, aiming for the 2050 renewable energy objectives, or Vancuover, where 30,000 citizens were involved in what can be claimed to be the most daring collaboration strategy for creating Vancouver Greenest City 2020 Action Plan.

For the next example, IMD's number one smart city, Singapore was chosen as it is also considered as a leading smart city based on the use of ICT with respect to smart mobility strategies as mentioned before. Singapore is the first city that announced itself as an 'intelligent' island. the 'Smart Nation' vision was suggested in the IT2000 report in 1992. Singapore's smartness is shown in lots of areas such as health and safety, mobility, education and governance both as structure and technology. One feature of the city is the densely centralized and inter-connected systems from a number of services ranging from traffic management to environmental and climactic monitoring as well as their real time information generation, which leads to an effective management by public agencies for urban environment. Other features include Smart Care, another monitoring initiative for elder people, and Smart participation approach, where individuals can contribute to the city's production with ease. An example for this can be seen with the event called "hackathon" in which many participants, each from a different field of expertise, work commonly for developing software applications for effective

problem solving. The event has been generating valuable data and solutions with the cooperation from the government agencies as well as companies since 2012, and so far, over 30 hackathons have resulted in significant positive outcomes in fields like port management, air pollution and online dating (Ho 2016; Hoe 2016).

2.10. A critical approach to the literature: re-thinking of the smart people and smart governance

Throughout the literature review, the study has examined three most important characteristics of the smart city concept, which are smart mobility, smart people and smart governance. Smart Mobility is a technical topic, which is related with the technology capability. In the scope of the thesis, smart mobility indicators are used to evaluate the technology capability in Turkey with the selected four cities that are explained in the next chapter. Smart mobility applications are critical factors for the smart cities as they are required to be used by people. So it is an important factor for any study that aims to evaluate the "smart people" component of smart cities.

Smart people, in the literature, is defined as level of qualification, affinity to life long learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism/open-mindedness, participation in public life. In addition, it is described as the potential of becoming a knowledge centre (top research centres, top universities etc.), and defined with reference to foreign language skills, book loans per resident, participation in life-long-learning in percentages, participation in language courses share of foreigners, share of nationals born abroad, perception of getting a new job, share of people working in creative industries, immigration-friendly environment (attitude towards immigration), voters turnout at city elections, and participation in voluntary work (Negre and Rosenthal-Sabroux 2014; Giffinger 2007; Benamrou, et al. 2016; Gupta, Mustafa and Kumar 2017; Raj and Dwivedi 2017; Agarwal and Dixit 2017; Wall, et al. 2015; Sanseverino and Orlando 2014).

However, these are the indicators that need to be re-evaluated as they are all about having a social rights and democracy since they are all related with education, having foreign residents or immigrants and foreign language qualification and etc.

However, in this study, as seen in lots of example such as Amsterdam, Genoa, Helsinki, London, Barcelona as described in section 2.4, within the scope of the smart cities, or in order to have successful smart applications and to attain the sustainability of the smart cities, people are vital as being aware and as individuals who are able to use those applications. From various examples in the literature we have learned that for a successful smart city awareness and usage attitute of the people is the key factor to define smart people.

As a result, although the literature does not include the smart people discussion in detail and as an independent topic or does not make a clear definition about it, the thesis defines and evaluates the smart people by their awareness and usage attitute regarding smart city applications. Here smart city applications refers to smart mobility mobile applications produced for the citizens, namely travellers information systems, because smart mobility is one of the most important components of the smart city applications as we have just mentioned above and it is the most citizen centric characteristic of the smart city context as it produces all its applications for the use of the people. Also in the Turkey case, majority of the smart applications are done in smart mobility area as will be seen in section 4.2.

In addition, as Paskaleva (2011) states, smart city needs to generate civic engagement to create a partnership between the city and its stakeholders and to ensure that people are active, dedicated and view their city as their own project not only for acting as a user but also identifying needs and developing solutions. As a result although the literature discusses citizen participation as a political participation and neglect the non-political participation (Berntzen and Johannessen 2016) and smart city requires innovative and entrepreneur citizens as mentioned in section 2.4, the thesis evaluates smart people as the people who take action, at least, in micro level urban design developments such as street design. For

example a smart people in a smart citizen should report a faulty curb to the authorities in order to make it fixed.

The best example to the statement above is Cuquis Robledo who was graduated from Duke in 2017 with a B.A. in Psychology and received her M.A. in Interactive Media from Elon University in 2019. She is a person who is using a wheelchair. As stated in the corada[16], comprehensive online resource for the ADA, five years earlier she started an act with hash tag 'crappy curb' in Seattle in USA against the 'Complete Street Design' Project organized by Smart Growth America[17]. Seattle is one of the first cities, which applied the complete street design principles at that time. So, she record a video in which she experienced all the faulty curbs; and today it is all over the social media, from different cities many people tag the abovementioned hash tag to get the attention of the authorities and to report all the faulty curbs to make them fixed. This is a great example of being an active citizenship. Besides they are using ICT, smart devices and online platforms, in order to communicate with the authorities.

As a result, the thesis also defines smart people as active citizens who are taking action in city matters, physically, although in the literature it is not considered as it is. The thesis evaluates the active citizenship by using interaction tools that exist in the selected cities in Turkey as a case study.

Finally, the thesis also re-evaluates the smart governance. According to the smart city indicators it is about transparent government, public and social services such as share of children in day care or satisfaction with quality of schools, city representatives per resident, share of female city representatives and etc (Negre and Rosenthal-Sabroux 2014; Giffinger 2007; Benamrou, et al.

[16] https://www.corada.com/videos/crappycurb

[17] The National Complete Streets Coalition, a program of Smart Growth America, is a non-profit, non-partisan alliance of public interest organizations and transportation professionals committed to the development and implementation of Complete Streets policies and practices. A nationwide movement launched by the Coalition in 2004, Complete Streets is the integration of people and place in the planning, design, construction, operation, and maintenance of transportation networks.

2016; Gupta, Mustafa and Kumar 2017; Raj and Dwivedi 2017; Agarwal and Dixit 2017; Wall, et al. 2015; Sanseverino and Orlando 2014). In addition, smart governance is evaluated in the literature with the e-government tools such as web sites of the authorities as it is about using the ICT, which encourages citizens to communicate and participate as it provides easy access to the government (Conroy and Evans-Cowley 2006; Bonsón, et al. 2012; Bertot, Jaeger and Grimes 2010; Gil-Garcia and Pardo 2005).

The thesis also evaluates the e-government capability, by examining the governmental web sites. (Here for the case of Turkey, since all the smart applications are produced and managed by the municipalities as mentioned in Chapter 1, the study focuses on the municipal web sites for the e-government evaluation).

However, although it is important for the citizen to be active and take responsibility as mentioned above, it is equally important that the authorities respond to these actions and attempt having collaboration with the citizen. According to the result of the citizen survey that the thesis conducted, as will be seen in section 5.2 and 6.3, providing ICT tools such as call centers, e-mail and social media accounts for citizens to communicate with the government, is not enough to encourage the citizens to be active and achieve smart governance goals as defined in the literature, unless the authorities respond to those tools properly and are enthusiastic about producing solutions.

As a result, this study places particular emphasis on the maturity of the government, as a factor that is as important as the aware and active citizen. So the thesis defines the smart governance as, first of all, technologically capable and **mature** about the smart actions. Maturity here refers to, within the scope of the thesis, being responsive, active and interactive with the city and the citizen actions.

As a summary, the thesis re-defines smart people as aware and active individuals who use smart applications and take responsibility to improve the city. In addition, this study re-defines smart governance as authorities that have smart technology

infrastructure and make it a priority to respond to the complaints and suggestions of their active citizens and produce solutions.

Consequently, for a successful smart implementation we need smart people who are aware active and willing to use the smart applications as they are for reducing environmental problems, increasing energy efficiency such as smart parking and public transportation tracking applications or route planning applications as they save time and petrol, providing more time for people in their personal life (which shares the same aim with the sustainable urban design principles).

CHAPTER 3

METHODOLOGY

3.1. Hypothesis and research questions

'How to successfully implement smart to the city?' is the main question that the thesis tried to find out. Because, as mentioned in the literature, there are many successful or unsuccessful examples regarding smart city practices. There are also many different views and debates on smart city management and implementation.

The main purpose of this thesis is to bring all these discussions together, identify the most important factors of smart cities and re-evaluate existing terminologies and re-define them for a successful smart city implementation.

As explained in the previous chapter, the smart city issue is a very comprehensive subject. Since it covers many areas from different disciplines and has been studied with a wide range of perspectives. It is also a subject with different applications and approaches for each discipline with many stakeholders and various problems. For this reason, as the researches for this study progressed, it was seen that the literature of the smart city is very scattered because variety of issues related to the smart city were handled under different components of this concept and discussed at the same time. As a result, in order to achieve the main aim of the study described above, first of all, the study aims to clarify the concept of the smart city with a number of questions, given below, as it is quite difficult or even impossible to deal with the subject chronologically.

1. What is the smart city? (This question later changed to 'what is the smart city about?' because as mentioned earlier, the smart city is a vast concept and does not have one truly accepted definition)
2. How did it emerge?

3. How did it develop?
4. What does it cover?
5. What are the most important components? What should they be?
6. How is it governed and implemented? How should it be governed?

Answering all these questions required an extensive literature research and finally as explained in the section 2.7, the study concluded with a new proposed triple helix model for successful implementation of the smart to the city as seen in figure 2.10 with the new description of the smart city characteristic it uses, which are smart people who is active, willing to use smart applications and active in city matters; and smart governance which is mature enough to respond to the citizen action and willing to make collaboration with the citizen.

After proposing this new helix model, the thesis questioned the relationship between the three components it proposed and define a two-way relationship between the components. The study defines this bilateral interaction by the following questions;

If we look from the technology side, the questions to be answered should be:

1. Do smart technologies help the citizen strengthen its relationship with the government?
2. Do smart technologies help the government strengthen its relationship with the citizen?

If citizen side is examined the questions to be answered should be:

1. Is the citizen aware of smart city applications?
2. Does the citizen contact with the government via ICT?

The government side of this collaboration must answer the following questions:

1. Does the government respond to the citizen's smart actions?
2. Is the government familiar with smart city applications?

With respect to that exploration, this thesis tries to answer another set of questions according to the new tripe helix model:

1. How familiar is the government with the smart city tools (e-government) in Turkey?
2. How much action does the government take on smart city applications in Turkey?
3. How familiar is the citizen with the smart city tools and applications in Turkey?
4. How successful is ICT in creating a relationship between government and citizen in Turkey?

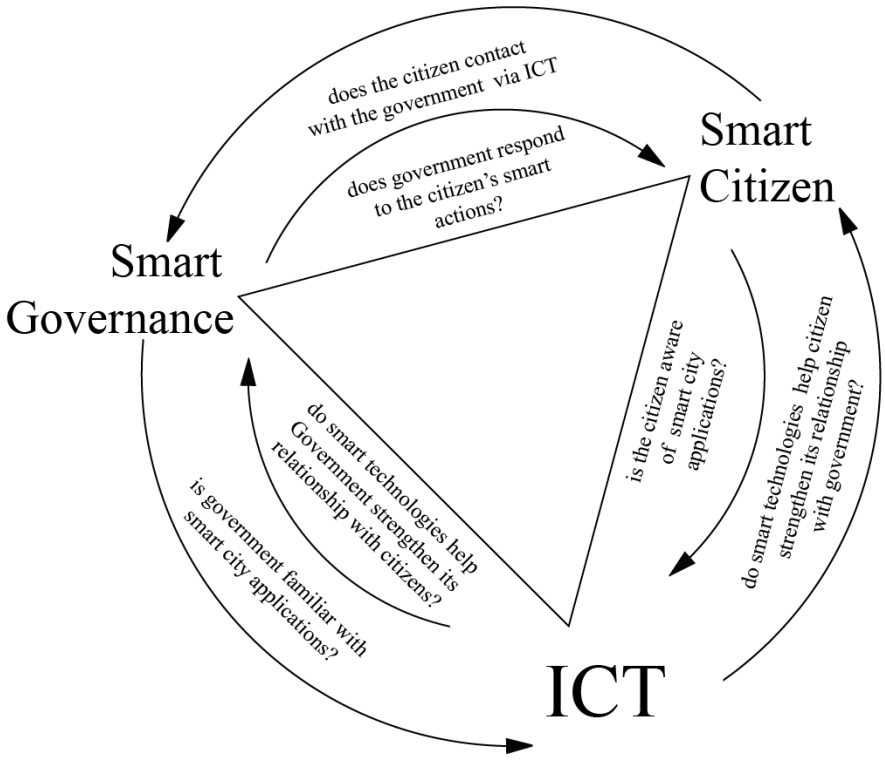


Figure 3.1: Bilateral relationship between the components of the proposed new triple helix model for the successful application of the smart to the city

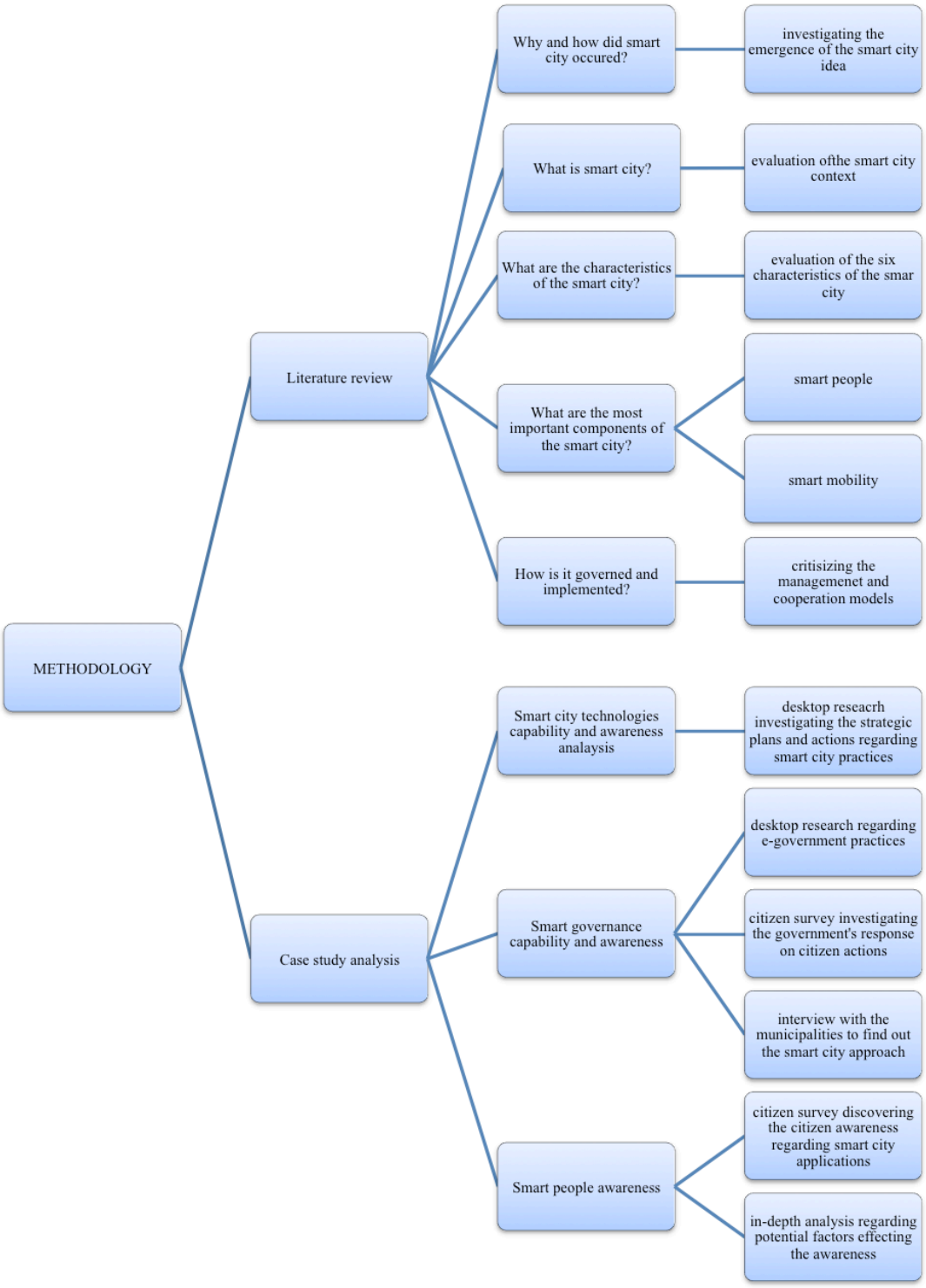


Figure 3.2: Methodological approach of the thesis

3.2. Method of analysis

To answer the research questions described in section 3.1, the thesis conducted a tripartite analysis, which are smart governance, smart people, and smart technologies analysis according to new descriptions of them as explained in section 2.10 in Turkey.

The study searched for the smart technologies capability and awareness analysis in Turkey as a country. However, for the smart governance capability and maturity and smart people analysis, studies were conducted only in the four cities that the thesis selected for the case study, which will be explained in section 3.4.

3.2.1. Smart technologies capability and awareness analysis

In order to evaluate the technological capability, first of all, Turkey was examined regarding legislations, policies and implementations based on smart city implementation starting from the very first attempt till the end of 2019.

Secondly, the study fouced on the Smart Mobility capability (Figure 2.7) in Turkey and first of all, it was examined whether Turkey has the intelligent transportaion systems which was listed in the literature within the scope of the smart city literature. Then the study examined the sustainable transportation approach by investigating the commute sharing attitude and green vehicle usage such as bicycle usage and electricle vehicle usage.

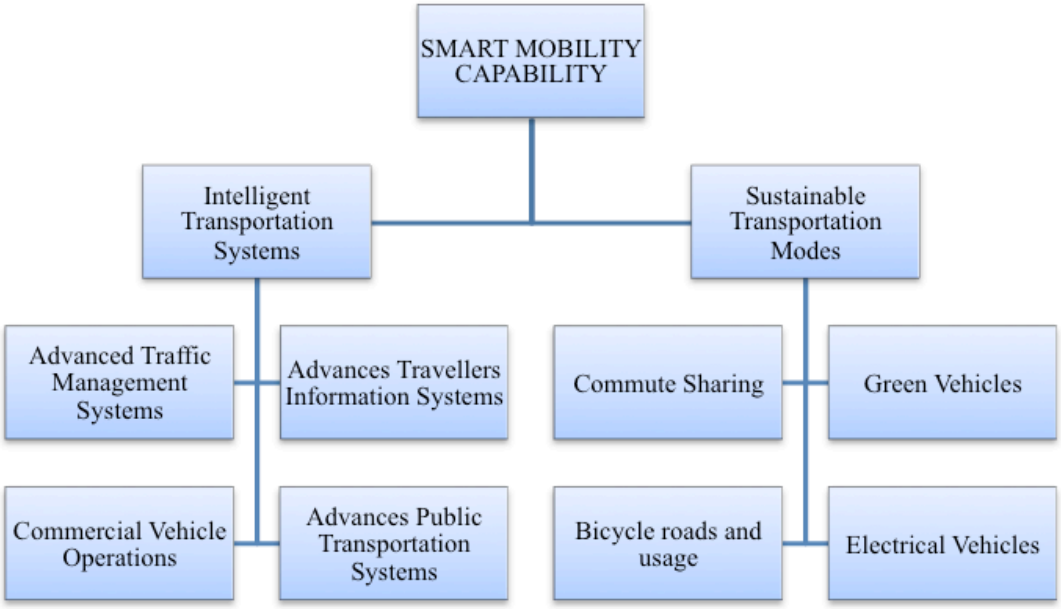


Figure 3.3: Smart mobility indicators within the thesis context in order to evaluate

3.2.2. Smart governance capability and maturity analysis

As we learned from the literature, smart governance is evaluated with the e-government practices such as Internet based services that the government provides for the citizens as it uses ICT. It is defined as the governmental web pages, which should provide both information and interaction. Consequently, first of all, the thesis evaluates the governmental web pages in selected four cities. However, as the thesis focused on the municipal practices as mentioned in Chapter 1, here government refers to the four metropolitan municipalities of the selected four cities and all the district municipalities of those cities.

Then as a criticism of the literature explained both in section 2.8 and 2.10 the priority and response given to those information and interaction tools are as important as having those tools or platforms. The thesis defines this with the new terminology, which is maturity of the governance as explained in section 2.10. As a result, the maturity, namely the responsiveness of the authorities regarding citizen

actions through provided interaction tools are also evaluated. Since the thesis focused on the municipal smart applications, authorities here refer to metropolitan municipalities of the selected four cities as the metropolitan municipalities produce all the interaction-related applications.

3.2.3. Smart people analysis

For the smart people context, as explained in section 2.4 and 2.10, awareness and usage of the smart applications as well as being an active citizen for the city matters are vital. As explained in section 2.5, smart mobility is the most citizen centric characteristics of the smart city because traveller information systems and public transportation systems and traffic management systems are all about collecting data and information and delivering them to the citizen (those systems were explained in section 2.5.1). As a result, smart mobility produces various mobile applications for citizens. London smart parking example for instance as seen in section 2.4 is a smart mobility mobile application and this example with various other examples seen in the same section showed that the active usage of the smart applications are vital for the success of the smart city practices.

As a result awareness of the people and usage attitude of the people based on smart mobility mobile applications was evaluated as a smart people analysis.

Additionally, being an active citizen in city matters is also an important factor for the smart people as explained in section 2.10. As a result people's attitude based on using provided interaction tools is also evaluated.

For the awareness and the usage, all the smart mobility mobile applications that are provided for the citizens in each four cities selected for the case study are classified according to the ITS categories that was explained in section 2.5.1, such as advanced public transportation systems and advanced travelers information systems as seen Table 3.1.

Advanced public transportation systems related applications are for the real time information about changes in transport systems and the buses' location. Those applications are named as public transportation information applications.

Advanced travelers information systems related applications are for the drivers to give information about the traffic conditions and travel planner for the most advantageous road to reach the destiny, the most favourable transportation service and the most appropriate schedule to adopt. Those applications are named as driver information applications.

In addition, there are metropolitan municipality mobile applications for interaction, which allow citizens to reach all the metropolitan municipality services from a single point, and these are named as digital municipality.

Table 3.1: Smart mobility mobile applications in selected four cities as a case study for the smart people analysis

	Public transportation information mobile applications	**Driver information mobile applications**	**Digital municipality**
İstanbul	Mobiett	IBB Yol Gösteren IBB Cep Trafik Şehir Hatları İSPARK iTaksi İSBİKE Smart Bike	İBB İstanbul İBB Beyaz Masa
Ankara	EGO Cep'te	ABB Trafik	ABB Ankara Mavi Masa
İzmir	ESHOT Mobil	IZUM	IBB mobile
Bursa	Burulas Ulaşım	Burulas Trafik	Bursa Cepte

3.2.4. Factors affecting smart people attitude

The thesis also tried to find out the factors affecting awareness and usage based on smart mobility mobile applications and interaction tools usage to communicate the metropolitan municipalities. This analysis was carried out using SPSS programme and making various cross-tabulations, examining 13 relations/factors on the usage

and awareness of 19 mobile application produced by the metropolitan municipalities in four cities selected as case study with the data obtained from the citizen survey.

3.3. Data collection

A number of different studies and surveys have been carried out to perform the analyses described above.

3.3.1. Desktop research

In order to find out the smart technologies capability and awareness a vast desktop research was conducted via Internet for all the legislations, strategies and smart mobility practices in Turkey. First of all, all the strategy and action plans related with the smart city practices were examined. Additionally, the institutions producing the intelligent transportation systems were examined to compare Turkey's potential with the literature.

3.3.2. Review of municipal web sites

In order to measure the e-government feature in Turkey for smart governance capability and maturity analysis, 115 web sites, which are the four metropolitan municipalities with their all district municipalities in selected four cities, have been examined according to the McMillan interactivity model.

McMillan formulated an interactivity model that highlights the communication types possible through Internet (Table 3.2) (McMillan 2002). According to this model, there are two types of communication direction: one-way and two-way. Consequently there are four types of communication; Monologue, where the sender has the control; Feedback, where the receiver has the control; Responsive

Dialogue, where the receiver and the sender have equal control, and the Mutual Discourse where sender and receiver roles are interchangeable.

Monologue type of communication provides information only, the others, on the other hand, offers interactive communication.

Table 3.2: Model of interactivity via Internet

Model of Interactivity via the Internet				
Direction of communication	One-way		Two-way	
	Monologue Sender → Receiver	**Feedback** Sender ← Receiver	**Responsive Dialogue** Sender ↔ Receiver	**Mutual Discourse** Participant ∩ Participant Sender/Receiver roles are interchangeable
	Informative	**Interactive**		
Level of citizen control	Low	High	Low	High
Source: (Evans-Cowley ve Conroy 2010; McMillan 2002)				

3.3.3. Citizen survey

For smart people analysis a citizen survey was conducted in four selected cities via Internet. This was made with an Internet based link, which can be viewed from desktop computers, laptops, tablets and smart phones, shared through e-mail, social media accounts such as Facebook and twitter, and WhatsApp.

In order not to create a bias, the link was shared randomly to the citizens in four cities regardless of residence, socio-economic status, education, age, etc. On the other hand, this randomness approach also meant that the control of the sample was difficult in terms of ensuring its representativeness. In addition, conducting the survey via the Internet excluded certain citizens who may not have access to internet. This made the survey and study to exclude any issues of digital divide, as mentioned in earlier parts of the thesis. While this may be seen as a limitation, it

also helps focus the analysis on those who already have access and hence can help focus on providing a better understanding of the awareness and usage of citizens.

Having noted the above shortcomings, it should also be stated that reaching a sample size of more than 1100 people was an important achievement, also considering the lack of any funding for carrying out a survey.

The survey was conducted between March and September in 2019 and it did not include any kind of personal information like names and addresses.

The survey reached out to 1141 respondents in total of which 39% is from Ankara, 34% from Istanbul, 14% from Bursa and 13% from Izmir.

All the respondents are the citizens of the Turkish Republic.

In order to increase the statistical significance, the survey results have been evaluated as total rather than being evaluated city by city, for the analysis. Since two of the cities have much fewer respondents, making a city-comparison would not yield reliable results.

The survey investigated, first of all, awareness of the citizens regarding smart mobility mobile applications as well as their usage attitude regarding those applications.

Secondly, it investigated the citizen's attitude with regards to using interaction tools and communicating with the authorities, which are the metropolitan municipalities within the scope of the study in city matters in order to measure the active citizenship.

The survey also investigated the metropolitan municipalities' response regarding the interaction tools used by the citizen to find out how much responsible and interactive they are.

Finally the survey investigated the citizen approach and knowledge on smart city notion.

Questions are attached as appendices.

3.3.4. Interview with the metropolitan municipalities

An interview was conducted with the four metropolitan municipalities. As the thesis deals with the smart city and mainly transportation related applications, all the contacts are from the related departments such as ISBAK (Istanbul Computing and Smart City Technologies Inc.) from Istanbul, department of transport from Izmir, smart city department from Bursa and transport and smart city departments from Ankara.

The metropolitan municipalities were contacted in June 2019 via Internet by using all the interaction tools that they provided, namely the e-mail services, special line call and e-mail services, and via the social media. These methods did not yield success as the queries were either not responded or responded but not concluded with a solution. After getting personal contacts the answers were conveyed by the end of September 2019.

The interview tried to identify the benefits and difficulties of managing e-government tools and smart mobility applications. It also explored whether they appreciate the citizen feedback through interaction tools, and whether they respond or not. Moreover, according to the survey result, most of the citizens are not aware of the smart mobility applications that metropolitan municipalities produced so the interview also questioned the actions to introduce and disseminate their products.

Table 3.3: interview with the municipalities' timetable

City		Interaction tools	Interviewed	When questions are posted	When there is a response	Notes
İstanbul	1st contact	Municipality e-mail services		Multiple times between Sept 01 - Oct 01, 2019	Delivery error or not responded	
	2nd contact	Personal e-mail	ISBAK Smart City Director	Sep 28, 2019	Oct 7, 2019	Personal contact
	3rd contact	Personal e-mail	Istanbul Metropolitan Municipality Smart City Director	Oct 7, 2019	Oct 10, 2019	
Ankara	1st contact	Municipality e-mail services		Multiple times between Sept 01 - Oct 01, 2019	Delivery error or not responded	
	2nd contact	Municipality call center		Oct 17, 2019	Immediately responded	Informed to sent the questions to the executive assistant to the mayor
	3rd contact	Executive assistant's e-mail		Oct 17, 2019	Not responded	
				Oct 31, 2019	Not responded	
	4th contact	Personal contact in the smart city congress	Press and Public Relations Department	Jan 17, 2019	Jan 31, 2019	Personal contact
İzmir	1st contact	Municipality e-mail services		Multiple times between Sept 01 - Oct 01, 2019	Delivery error or not responded	
	2nd contact	Personal e-mail	Construction Control Chef	Oct 9, 2019	Oct 31, 2019	Personal contact
Bursa	1st contact	Municipality e-mail services		Multiple times between Sept 01 - Oct 01, 2019	Delivery error or not responded	
	2nd contact	Smart City department e-mail service	Head of Smart city department	Oct 09, 2019 Oct 16, 2019	Oct 30, 2019	

3.4. Case study selection

As it will be explained in the next section, smart mobility mobile applications for the citizens are used for the evaluation of the people awareness and usage. As a result while selecting the cities for the case study, the thesis focused on the cities, which have more smart mobility mobile applications.

Although many cities in Turkey have smart city actions, there are four major cities that have more smart mobility applications than the other cities for the citizens as described in detail in Chapter 4. These cities are Istanbul, Ankara, Izmir and Bursa.

Istanbul is Turkey's most populous city. It has 15 million residents in a 5,461km^2 area. Istanbul is a world city located at the intersection of Europe and Asia continents with a settlement date of 8500 years, an urban history of approximately 3,000 and a capital city of 1600 years. It is of great geopolitical importance as it is home to the Bosporus, which connects the Black Sea and the Marmara Sea and separates Asia and Europe. In 2016, with the initiative of Istanbul Metropolitan Municipality, a study started to turn Istanbul a smart city. It was decided to be done with local experts instead of working with global companies. As a result, ISBAK, Turkey's first Smart City Office was established. Istanbul has 20 smart city applications that are provided by the metropolitan Municipality in which seven of them are the smart mobility applications, two of them are e-government related applications and 11 of them are the cultural applications. As the scope of this thesis is related with the government and the mobility, nine out of the 20 smart applications have been selected and studies.

Ankara, capital city of Turkey, is the second most populous province with its 5.5 million residents; and with 25,632-km2 areas, it is the third largest province in the country. The known history dates back to at least 10 thousand years and has hosted many civilizations from prehistory to the present. Ankara has a high number of universities when compared to most cities in Turkey. Moreover, the ratio of university graduates is twice the national average. This educated population

constitutes the labor force required by technology-based investments. Ankara comes first in the defense industry, software and electronics sectors in Turkey. Ankara has 10 smart city applications that are provided by the metropolitan Municipality, two of them are the e-government related applications, two of them are smart mobility related applications and the other six are related with the cultural and other Municipality services.

Izmir is the third most populous city with its 4.2 million population in 7,340-km2 areas. The city is a trade and port city since ancient times, which is home to leading ancient cities. According to the latest archaeological findings, the history of Izmir dates back to the 8500BC. Izmir has eight smart city applications that are provided by the metropolitan Municipality. One of them is the e-government related application, two of them are the smart mobility related applications and the rest are cultural applications.

Bursa is Turkey's fourth most populous city with 2.9 million of population in 10,882-km^2 areas. Bursa is an important center for automotive industry. These factories are one of the most important factors in the migration to the city. Also, it is one of the most developed cities in Turkey's textile industry. Bursa has three smart city applications that are provided by the Municipality. Two of them are the e-government related applications and the other two are smart mobility applications.

CHAPTER 4

SMART CITY TECHNOLOGIES CAPABILITY AND AWARENESS IN TURKEY

4.1. National strategies and action plans

In Turkey, Central Government policy documents such as the Five Years Development Plans, the Medium Term Plans and the Strategic Plans of the Ministries are important in guiding the investments, priorities, and incentives, thus shaping the country's development. These policy documents that are produced by the Turkish government have been referring to smart cities and smart city solutions since the early 2000s. Number of goals, targets and actions for the use of smart systems are mainly found in the transport sector in these documents prepared by various public authorities. Together with the determination of Turkey's smart city needs and actions taken respectively smart city implementations have been started to be discussed and initiatives have started to be formed in different upper-tier policy documents created by the government.

According to **2006-2010 Information Society Strategy Action Plan**, published in 2006, with the proposed action of the *National Transport Portal Project* and *Transportation Demand Management System,* it is aimed to provide nationwide transportation information to those in need from a single point. Accordingly the plan aims to produce applications to manage transportation demand by using new technologies and establish database decision support systems. At the end of those action plans, alternative transportation routes, estimated arrival time, important points on the route, travel planner, development of mobile applications, integration of urban public transport, standardization, nationwide dissemination and integration of electronic payment systems, smart card, mobile and e-ticket

applications in public transportation, development of different language options, providing new information resources are targeted.

Table 4.1: Strategic Plans and Actions Contain Smart City Policies Prepared by Turkish Government

2006-2010 Information Society Strategy Action Plan
2009-2013 UDHB Strategic Plan
2009 Turkey UDHB Transport and Communication Strategy Target 2023
2010-2023 Integrated Urban Development Strategy And Action Plan.
2011-2020 Climate Change National Action Plan
2012 Traffic Safety Action Plan
2012-2023 Energy Efficiency Strategy Document
2014-2018 Tenth Development Plan
2015-2018 Information Society Strategy and Action Plan
2017-2020 National Broadband Strategy and Eyem Plan
2019-2022 National Smart Cities Strategy and Action Plan Project

2009-2013 UDHB Strategic Plan aims to utilize Intelligent Transportation Systems to contribute to safety in highway and rail transport under its strategic aim of 'implementing regulations, practices and inspections in order to attain a sustainable transportation system where the safety of life and property is ensured at the highest level'. Also in the **2012 Traffic Safety Action Plan**, it was mentioned that carrying out the development of smart technologies for traffic safety is of great importance.

In order to increase energy efficiency in transportation, provision of transport services with environmentally friendly vehicles and equipment and smart traffic management applications using information and communication technologies have been identified as an action in the **Turkey UDHB Transport and Communication Strategy Target 2023,** published in 2009 and **Energy Efficiency**

Strategy Document prepared by the **Ministry of Energy and Natural Resources for 2012-2023.**

Even the **2011-2020 Climate Change National Action Plan** refers to use of information and communication technologies on urban transportation and intelligent transportation systems as transportation has a huge effect on climate change.

Turkey UDHB Transport and Communication Strategy Target 2023and **2012 Traffic Safety Action Plan** also aim to establish and disseminate and effectively use of urban traffic control systems/Traffic management systems on all urban roads. In fact, establishing 18 Traffic/Transport Management Centers by 2020is included in the 2012 Traffic Safety Action Plan by the General Directorate of Highways.

Dissemination of Information and Communication Technologies has also been identified as a target in the **2010-2023 Integrated Urban Development Strategy and Action Plan.** According to that action plan service quality and technological level of public transportation systems will be improved and regulations will be made for the efficient use of information technologies in urban transportation. Also, establishment of Transport Management Centers, real-time monitoring of the mobility/traffic and providing information with the Information Communication Technologies are mentioned. Besides it is emphasized that Information and Communication Technologies should be utilized to the maximum extent in order to ensure the participation of the citizens in every stage of in the spatial planning processes and decisions.

Tenth Development Plan 2014-2018, published in 2013, aims to expand the use of smart applications, especially in areas such as health, building, energy, disaster and water management in addition to the transportation. It was stated that Information Communication Technologies and Smart Transportation Systems would be utilized effectively in urban transportation, traffic management and public transportation services.

Information Society Strategy and Action Plan 2015-2018, published in 2014, also have targets for transformation into smart cities. For this purpose, the plan proposed that strategies and targets are stated, and implementation of the required governance models with the integrated working principles is determined. In metropolitan and urban regeneration areas, smart city applications are to be given priority. The plan also proposes intelligent transportation systems to be developed and coordination between different institutions in this field to be ensured. Call-based support is to be provided for the development of smart applications by using public data produced by central institutions and local governments. It is also stated that the main objective is to ensure the effectiveness of the services from design to implementation in the provision of e-Government services and to adopt the user-oriented principle.

It should be noted at this stage that e-Government solutions have been referred to since 2002 in different strategic action plans, and this issue will be presented in further detail in the next section.

National Broadband Strategy and Action Plan 2017-2020 identified targets for the development of Smart Cities Program and Intelligent Transportation Systems. The aim is, first of all, to manage urban infrastructures and networks such as transportation, logistics, environment, water and energy without the need for human interference. Additionally, it is proposed to increase the living standards of citizens by disseminating smart city applications. Besides, the plan aims to use information and communication technologies in all types of transportation and to establish coordination between Intelligent Transportation Systems services / solutions of different institutions. At the end the main target is to achieve integrated, safe, efficient, innovative, and human and environment friendly, sustainable and smart transportation network.

Finally, the very first **National Smart Cities Strategies and Action Plan 2020-2023** was published in 2019 by the under the leadership of presidency with the

cooperation of Ministry of Environment and Urbanization General Directorate of Geographic Information Systems.

4.2. Current situation in Turkey; municipalities surveys

Since 2011, there are many surveys conducted with Municipalities. These surveys are conducted to determine the smart city approaches of Municipalities, to what extent they achieve to the written plans and strategies, in which actions they need contribution and support and their current status.

Table 4.2: Participation Rates of the KENTGES Municipalities Survey

	Number of Municipalities in 2013	Number of Municipalities in 2014	2013 Survey Participation Rate	2014 Survey Participation Rate
TOTAL	2950	1396	%70	%82

KENTGES Municipalities Survey Report (2011, 2013, 2014); The KENTGES (Kentsel Gelişme Strateji Belgesi and Eylem Planı/ Urban Development Strategy Document and Action Plan) Municipalities Questionnaire was applied to all Municipalities in Turkey. The questionnaire was prepared in electronic environment and published at 'www.kentges.gov.tr'. A unique user name and password have been produced for each Municipality and delivered to the Municipalities with official letter. According to the survey results it has been observed that 12% of metropolitan Municipalities never use smart transportation applications. The usage rates of smart mobility applications are as follows; electronic card payment systems in public transportation: 84%, traffic cameras: 52%, smart stops: 44%, traffic rules violation detection: 32%, mobile and web traffic information applications 28%, travel planning systems: 24%, traffic density map: 20%.

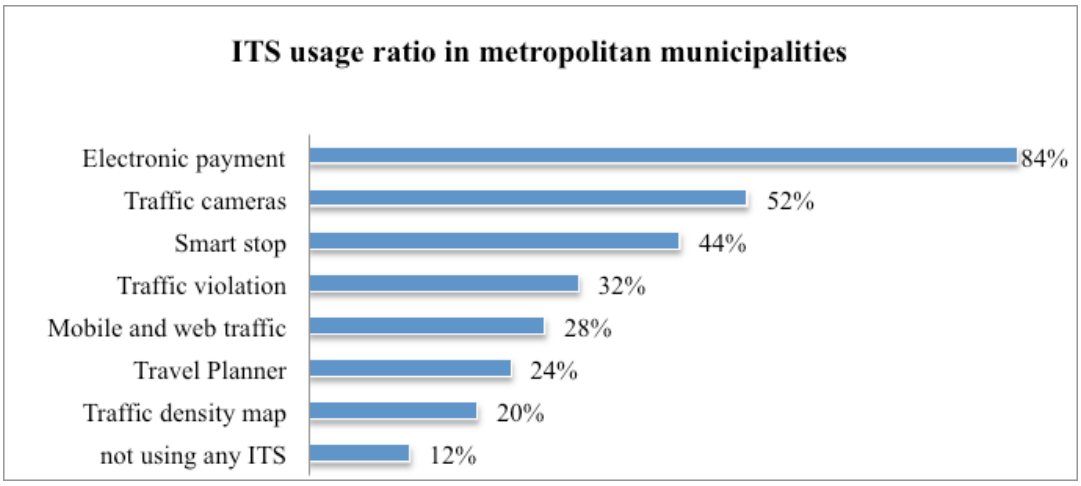


Figure 4.1: Intelligent Transportation Systems Usage Rate in Metropolitan Municipalities (KENTGES 2014) - According to 82% participant out of 1396 Municipalities

Information Society Strategy and Action Plan 2015-2018; Within the scope of 'Information Society Strategy and Action Plan 2015-2018' in February 2013 "Municipalities Smart City Applications Survey" was conducted with the participation of ***40 Municipalities*** in Turkey. The survey shows that Municipalities pay more attention to the transportation compared to energy and water. However, after a year in 2016, another survey conducted within the scope of Turkey **Smarter Cities Assessment Report 2016,** between June 2015 and January 2016. It was prepared in cooperation with TBV and Istanbul Technical University Computer Engineering Department and applied under the leadership of Novusens' Institute of Smart Cities with the MasterCard and Intel Turkey sponsorship. According to the report existing smart city applications are mostly seen in Transport, Energy and Water. On the other hand, **Deloitte-Vodafone Smart City Roadmap** conducted in the same year in 2016 found out that 95% of smart city solutions are in transportation, which was followed by water services with 42%.

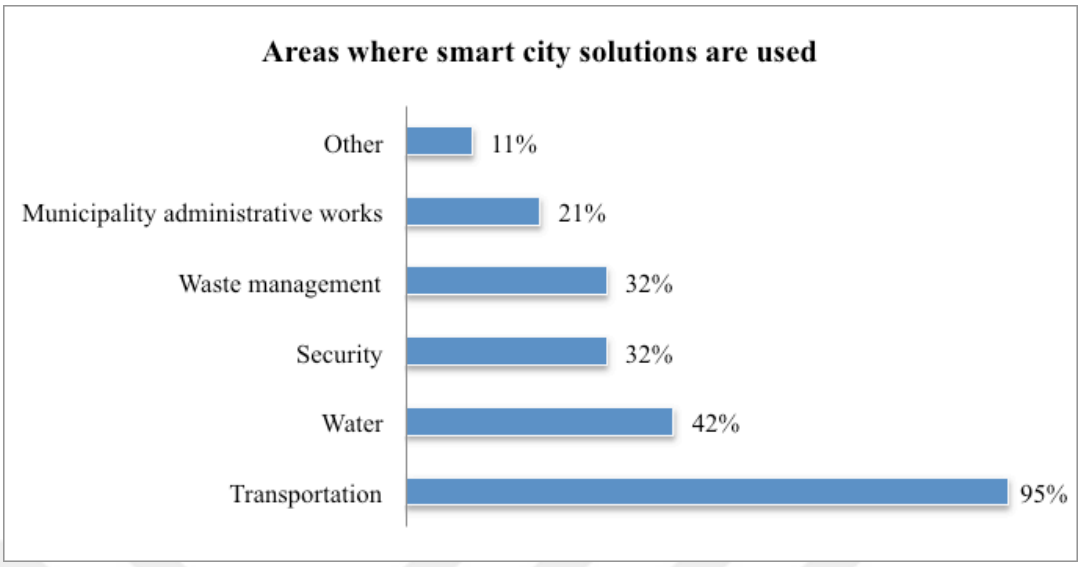


Figure 4.2: Areas where smart city solutions are used based on Deloitte-Vodafone smart city roadmap

Deloitte-Vodafone Smart Cities Roadmap 2016; Online survey, prepared in cooperation with Vodafone and Deloitte, which was sent to the ***19 metropolitan Municipalities***, mainly filled by the personnel working as experts, chief, branch manager and head of department in IT department. According to the **2016 Deloitte-Vodafone Smart City Roadmap**, the average digitalization score of the Metropolitan Municipalities is 55%. It is seen that approximately 42% of the metropolitan Municipalities are below average, the other 46% are between 56-75 and 12% are between 76-100, where the average score is 91 and the lowest average score is 30 out of 100.

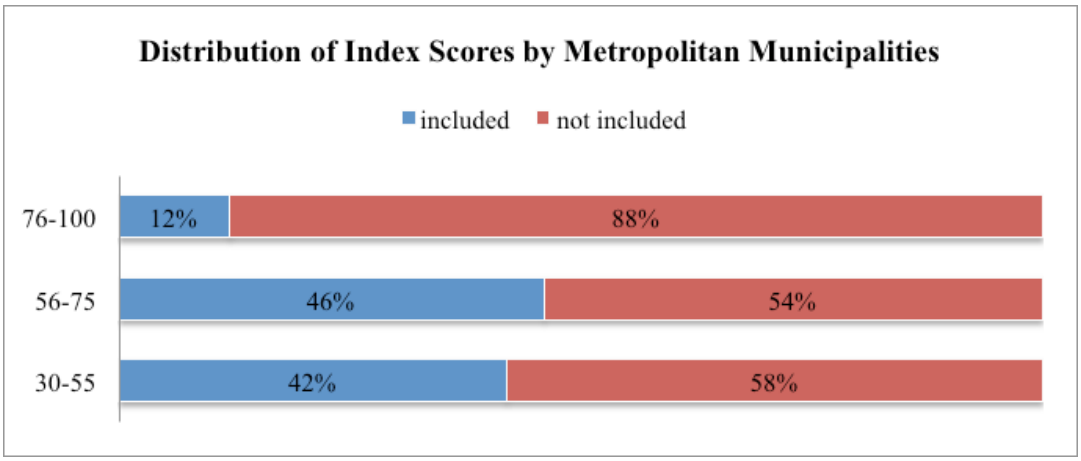


Figure 4.3: Digitalization scores by metropolitan municipalities based on Deloitte-Vodafone smart city roadmap

In addition, 17 of the 19 metropolitan municipalities participating in the study stated that they have a smart city vision. According to the survey results, smart city plan was prepared in 15 municipalities out of those 17. However after face-to-face meetings, the study stated that it is seen that the prepared plans are partial in the form of transportation or energy master plan. Also, in our cities, a plan or strategy specific to the concept of smart city, where all components are evaluated, has not yet been shared through public resources. Yet, in 73% of the municipalities, smart city teams were formed with staff from different units. Even though they are not included in the municipal organizational chart, assigned staff carries out studies for smart city applications. However face-to-face meetings, according to the same study, shows that the 'smart city unit', which works only for smart city applications and strategies within the municipality and whose basic duties are determined for this purpose in the organizational structure of the municipality, is established in a very limited number of cities. Therefore, the institutionalization process of the teams responsible for smart city design and implementation in our country is still at the beginning stage.

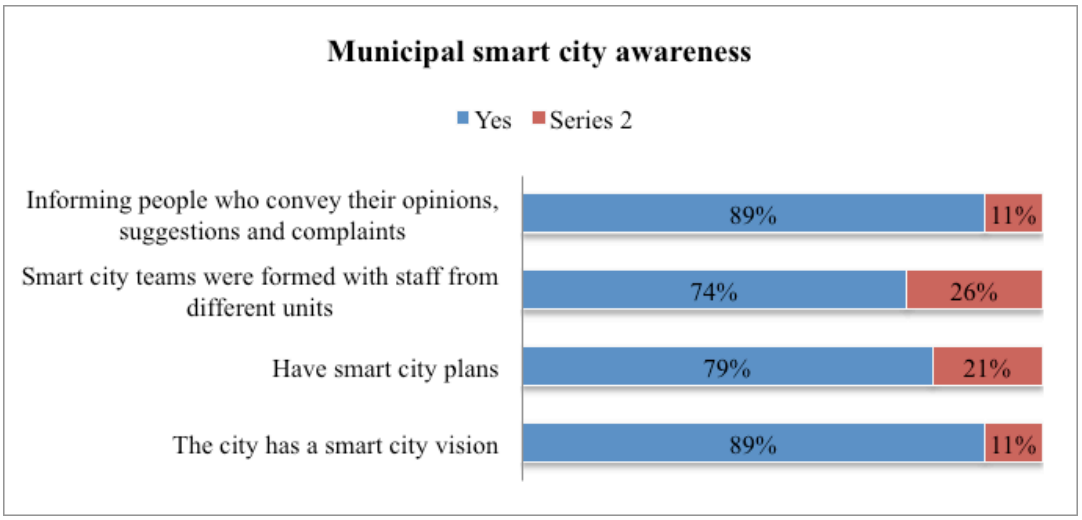


Figure 4.4: Municipal smart city awareness based on Deloitte-Vodafone smart city roadmap

According to the conducted surveys, the major obstacles faced by municipalities in implementing smart city solutions are financing, the need for standards and guidelines to ensure interoperability between cities, problems with legislation, lack of adoption of practices by citizens and lack of qualified human resources. Lack of coordination on provincial level, inter-institutional cooperation culture, open understanding of innovation and lack of financial adequacy are some other difficulties that municipalities have been faced with. Furthermore and more importantly bureaucratic disabilities and tendering processes, reluctance to share data and different perceptions of the concept of smart city in institutions are stated as the biggest problems in smart city practices.

4.3. E-government in Turkey

Turkey, during the transition to an information society, particularly after the **2006-2010 Information Society Strategy and Action Plan**, has given great importance to provide public services in electronic environment. Many public services that are frequently used by citizens and entrepreneurs are provided electronically. Some of the governmental services that have been implemented in the last period can be

listed as Central Population Administration System (MERNIS), Address Registration System (AKS), Land Registry and Cadastre Information System (TAKBİS), Central Registry System (MERSİS), common infrastructure and services such as ID cards. Also, there are basic practices commonly demanded by citizens and entrepreneurs, in education, health, tax, justice, safety, social security, customs and some local government services.

The very first report, which includes more effective use of information technologies in the public sector, was prepared in cooperation with the World Bank in 1993 as Informatics and Economic Modernization Report. In 1998, with the Prime Ministry Circular No. 1998/13, PublicNet Technical Council was established to implement the public computer network. The council prepared the **e-Government Action Plan** within the e-Europe and e-Turkey practices and training in 2002.

It was seen that the action plans prepared before 2003 could not be implemented, were partially implemented, or did not provide the expected contribution. As a result, in 2003, with the 2003/12 Prime Ministerial circular, it has been decided to combine all of the studies on information and communication technologies carried out by different institutions / organizations until that day, under the responsibility of State Planning Organization with the name of **e-Transformation Turkey Project.** In that context the **e-Transformation Turkey Project Short-Term Action Plan (2003-2004)** were prepared and implemented.

2006-2010 Information Society Strategy and Action Plan has been prepared and implemented in the context of **e-Transformation Turkey Project, in 2006**. This action plan includes e-Government applications aimed at 'Citizen-Focused Service Transformation' and 'Modernization in Public Administration'. According to the Final Evaluation Report of the 2006-2010 Information Society Strategy and Action Plan, as of June 2012, the success rate in the 'Citizen-Focused Service Transformation' was 65.6% and the success rate in the 'Modernization in Public Administration' was 50%.

With the Decree Law No. 655 (Decree Law No. 655), which was enacted in 2011, the duty and responsibility for e-Government policies was given to the Ministry of Transport, Maritime Affairs and Communications (UDHB). Within the Ministry, the Department of e-Government Services has been established under the umbrella of the General Directorate of Communication for e-Government activities.

In 2014, the **Tenth Development Plan (2014-2018)** was published, which guided public policies at the highest level. The e-Government structure targeted in this document is defined as follows: To contribute to effective, participatory, transparent and accountable public administration; The main objective is to create an e-government structure where the services designed according to user needs, including disadvantaged segments, will be offered in various platforms, user-oriented, interoperable, integrated and reliable by providing personal information privacy and information security.

In addition to the strategy plans that define the framework of e-Government policies, it has been seen that, other sectorial / thematic strategy documents, strategic plans of public institutions and organizations, government programs, documents prepared by political parties, reports of non-governmental organizations and international organizations include various targets, projects and actions related to e-Government.

Finally, maritime transport and Communications Ministry has prepared **2016-2019 National e-Government Strategy and Action Plan** within the framework of information society policy for Turkey's e-Government policy to be shaped by a holistic perspective.

The e-Government Gateway, which aims to provide electronic public services from a single point, in an integrated and secure way, has been in service since 18 December 2008. According to the **2018** results of **Turkey Statistical Household Information Technology Use Survey**, computer and Internet use rate is between 59,6% - 72,9% for 16-74 age group. However, according to the survey conducted during the twelve-month period covering April 2017 and March 2018, the rate of

individuals using the Internet/e-government services in order to contact public institutions / organizations for personal purposes or benefit from public services was 45.6% for 16-74 age groups.

National e-Government-Strategy and Action Plan 2016-2019 stated that there are differences in e-Government transformation levels. The major factor in the emergence of these differences is the difficulty in employing qualified human resources that is necessary for e-Government studies. As public institutions / organizations try to carry out e-Government projects with their own resources; problems may arise in the planning and implementation of e-Government projects. Also, due to the fact that public information systems are not shaped within the general framework of e-Government architecture, many problems occurred such as security risks, decrease in service quality, maintaining of same data in different systems over and over again, which also causes unnecessary costs. Besides, lack of common infrastructures such as electronic data and data sharing, electronic identity card, central authentication infrastructure and public network complicates the interoperability of public institutions.

However, there are very important obstacles that cause the complicate data sharing among institutions. There is lack of a common understanding in e-Government approaches, resulting in lack of integration between public institutions/organizations, failure to operate holistic processes, administrative and technical disruptions in system integration between institutions and lack of necessary legislative arrangements. Most importantly, publicity and information activities on e-Government services are not to the desired extent and therefore, user participation in electronic service creation processes cannot be ensured sufficiently.

4.4. Smart mobility in Turkey

As mentioned before, there are many strategy documents and action plans that include transportation to achieve smart city approach. Correspondingly **National**

Intelligent Transportation Systems Strategy Document 2014-2023 was published in 2014. Giving importance and priority to the improvement traffic safety in all modes of transport, protection of existing infrastructure and efficient use of information and communication technologies at the highest level have been determined as smart transportation strategies. Besides, it is stated that in order to provide a basis for transportation studies, it will be ensured that urban information systems, which collect data on current transportation system and travel demand in cities and regularly update them, will be developed and disseminated. These systems will be developed to meet the citizens' demand for information.

According to the Smart Transportation Strategies, applications according to areas of use are classified as follows:

1. **Passenger information systems**
    a. Mobile and Web Traffic Information Applications
    b. Route Planning
2. **Traffic management systems**
    a. Traffic management centers have been established in different cities and Municipalities to ensure the continuity of traffic flow, to make effective use of road network capacity, to monitor traffic in real time, to control and manage from a single center. There are meteorological sensors, variable message signs and cameras attached to these centers
    b. Tunnel control and sub-control centers with changeable electronic message signs and control with cameras inside and outside the tunnels
    c. City Security Management Systems (MOBESE) taking images with dynamic and fixed cameras, Plate Recognition System to detect the red light and speed violations (EDS)
    d. Traffic Control Systems regulating signal times by sensing instantaneous intensity

3. **Public transportation systems**
    a. Passenger information systems: to prevent inefficient use of time and energy and thus to encourage and improve public transport (applications and smart screens in stations giving the schedules and arrival times of the public transport vehicle).
    b. Electronic payment systems with ticket machines inside the vehicles, at stops and stations and at interchange nodes, smart cards
4. **Electronic payment systems**
    a. Card payment system (KGS) / automatic pass system (OGS) / Quick Pass System (HGS) in highways
5. **Freight and fleet management systems** aiming at load optimization and planning of a fleet, with a certain quality program monitoring and managing the delivery of the cargo to the customer, aiming at the order of all other auxiliary processes, their relationship with each other, their measurements and improvement of all processes.
    a. Fleet Command System: managing planned tasks, violation detection, messaging, adding new tasks and routes, emergency management and vehicle delivery and inventory tracking;
    b. Fleet Tracking System: real-time tracking of vehicles on a map, monitoring of devices on the vehicle and messaging
6. **Driver support and security systems** includes cruise control, anti-lock braking systems (ABS), **emergency brake assist,** emergency brake-force distribution, electronic stability control, emergency call **(e-**Call), roll stability control, electronic stability program
7. **Accident and emergency systems:** Traffic Incident Management (e-Call)

According to the KENTGES Municipalities Survey Report 2014, as seen in Figure 4.1, although smart transportation applications have started to be used in metropolitan Municipalities, it has been reported that in 12% of metropolitan Municipalities have never used such applications. In Turkey, only 26% of cities have the intelligent transportation systems.

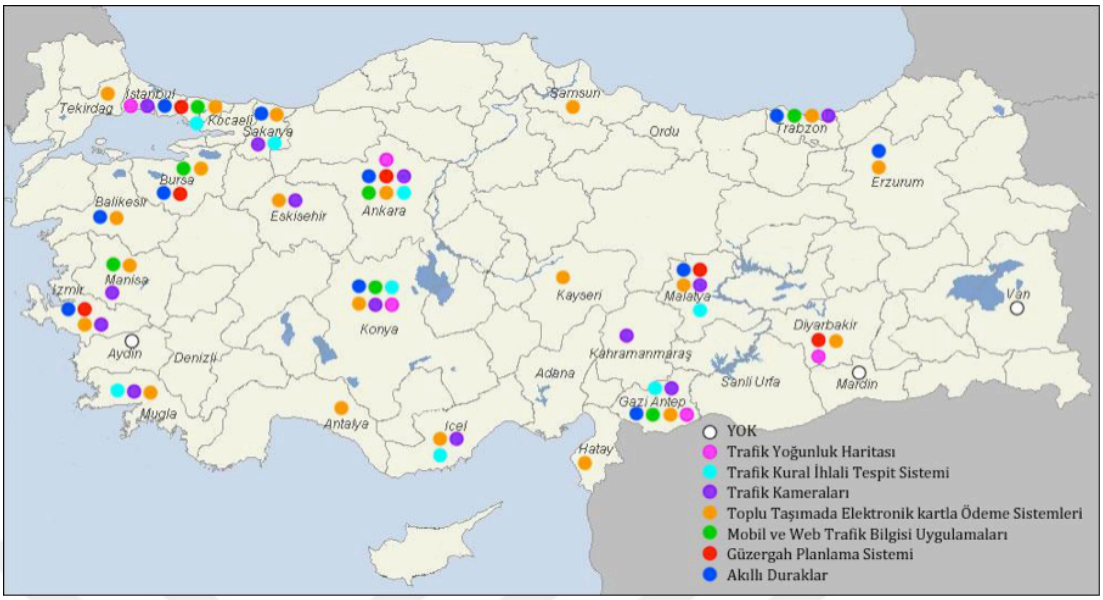


Figure 4.5: Distribution of Metropolitan Municipalities with Intelligent Transportation System (KENTGES, 2014) - According to %82 participant out of 1396 Municipalities

However, according to the Turkey Smart Cities Evaluation Report 2016, smart transportation applications evaluation showed that two-third of the metropolitan Municipalities implemented traffic-monitoring systems. Half of the metropolitan Municipalities implements electronic payment systems and smart stations. Smart intersections are implemented by 42% of the participated metropolitan Municipalities. Freight and fleet management systems are implemented by one third. Smart parking applications constitute 1% of total applications.

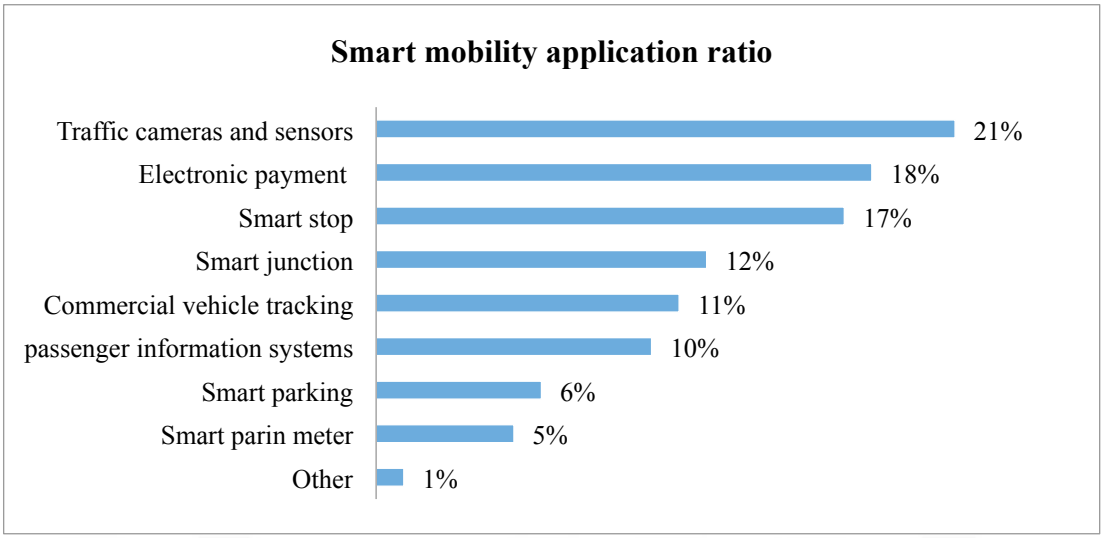


Figure 4.6: Turkey Smart Cities Evaluation Report 2016 - According to %83 participant out of 30 Municipalities

According to the ITS indicators that was mentioned in section 2.5.1, Turkey is able to produce the ITS technologies as seen in table 4.3. However, governmental surveys mentioned above resulted with only 26% of the cities using the ITS showing that the ITS usage is not seen country wide and it is not even close to the half of the country. Also smart mobility mobile applications, as travellers information systems are not seen countrywide. Only few cities in Turkey, mostly in the selected four cities as a case study, have the smart mobility mobile applications and it is limited with the bus tracking and route planning applications.

Table 4.3: ITS capability in Turkey compared to the ITS indicators based on literature

ITS indicators according to the literature	Türkiye ITS capability
Advanced Traffic Management Sytems	Traffic management centers
	Tunnel control and sub-control centers
	City security management systems
	Traffic control systems
Advanced Travellers Information Systems	Driver support and security systems
	Mobile and web traffic information mobile/web applications
	Route planning mobile/web applications
Commercial/Business Vehicles Operation	Fleet command system
	Fleet tracking system
Advanced Public Transportations Systems	Public transportation tracking mobile applications
	Smart public transportation stops
	Electronic payment systems

When examined in sustainable mobility aspect, as seen in figure 2.7 commute sharing, use of autonomous vehicles and green vehicles are the key factors.

In Turkey, autonomous vehicle studies have been done in a scope of R&D project and universities or multiple companies have done several innovations. However, in 2020 March, the driverless vehicle, Adastec's autonomous vehicle, developed by Turkish entrepreneurs started test studies in Istanbul traffic. Adastec is a member of Turkey and the Autonomous Connected Vehicle Cluster, which was implemented under the coordination of TOSB Innovation Center and ITU OTAM (Istanbul Technical University Automotive Technologies Research and Development Center).

Commute sharing is another factor, which has an effect on reducing traffic congestion and CO2 emission. However, as seen in citizen survey conducted with

the 1141 citizens in Turkey as a case study in section 6.4, 50% of the respondents think that car sharing is not safe.

When it comes to the green vehicles, the most cited green vehicle mode is the bicycle. The citizen survey, again conducted within the scope of the thesis, showed that, as seen in section 6.4, only 2% of the respondents state that they are using bicycle as their commute mode. However, Konya is the leading city with the 515 km bicycle roads. According to the WRI's (World Recources Institute) Turkey's Sustainable Cities Report published in 25 October 2018, bicycle roads in other cities can be seen in Figure 4.7.

Within the scope of the thesis' case study, Istanbul has 213,7 km reserved bicycle road, 82,6 km shared bicycle road and 667,9 km projected bicycle roads. Also with bike sharing application produced by ISBIKE, the city has 1500 bicycle and 140-bike stations across the city.

In addition to the current bicycle roads, "Bicycle Roads Regulation" entered into force after being published in the Official Gazette dated 12.12.2019 and numbered 30976.



Figure 4.7: Available bike path by city (km), 2018

Accordingly, again within the scope of the thesis' case study, in Ankara the first stage of the 900 m of the 53.6 km bicycle roadwork, which is planned to be completed until the end of 2020, was completed in August 2020. Bursa, in Nilüfer district, there is a 153 km bicycle road and the city has planned to construct 235 km bicycle roads. According to the records of the municipality in Izmir, there is a 52.7 km bicycle road. Also with bike sharing application BISIM, the city has 750 bicycles and 45-bike stations across the city.

Table 4.4: Bicycle roads in four cities selected as case study for the thesis.

Bicycle Roads	Current	Planned
Istanbul	213, 7 km reserved 82,6 km shared	667,9 km
Ankara	900 m	53,6 km
Izmir	52,7 km	
Bursa	153 km	235 km

The last factor for the sustainable mobility is the electric cars. Otokar, one of the Koç Group companies, launched its electric bus Doruk Electra in 2010. In 2015 Bozanka was chosen as the company of the year in Europe as domestic e-bus and the first domestic TRAMBUS manufacturer in Turkey. TEMSA and ASELSAN also launched Avenue as a domestic electric car in 2016. Also Elazığ, Manisa and Kayseri municipalities signed a contract for the purchase of electric vehicles in 2017.

According to the interviews conducted with the municipalities, as of 31 August 2020, there are no electric cars/buses in Istanbul, Ankara and Bursa. Izmir has been using electric buses since 2017 and according to the data collected since 2017 August; the city has saved 3,827,672 kWh energy and provided 1887-ton CO2 emission.

As seen above, Turkey has some projects and works regarding sustainable transportation although there are still certain areas requiring progress.

4.5. Smart city experiences in Turkey

The very first smart application in Turkey is the Istanbul Smart Station and Public transportation information applications Project, which was published in official newspaper dated 24.07.2003. After that many strategy documents and action plans included the issue of supporting the transformation to smart cities by increasing the infrastructure, capacity and skill levels in the field of ICT (see chapter 3). However, the very first national smart city strategy and action plan was written and published in 2019 (2020-2023 National Smart City Strategy and Action Plan).

Although the stakeholders are listed[18] as Environment and Urban Ministry, Ministry of Development, Ministry of Health, Maritime transport and Communications Ministry, Energy and Natural Resources Ministry, Ministry of Forestry and Water Management, Ministry of Science, Industry and Technology, Ministry of Interior, The Ministry of Finance, President of revenue management, TUBITAK, TOKI, TSE, Disaster and Emergency Management Authority, Development Agencies, Local Governments, Universities and NGOs, Local Municipalities carry out the smart city actions and they are very enthusiastic about doing smart things.

There are 81 cities in Turkey, and although all Municipalities are using e-government tools and offering easy communication and online payment tools for citizens as one of the smart government characteristics, only 7 cities (Istanbul, Izmir, Ankara, Antalya, Konya, Karaman, Kahramanmaraş) are producing some smart city applications in other areas. The others are either not interested or have just started to apply smart city strategies. It should also be added that almost all smart city applications are based on Smart Mobility.

As it is quite difficult to access governmental data in Turkey, it was very hard to find out which city, when and with what project started its smart city actions. The

[18] According to TC Kalkınma Bakanlığı '2015-2018 Information Society Strategy and Action Plan '

data given below is from news from newspapers, Municipalities web sites and Smart City Bulletin (‘Akıllı Şehir Beyaz Bülteni’) published by the Environment and Urban Ministry.

The very first smart city project under the name of smart city was launched in **Karaman** in 2015 with the cooperation of the local Municipalities and Turk Telekom. The smart applications include smart junction, sensor on trash bins to track the capacity, sensor in parks to track the humidity, smart bus stops, smart car parking, smart lighting, smart security with cameras around the city and health tracking. However, there is no information available about the current situations and development of all those applications in the Municipal web site or any other online source.

Çanakkale has been describing itself as a smart city since 2008 due to the provision of online payment systems for governmental bills; however, what has been particularly important in this areas was that in 2017 the Municipalities launched the ‘Aklım Fikrim Çanakkale Project’ to create a common portal for the citizens. The project, initiated with the collaboration of Kale Group, Turkey Informatics Foundation and Novusens Smart City Institute, aims to enhance Çanakkale’s competitiveness, both nationally and globally, by contributing to Çanakkale’s livability and sustainability through technology. The project consists of 5 phases, identifying the understanding, vision, strategy, preparing action plans and implementation and monitoring. According to the Çanakalle’s Roadmap to Becoming a Smart City Report written in 2017 only the first phase is completed. And there is no current information about the project’s development.

The Metropolitan Municipalities of **Kayseri** is also working to be Smart by developing projects on transport, environment, economy, energy, security, people, health, infrastructure and governance. However, 7 of the total 13 projects are ongoing projects that have not been completed as of 2020 April. One of the completed works is a sport center, which is not a smart city application. The others

include Wi-Fi access in public spaces, smart bus stop, fleet tracking and document management system.

Within the scope of "Smart City" applications, Turkcell offered dozens of different technological solutions to **Gaziantep** Metropolitan Municipalities under 8 main headings. Thanks to the “Smart City” practices that save 30 million liras in a year (2015) in the budget of Gaziantep, both the efficient use of natural resources and the quality of life of the city residents have been increased. The project also achieved savings and efficiency in electricity and water consumption and excavation management. It is also planned to establish a technological infrastructure in the Zeugma Museum and the zoo (in the area where Giraffe Şakir lives, temperature control is provided with Turkcell's M2M (Machine to Machine) technology), which is visited by 2.5 million people annually.

The Gaziantep Municipalities also created the ‘Innovation Gaziantep’ project. By establishing the innovation ecosystem with this project, it is aimed to apply innovative solutions in all areas instead of traditional methods. Most importantly, it aims to spread the culture of innovative thinking within the society. With ‘I have an idea’ link anyone can present their smart ideas.

Joining their forces for smart cities, Turkcell and Huawei also signed an important cooperation in **Ordu** in 2019. The two companies will develop technological solutions through joint collaborations in agriculture, transportation, energy, park and similar fields. They also agreed to launch the 'Smart City' project in **Samsun** in 2018. With this project, it is aimed for the people of Samsun to experience the most up-to-date smart city technologies before everyone and benefit from the digital transformation in many parts of the city. However there is no information in the Municipality’s web site about it.

It is also seen that many activities have been implemented in **Konya** in terms of smart city applications. Smart city studies such as Smart Public Transport System (ATUS), contactless card system, smart junction system, smart bicycle system, smart waste management, mobile applications, City Information System, which are

put into practice in Konya can be given as examples. A cooperation protocol was signed between TÜBİTAK (Scientific and Technological Research Council of Turkey) and Konya Metropolitan Municipalities for establishing Fiber-Optic infrastructure for electronic communication within Konya Metropolitan Borders. With this protocol, the transportation and communication infrastructure has been improved within the scope of smart city approach in Konya. Dissemination of traffic control systems and the preparation of the city's network infrastructure can be considered as the steps taken in this context.

Kahramanmaraş is rapidly advancing to become a Smart City. The smart applications that are completed can be listed as: Smart Elderly Care And Coordination Center, traffic management system, City Information System, Infrastructure Information System, smart junction, fiber optic infrastructure, Wi-Fi in public places, smart kiosk and smart bus stop. Also Kahramanmaraş is the unique city that uses national operating system 'pardus'.

Antalya is another city, which is working to be a smart city with projects like, intelligent lighting system, chronic patient tracking, smart city management platform, solar power plants in agriculture and electric generating stadium.

Istanbul is the smartest city according to the MCDA (multi criteria decision analysis) methods according to study conducted by Adıgüzel (2017). Istanbul Smart City initiatives include eight functional areas: "Mobility, Environment, Energy, Governance, Economy, Life, Human and Security" on the contrary of the six characteristics of smart cities defined by (Giffinger 2007). Istanbul Smart City includes *Environmental projects* such as Environmental Control Center, Air Quality Monitoring Center, Smart Recycling Container; *Energy projects* such as Domestic Waste Incineration and Energy Generation Plant, Energy Production from Landfill Gas; *Intelligent transportation systems* such as Transportation Management Center, Traffic Signaling Systems, Adaptive Traffic Management System, Istanbul EDS Control Center, Mobile EDS; *e-government projects* such as Beyaz Masa and Municipalities Web site development. Besides, Istanbul has 9

active smart mobility applications for citizens to get the real time information about daily commutes (details of the applications are given in chapter 4).

Ankara is the second smart city according to the MCDA (multi criteria decision analysis) methods (Adıgüzel, 2017). The most important applications and projects implemented in the city of Ankara that facilitate urban life and improve the quality of life can be summarized as follows: in order to ensure the *safety, as smart living*, in public parks there are Intelligent Video Systems, Intelligent Operation Center Tracking Systems and LTE Radio Notification Systems. City and Traffic Cameras are also to both manage the traffic and provide safety within the city. The city has *Intelligent Transportation Systems* as traffic information display, signaling system for Central Junction Control System, Dynamic Junction Control System and mobile and web traffic density maps. Also Intelligent Public Transportation Systems allow citizens to manage their times during public commutes. Moreover the city has Environmental projects such as Integrated Solid Waste Management System, Smart Water Management Systems. Moreover Ankara has 4 active smart mobility applications for citizens to get the real time information about daily commutes (details of the applications are given in chapter 4).

Izmir is another smartest city managed by more than 10,000 smart devices. It has the longest fiber-optic network since 2017 in Turkey with 621 thousand meters fiber optic cable within the scope of IzmirNet Project and Intelligent Traffic Systems. In addition to the mobility development Izmir also has wastewater treatment plants, solid waste disposals, full electrical buses, which are supported by Solar panels, installed on 10-thousand m2 roof area in the workshop buildings of ESHOT General Directorate, eco-lighting systems in public spaces as *Environmental* Projects. Additionally Izmir has 4 active smart mobility applications for citizens to get the real time information about daily commutes (details of the applications are given in chapter 4).

Bursa has a very special smart living application named love chip for Alzheimer and mentally disabled citizens. The chip allows carriers to be followed instantly by

their relatives. Bursa city like the other cities start smart city solutions with on transportation as smart junction, city and traffic cameras, traffic density maps, smart car parking solutions, public transportation information applications systems. The city also has environmental projects such as Energy Production from Methane Gas, Energy production with sludge incineration, Tracking of Sea Brooms and Solar Power Plants. Furthermore Bursa has 3 active smart mobility applications for citizens to get the real time information about daily commutes (details of the applications are given in chapter 4).

Also According to the "IESE Cities in Motion Index (CIMI)" about city rankings that has been published annually by IESE Business School since 2014, including three cities from Turkey except the latest version (CIMI 2018) which are Istanbul Ankara and Bursa (Ahmet and Zaim 2018). Also, respectively, these are the four largest cities by population in Turkey.

As a result for the thesis Istanbul, Ankara, Izmir and Bursa was selected for the case study analysis.

CHAPTER 5

SMART GOVERNANCE CAPABILITY AND MATURITY ANALYSIS IN TURKEY

(who is technologically capable and mature enough to respond to the citizen actions and willing to collaborate with them in city matters)

Guenduez et al. (2018, pg. 97) define the smart government as follows: 'smart government takes advantage of the opportunities offered by ICT, connecting and integrating physical, digital, public, and private environments to passively and actively interact and collaborate with citizens so as to better understand their needs and to creatively, effectively, and efficiently provide services at any time (even predicatively) and anywhere'

5.1. E-government analysis

E-government tools enhance information and service delivery to citizens; potentially expand opportunities for citizen participation. As an internet-based technological participation tool, websites of four metropolitan municipalities with their district municipalities were evaluated based on the availability of the information and interaction approaches as mentioned in the McMillan model of interactivity.

In Istanbul there are 39 districts. Within the borders, there are 40 Municipalities together with the Metropolitan Municipality. Ankara has 25 districts with 26 Municipalities together with the Metropolitan Municipality. In Izmir, the city has 30 districts and 31 Municipalities with Izmir metropolitan Municipality. Bursa has 17 districts and 18 Municipalities with Bursa Metropolitan Municipality.

With the Metropolitan Municipalities web pages, a total of 40 Municipal web pages in Istanbul, 26 web pages in Ankara, 31 web pages in Izmir and 18 web pages in

Bursa were examined to find out the extent to which Municipal web pages are informative and interactive.

5.1.1. Information tools

Information tools are considered as one-way communication and allow low level of citizen control because citizen has no control over the type of information. Monologue information are formed with GIS maps and plans, online documents provided as PDF format, news and announcements, multimedia like videos and images and different languages for foreign residents.

GIS maps are interactive maps that you can zoom in and out and move around. They were examined to find out whether they provide the information about zoning status, location information (for places like hospitals, schools, libraries, restaurants and etc.), pharmacies on duty, bus commute information, locations of the city cameras and Wi-Fi points. Plans refer to 1/1000 Implementation Development Plan.

Online documents provided as PDF format were examined to see whether they provide the documents as regulation/legislations, budget/final accounts, strategic plans, activity reports, council decisions and performance programs. News and announcements are for all the activities of the Municipalities, which are supported with the photo gallery.

5.1.1.1. Istanbul all municipalities

Istanbul Municipalities are very powerful in e-government. Almost all Municipal web sites are very informative about the district they belong.

82,5% of the GIS Maps and Plans they provide allow citizen to access to the 1/1000 development plan. 70% give the location information about all the important places and pharmacies on duty. 32,5% provides the direction services

and 7,5% enable the bus commute tracking although Istanbul Metropolitan Municipality has a mobile application for that service. 5% shows the city cameras and 10% shows the Wi-Fi points.

The most provided online documents, as PDF format is activity reports with 77,5% for past 4 to 14 years and strategic plans with 75%. Performance programs (67,5%) for past 2 to 10 years and council decisions (57,5%) are the second most provided documents. 47,5% of all Municipalities provides documents about all the budget/final accounts for past 3 to 12 years.

Table 5.1: Information tools - total and percentages, Istanbul All Municipalities

	GIS maps and plans	Online documents (pdf)	News and announcements	Multimedia (video/images)	Multilanguage
Total	36	35	39	39	12
Percentage	90	87,5	97,5	97,5	30
N=40					

5.1.1.2. Ankara all municipalities

Ankara Municipalities are relatively weak on providing maps and plans. Only 30,8% of the Municipal web sites provides development plans and 34,6% provides location services. 80,8% did not even have the pharmacy on duty service. Although only 3,8% offers the bus commute tracking, Ankara Metropolitan Municipality have the EGO Cepte application for that purpose for all the citizens living in Ankara.

The most provided documents are the council decisions with 61,5%. Activity reports for past 2 to 15 years are the second most provided documents with 53,8%. Performance plans (42,3%) for past 2 to 12 years and strategy plans (46,2) are the third most provided documents. However, Ankara Municipalities are weak in providing budget/final accounts with 30,8%.

Table 5.2: Information tools - total and percentages, Ankara All Municipalities

	GIS maps and plans	Online documents (pdf)	News and announcements	Multimedia (video/images)	Multilanguage
Total	7	15	26	26	2
Percentage	26,9	57,7	100	100	7,7
N=26					

5.1.1.3. Izmir all municipalities

Although Izmir seems to be weak in providing multilanguage feature, Izmir Metropolitan Municipality web site provides six different languages for the citizens. Other than that, Municipalities are relatively weak in containing GIS map and plans. Only two Municipalities offer the access to zoning status and location services. 96,8% did not even provide pharmacy on duty and direction services. In addition, 6,5% of the provided maps are not working.

Within the online documents, the most provided information is about council decisions and activity reports, which are almost for ten to fifteen years. Strategic plans come second with 48,4%. Regulation/legislations with 41,9% is the third most provided information. But Izmir Municipalities are weak in providing the information about budget/final accounts. Mostly they have budgets.

Table 5.3: Information tools - total and percentages, Izmir All Municipalities

	GIS maps and plans	Online documents (pdf)	News and announcements	Multimedia (video/images)	Multilanguage
Total	2	28	30	30	5
Percentage	6,5	90,3	96,8	96,8	16,1
N=31					

5.1.1.4. Bursa all municipalities

Bursa Municipalities are quite good to give citizens the daily information about the city and Municipality works but they are weak in providing maps and plans. However 44,4% of provided maps allow citizens to access the pharmacies on duty but only 27,8% offers zoning status information. Only three Municipalities provide the location information of the institutions like hospitals, schools, museums and etc.

The most provided online documents, as PDF format is the council decisions. 12 out of 18 Municipalities are provided that information. Activity reports are the second most provided information that is for almost 10 years. Strategic plans (55,6%) come third and followed by performance programs (44,4%). Bursa Municipalities are also very weak in providing budget/final accounts as online document. 44,4% of Municipalities is providing that information but they are for past years and for one single year.

Table 5.4: Information tools - total and percentages, Bursa All Municipalities

	GIS maps and plans	Online documents (pdf)	News and announcements	Multimedia (video/images)	Multilanguage
Total	3	12	17	17	4
Percentage	16,7	66,7	94,4	94,4	22,5
N=18					

5.1.2. Interaction tools

Interaction tools contain three types of communication as feedback, responsive dialogue and mutual discourse. Feedback is one-way communication and high level of citizen control yet no guarantee of extended communication/no responds to the emails. Responsive Dialogue is two-way communication having low level of citizen control because it is a citizen-initiated communication. There is a respond to

the emails but government/interlocutor has the control. Mutual Discourse, on the other hand, is a two-way communication with high level of citizen control. Both government/interlocutor and citizen have the same level of control.

This study considers corporate e-mail and staff e-mail information as feedback because there is no guarantee that the staff will respond. Online transactions and citizen feedback applications for request, complaint or suggestions are considered as responsive dialogue because Municipalities have to respond to those applications within the 15 days as regulation. Mutual Discourse includes Social media accounts, live support and call center. Social Media is very strong e-government tool as it allows instant communication and information sharing. Live support refers to the chat box that requires a staff to provide live support.

5.1.2.1. Istanbul all municipalities

Istanbul Municipalities are also very good at interaction. It is the city that offers the contact details of the different departments within the Municipalities with the highest rate. Only one Municipality seems to have no online transaction but it is because that Municipality does not have access to its website. 92% of the Municipal websites allow citizen to deliver their complaints and suggestions. Indeed Istanbul metropolitan Municipality has *Beyaz Masa* center for that purpose so that all citizens living in Istanbul have an access to the Municipality staff for all kinds of requests.

Table 5.5: Interaction tools - total and percentages, Istanbul All Municipalities

	FEEDBACK		RESPONSIVE DIALOGUE		MUTUAL DISCOURSE		
	Corporate e-mail	Staff e-mail	Request complaint suggestions	Online transactions	Social media accounts	Live support	Call center
Total	29	25	37	38	40	0	39
Percentage	72,5	62,5	92,5	95	100	0	97,5
N=40							

All of the Municipalities have social media accounts. Moreover, 26 out of 40 Municipalities have also the smart phone application, which is the highest rate among the other cities. Yet some Municipalities either do not have the correct link to the application or do not even have the link even if they have the mobile application.

Table 5.6: Municipalities Social Media Accounts, Istanbul All Municipalities

	MUTUAL DISCOURSE				
	Twitter	Facebook	Instagram	Youtube	Whatsapp
Total	40	40	38	39	7
Percentage	100	100	95	97,5	17,5
N= 40					

5.1.2.2. Ankara all municipalities

Most of the Municipalities of four cities have the online transaction services and Ankara is in the third place in providing that service with 73 %. It is also in the third place in allowing citizens to deliver their request and complaints. However, Ankara metropolitan Municipality has *Mavi Masa* application for that purpose. It is also weak in providing contact information of the different departments.

Table 5.7: Interaction tools - total and percentages, Ankara All Municipalities

	FEEDBACK		RESPONSIVE DIALOGUE		MUTUAL DISCOURSE		
	Corporate e-mail	Staff e-mail	Request complaint suggestions	Online transactions	Social media accounts	Live support	Call center
Total	18	3	17	19	26	0	26
Percentage	69,2	11,5	65,4	73,1	100	0	100
N=26							

Social media account is again very popular within the Ankara Municipalities. It seems like Facebook is the most common social media account but it is not up-to

date as much as Twitter. Moreover only three out of 26 Municipalities have the smart phone application.

Table 5.8: Municipalities Social Media Accounts, Ankara All Municipalities

	MUTUAL DISCOURSE				
	Twitter	Facebook	Instagram	Youtube	Whatsapp
Total	25	26	22	22	6
Percentage	96,2	100	84,6	84,6	23,1
N=26					

5.1.2.3. Izmir all municipalities

Izmir Municipalities can be considered as highly interactive yet there are only two Municipalities that provide the staff e-mail as contact information for different departments. Corporate e-mail is like a standard for all of them although some do not have that information either. Almost all of them offer the online transaction services so that citizens can pay their debts, access to the application forms to have the city card for example. With 51,6% Izmir Municipalities give importance to the citizen feedbacks. Municipalities either have their private feedback box or they direct citizens to the Izmir HİM (Hemşehri iletişim merkezi), which is the main communication line for citizens with the government. None of the Municipalities has the live support yet they have the social media accounts and that can be considered as live support.

Table 5.9: Interaction tools - total and percentages, Izmir All Municipalities

	FEEDBACK		RESPONSIVE DIALOGUE		MUTUAL DISCOURSE		
	Corporate e-mail	Staff e-mail	Request complaint suggestions	Online transactions	Social media accounts	Live support	Call center
Total	27	2	16	28	31	0	31
Percentage	87,1	6,5	51,6	90,3	100	0	100
N=31							

Social Media Accounts are very popular among the Municipalities. Almost every Municipal institution and/or the mayor have a social media account. Twitter and Facebook is the most used social media tool. According to Table 5.10 Facebook seems to be most used social media account although they are not up-to-date as much as Twitter accounts. However some Municipalities do not have links in their Municipal web sites to the social media accounts they have, especially for Instagram accounts. Also lots of Municipalities have WhatsApp number for complaints. Moreover three out of 31 Municipalities have the smart phone application.

Table 5.10: Municipalities Social Media Accounts, Izmir All Municipalities

	MUTUAL DISCOURSE				
	Twitter	Facebook	Instagram	Youtube	Whatsapp
Total	29	31	27	22	13
Percentage	93,5	100	87,1	71	41,9
N=31					

5.1.2.4. Bursa all municipalities

Bursa Municipalities have the same issue with the other Municipalities: only five out of 18 Municipalities provide the staff e-mail as contact information for different departments. Corporate e-mail is like a standard for all of them although some do not have that information either. Bursa can be considered as weak offering the online transaction services. Yet it gave more importance to the citizen feedbacks than the Izmir Municipalities with 66,7%. Citizens can use *Beyaz Masa* for all kind of application and communication with the government. None of them has the live support yet they have the social media accounts and that can be considered as live support.

Table 5.11: Interaction tools - total and percentages, Bursa All Municipalities

	FEEDBACK		RESPONSIVE DIALOGUE		MUTUAL DISCOURSE		
	Corporate e-mail	Staff e-mail	Request complaint suggestions	Online transactions	Social media accounts	Live support	Call center
Total	16	5	12	12	18	0	18
Percentage	88,9	27,8	66,7	66,7	100	0	100
N=18							

For the Bursa case, Instagram and YouTube are also highly used social media tools - as much as Twitter and Facebook. Like in the Izmir case, according to the numbers Facebook seems to be the most used social media account although not up-to-date as much as Twitter accounts. Only four Municipalities have WhatsApp number for complaints. Moreover three out of 18 Municipalities have the smart phone application.

Table 5.12: Municipalities Social Media Accounts, Bursa All Municipalities

	MUTUAL DISCOURSE				
	Twitter	Facebook	Instagram	Youtube	Whatsapp
Total	16	18	16	15	4
Percentage	88,9	100	88,9	83,3	22,2
N= 18					

5.2. Citizen survey to find out government response on interaction tools

All Municipalities have various networks for citizens to contact to get information or deliver their claims or opinions. These networks include e-mail services; call centers, mobile applications and social media links. Also they have special departments, like *Mavi Masa* in Ankara, *Beyaz Masa* in Bursa and Istanbul and *HİM* in Izmir, which have their own e-mail services and call centers, in order to

receive all kind of claims and opinions. However, according to the citizen survey majority of the respondents do not prefer to contact the Municipality.

According to the Deloitte-Vodafone smart city roadmap survey, which was conducted with the 30 municipalities, the rate of "Informing people who convey their opinions, suggestions and complaints" was %89 as seen in figure 4.4. However, according to the survey conducted with the citizens as a scope of the thesis study, among the respondents who use the interaction tools.

In Istanbul; 25% of the respondents' claims are not responded by the government. 39% of the claims are responded to, but not concluded with a solution. Only 35% of the respondents state that the government officials both respond and solve the problems they convey.

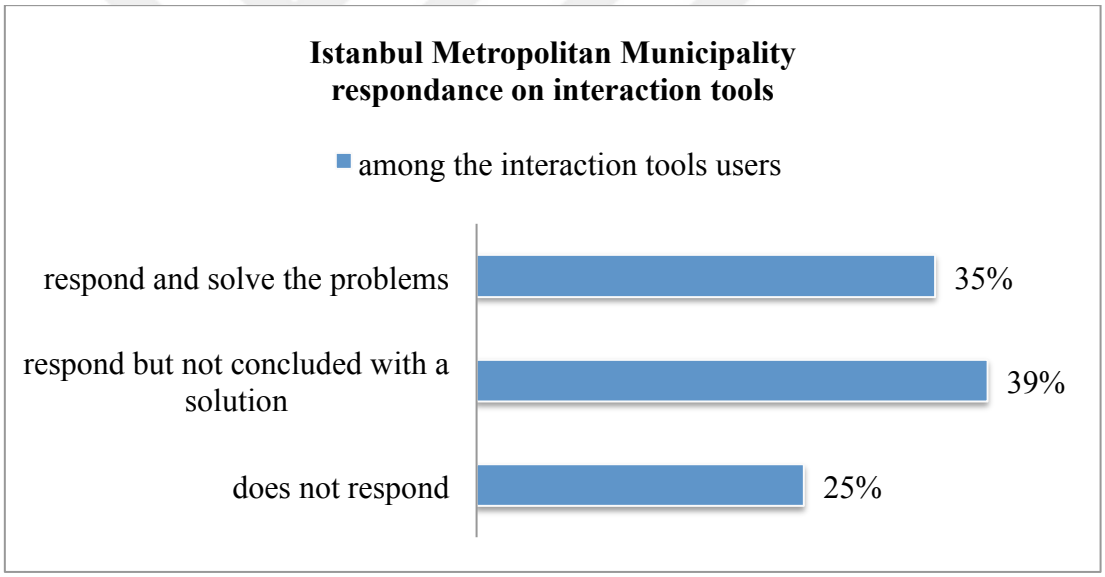


Figure 5.1: Municipalities response on interaction tools, Istanbul

In Ankara, 34,2% of the respondents' claims that government does not respond, 35,5% claims that they respond but do not conclude with a solution. Only 30,3% of the respondents state that the governments both respond and solve the problems they convey.

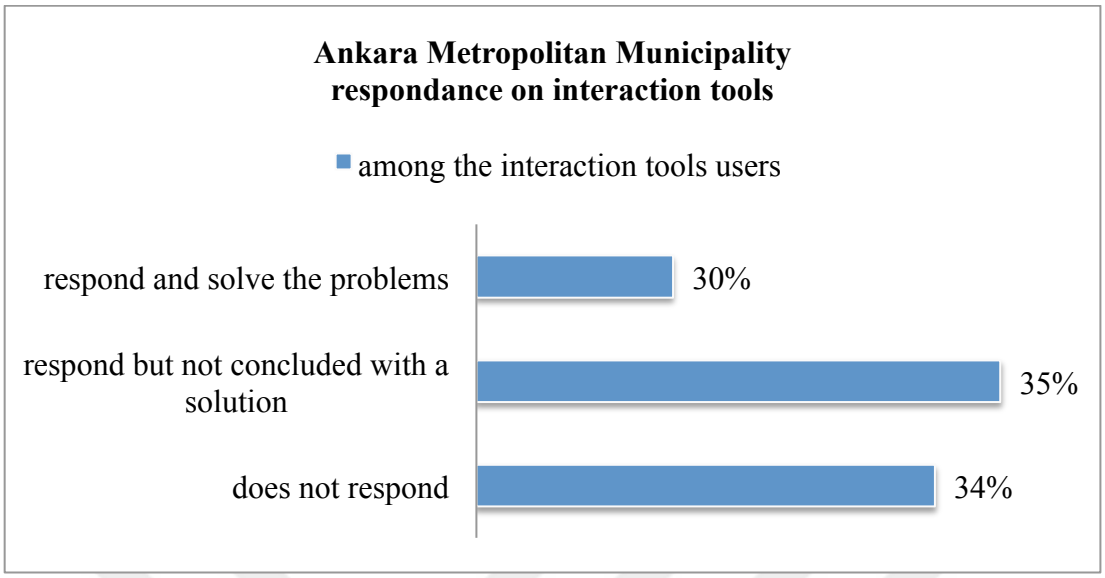


Figure 5.2: Municipalities response among the interaction tools users, Ankara

In Bursa, 37% of the respondents' claims that government does not respond, 45% claims that they respond but do not conclude with a solution. Only 18% of the respondents state that the governments both respond and solve the problems they convey.

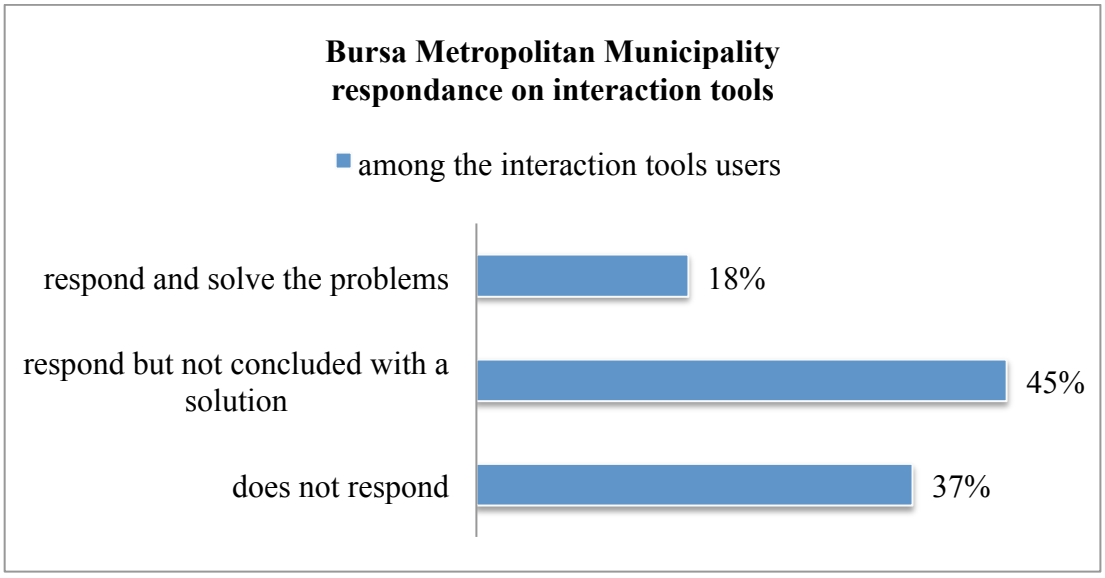


Figure 5.3: Municipalities response among the interaction tools users, Bursa

In Izmir, 22% of the respondents' claims that government does not respond, 32% claims that they respond but do not conclude with a solution. Only 45% of the respondents state that the governments both respond and solve the problems they convey.

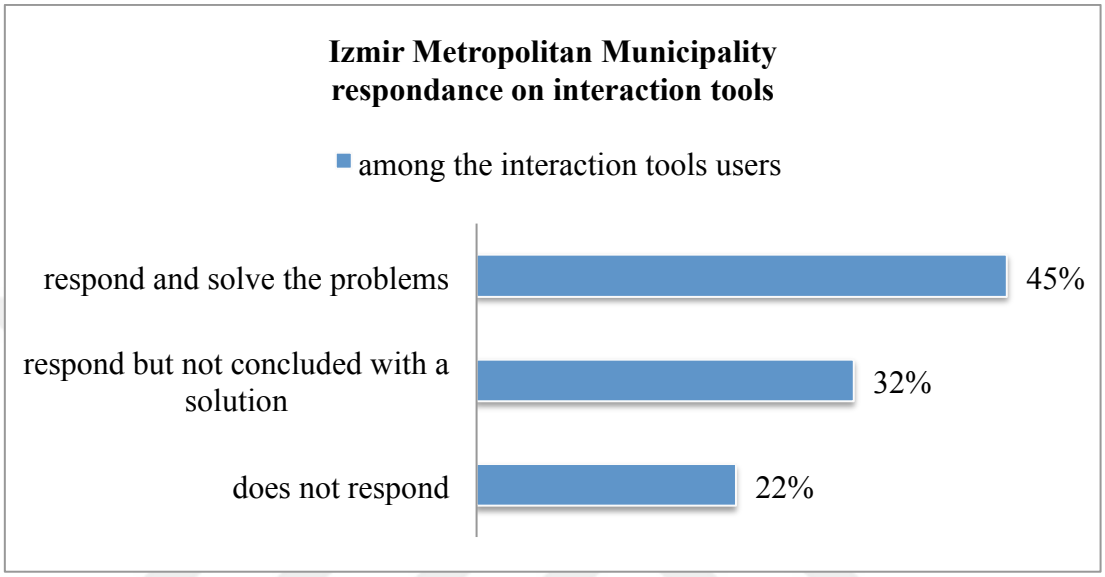


Figure 5.4: Municipalities response among the interaction tools users, Izmir

Rather than communication networks, in Bursa the Municipalities have official Smart City Bursa web site rather than Municipalities official web site. According to the citizen survey conducted for this thesis, only 10,4% of the respondents is visiting the site. Although the Smart City Bursa has the 'share your idea' option, 95,7% of the respondents does not use that option at all. Only one person claims that s/he shared his/her idea and it has been accepted and applied.

The results show that the government has the technological capability but they are not mature enough to use it. As the thesis stated before technology is not enough to make a city smart. For a city to become smart, all the users of the city should be mature enough to create an effectively functioning smart city.

5.3. Interview with the metropolitan municipalities to find out the municipalities' smart city approach

An online questionnaire was sent to each metropolitan municipality's smart city department officials. The questionnaire was firstly sent through the interaction methods that Municipalities provide to citizens within the scope of e-government. These methods are Municipal e-mail addresses, 'ask me question' tools and phone lines. However, since these were not sufficient and there was no answer for a few months, personal contacts were made and answers were received from all municipality officials.

Municipalities were asked how much importance they attached to the concept of smart city and what the concept of smart city meant for the Municipality. All Municipalities agree that smart cities are our future, citizens' quality of life is improved, providing more efficient use of resources, providing optimal solutions to the problems of the city thanks to the data it collects, and that it is an inevitable concept to which resources and time must be devoted.

Concretely, when asked how much resources and time are allocated to this issue compared to other tasks, Izmir Metropolitan Municipality responded this rate as 5% of the annual budget, although all Municipalities consider it a necessity as mentioned above. Ankara Metropolitan Municipality stated that they have been very inadequate so far, but they aim to allocate 50% of resources and time with new term projects. Bursa Metropolitan Municipality stated that it couldn't answer this question without analyzing the current situation. In other words, Bursa metropolitan Municipalities does not have information about the smart city studies that it carries out within its own body. Istanbul Municipalities left the question unanswered.

Ankara Metropolitan Municipality stated that they have implemented project studies with the suggestions and contributions of 427 non-governmental organizations, techno-cities and universities. It stated that 65% of the work done

was carried out within the Municipality and 35% of it was carried out with consultancy support. Bursa Metropolitan Municipality stated that since there is no legislation on this issue, there is no authority contributing in decision-making processes. It reported that the smart city studies were carried out in cooperation with the external contractors. Izmir Metropolitan Municipality stated that the decision authority was under the head of the Municipality and the head of the transport department. The official also reported that 50% of the work was carried out within the Municipality and 50% with external contractors. Istanbul Metropolitan Municipality also stated that the decision authority belongs to the Municipality. However, it has been stated that coordination, inspection and control works are done by the Municipality and operational works are done by external contractors.

As a result of the surveys conducted with the citizen, it was stated that citizens are not very aware of the current smart transportation mobile applications in the city where they live. The Municipalities were asked what kind of studies they carried out in informing the citizens. The Ankara Metropolitan Municipality did not comment on the practices of the previous metropolitan government; being elected in 2019 and they stated that they were about to launch a new application and that they would announce this to the citizens through the media. The new application, as promised, was introduced via the press on 14 February 2019 and published on the social media accounts of the metropolitan Municipality. However, the new application is designed as a mobile version of the Municipal website and has nothing to do with transportation.

Izmir Metropolitan Municipality stated that they made announcements on billboards and websites at the beginning. Bursa metropolitan Municipalities stated that they have made announcements through media and billboards and posters. Istanbul metropolitan Municipalities left the question unanswered.

Finally, it was asked what are the biggest difficulties encountered while doing smart city studies and what kind of studies they have done to overcome these

difficulties. Ankara Metropolitan Municipality stated that the biggest challenge is to develop strategies and plans with continuity. For this purpose, the Technology Working Group formed under the Municipal City Council brought together different stakeholders, including public employees, industry leaders, NGOs, universities and private sector representatives, and reported that strategic roadmap studies were carried out in the light of common mind. Bursa Metropolitan Municipality agrees with Ankara regarding the absence of legislation and strategy and reported that the Municipalities are undertaking strategy determination. Istanbul metropolitan Municipalities stated that the biggest problem is KVKK (Kişisel Verilerin Korunması Kanunu/Personal Data Protection Law) and legal obligations. They pointed out that questions such as the definition of the data and where to store should be answered. In this regard, they touched upon the need to increase the awareness of protecting individual data and storing our data within our own borders, not on global servers. Izmir left the question unanswered.

Briefly, even if all metropolitan municipalities agree that smart city studies are a necessity, and that it is necessary to allocate resources and time, it is seen that the studies conducted on this issue by the metropolitan municipalities are not carried out with great awareness, that there is no legislative execution, and to a certain extent it is motivated by a tendency to keep up with the smart city concept as a popular subject.

CHAPTER 6

SMART PEOPLE ANALYSIS IN TURKEY
(who are aware, willing to use smart applications and active citizens)

This part of the study firstly, analyzes the questions in order to understand the awareness and the participation level of the citizens against all the smart city applications that exist in the city produced by the metropolitan municipalities. According to the results, as a next step, the study analyzes the factors affecting the awareness and usage based on smart mobility mobile applications and active citizenship attitude regarding the usage of interaction tools that metropolitan municipalities provide.

Among 1141 respondents, as seen below, 52% have bachelor's degree, 26% are postgraduate and 22% hold only primary education degrees.

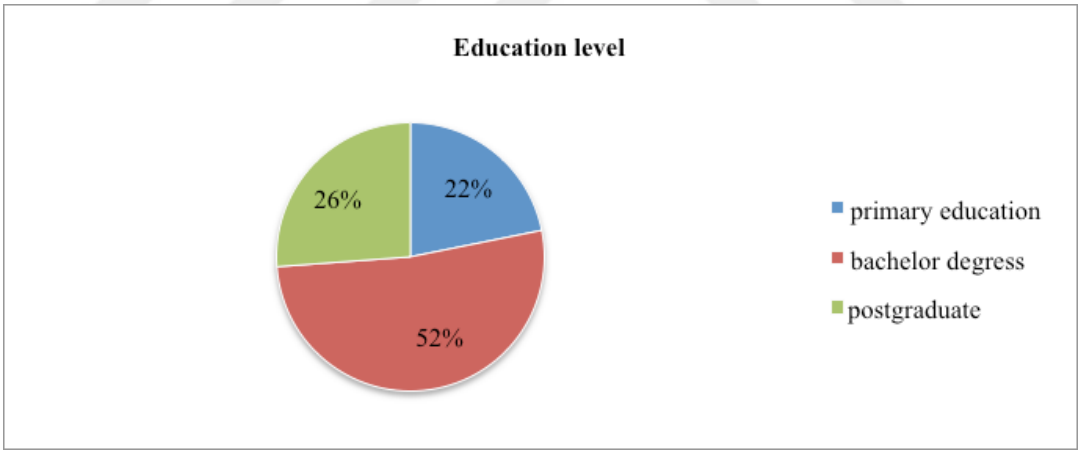
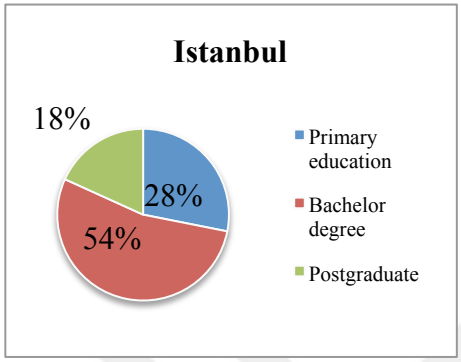


Figure 6.1: Distribution of the education level among the 1141 respondents in four cities

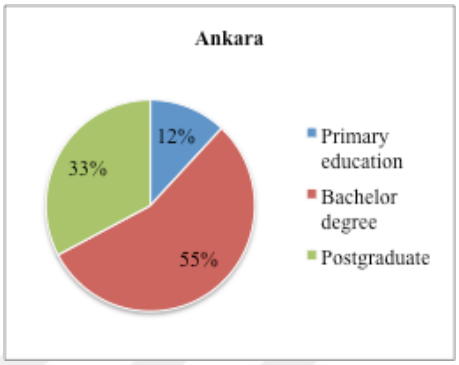
In addition, the distribution of the education level city-by-city can bee seen below.

Table 6.1: Distribution of the education level among the respondents city-by-city

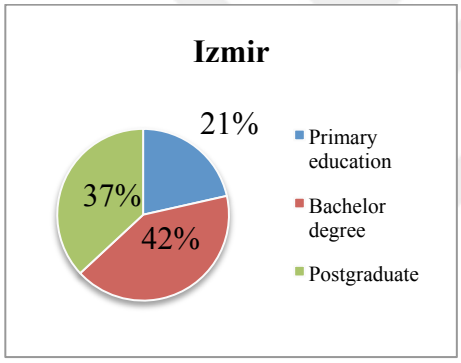
Education level in selected four cities



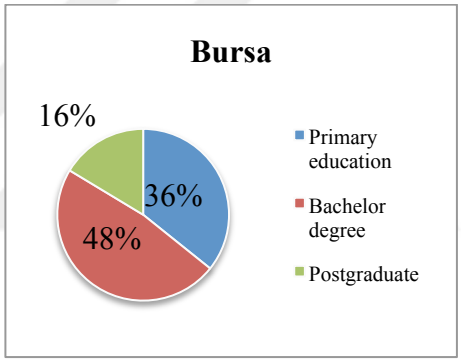
N: 384 respondents in Istanbul



N: 443 respondents in Ankara



N: 149 respondents in Izmir



N: 165 respondents in Bursa

As seen in Figure 6.2, 56% of those people are 26-45 years old, 35% are 18-25 years old, 8% are 46-65 years old and 1% 65 years old and over.

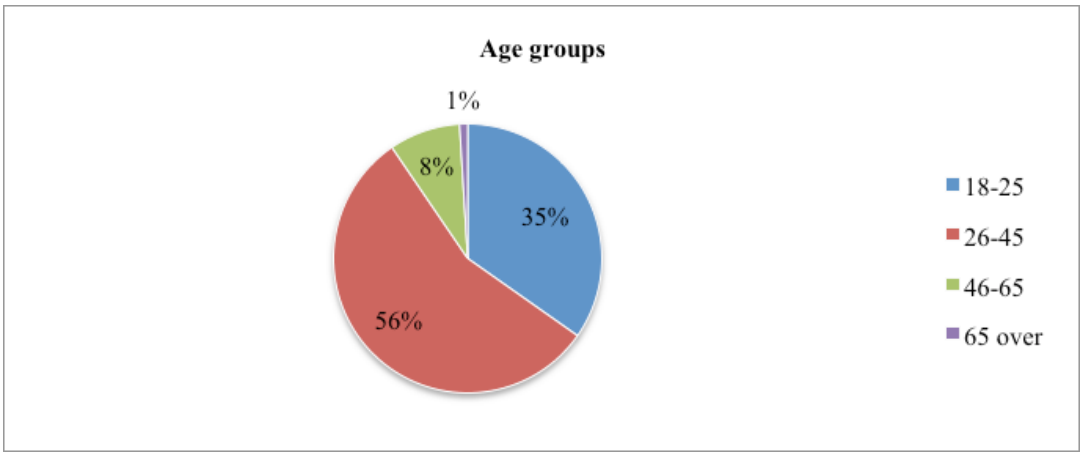
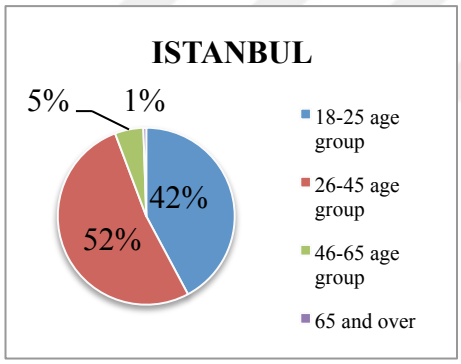


Figure 6.2: Distribution of the age groups among the 1141 respondents in four cities

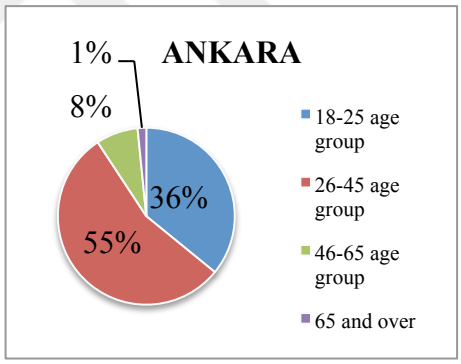
In addition, the distribution of the age groups city-by-city can bee seen below.

Table 6.2: Distribution of the age groups among the respondents city-by-city

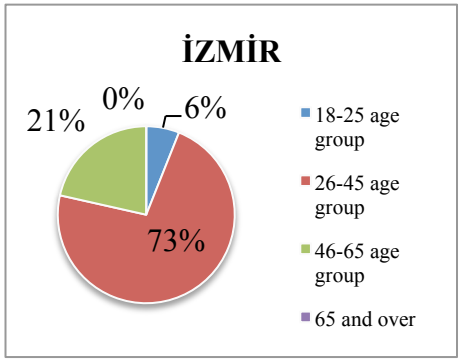
Age groups in selected four cities



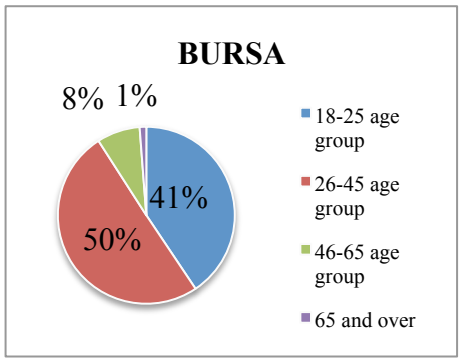
N: 384 respondents in Istanbul



N: 443 respondents in Ankara



N: 149 respondents in Izmir



N: 165 respondents in Bursa

As seen in Figure 6.3, 29% of the respondents are using public transportation almost every day (5-7 days a week), 24% of the respondents are using public transportation a few times a week and few times a year and 23% are using few times a month.

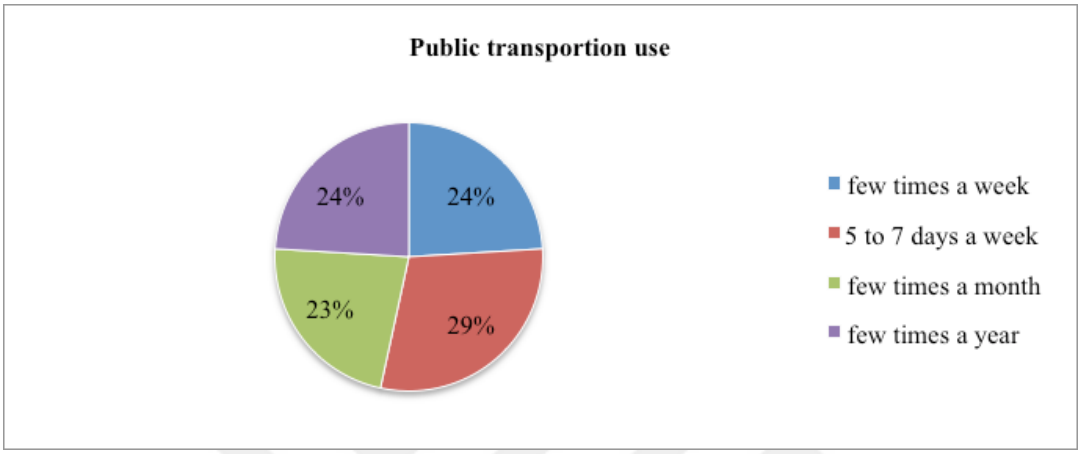
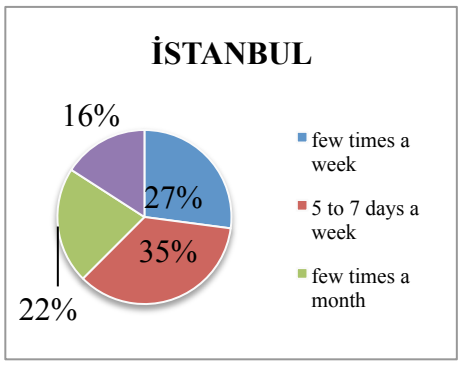


Figure 6.3: Distribution of the public transportation use among the 1141 respondents in four cities

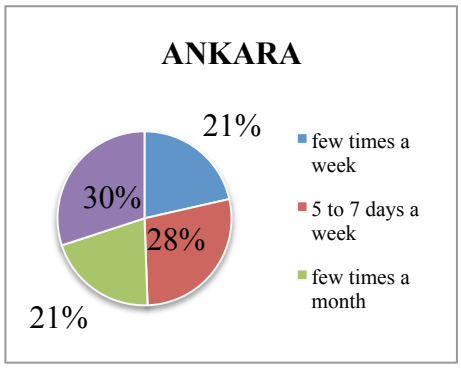
In addition, the distribution of the public transport use city-by-city can bee seen below.

Table 6.3: Distribution of the public transport use among the respondents city-by-city

Public transport use in selected four cities

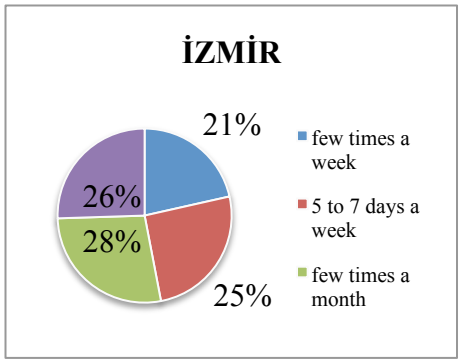


N: 384 respondents in Istanbul

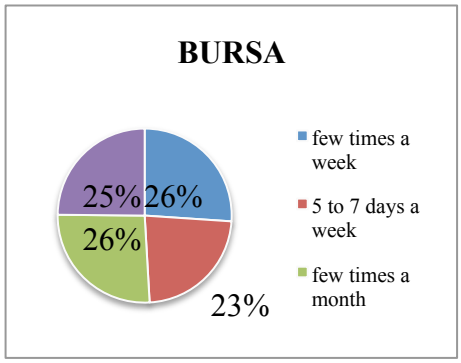


N: 443 respondents in Ankara

Table 6.3 (continued)



N: 149 respondents in Izmir



N: 165 respondents in Bursa

Among the four case cities, there are 11 different transportation modes, which are, subway, bus, minibus, cableway/car, sea transportation, tram, taxi, bicycle, walking and private car. However, when we look at the common transportation modes (Figure 6.4), which are subway, bus, taxi, private car, bicycle and walking, it is seen that bus is the most used public transportation with 30%, private car usage is following it by 23%. 19% of the respondents prefer to walk, whereas 14% prefer to use subway. 13% of the respondents prefer to use taxi but almost no one prefers to use bicycle with only 1%.

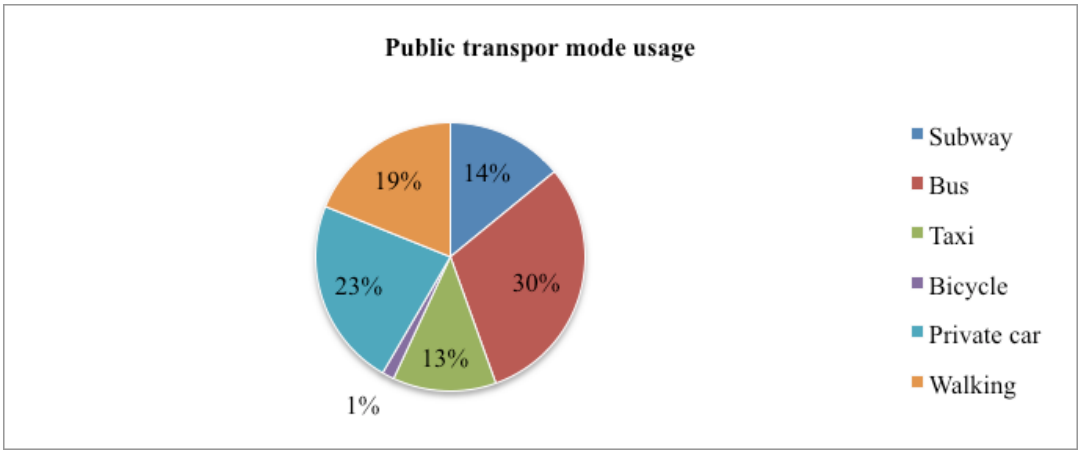
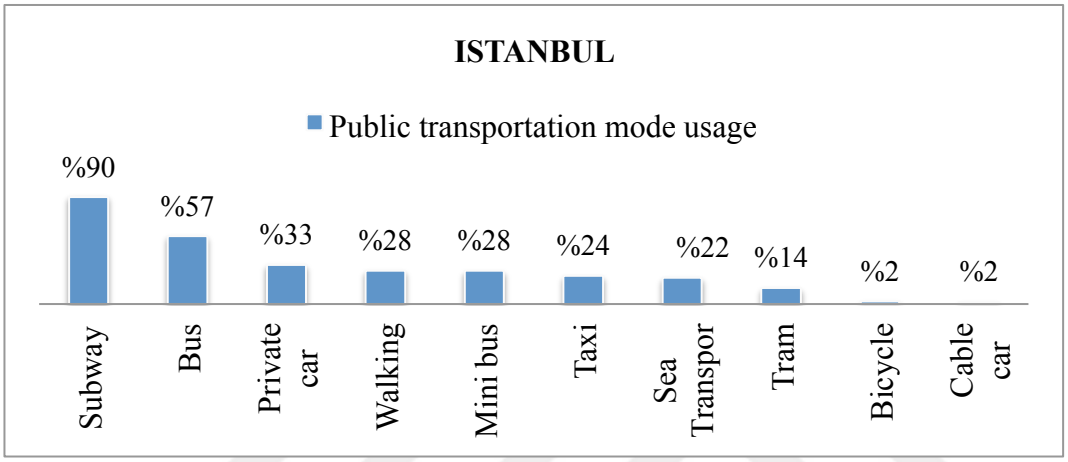


Figure 6.4: Distribution of the transportation modes usage among the 1141 respondents in four cities

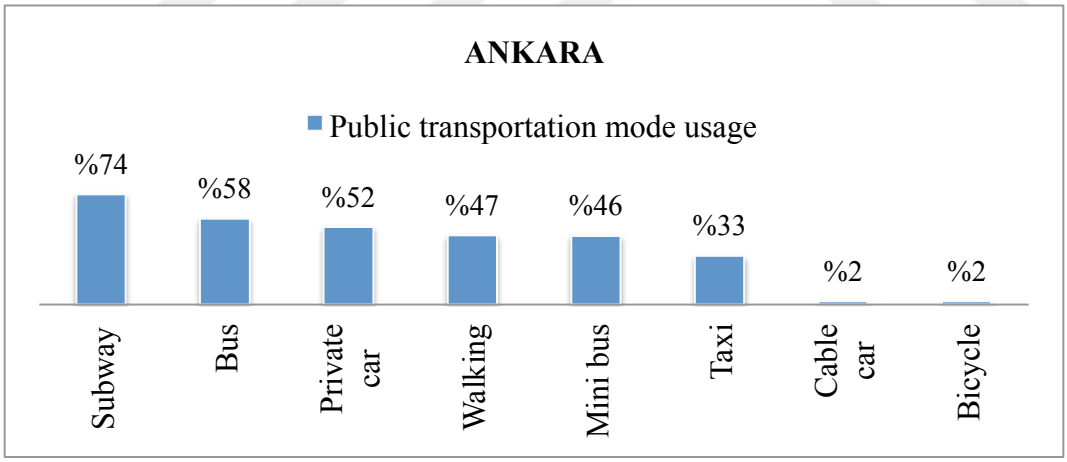
In addition, the distribution of the public transport mode use city-by-city can be seen below.

Table 6.4: Distribution of the transportation modes usage among respondents city-by city

Public transport mode usage

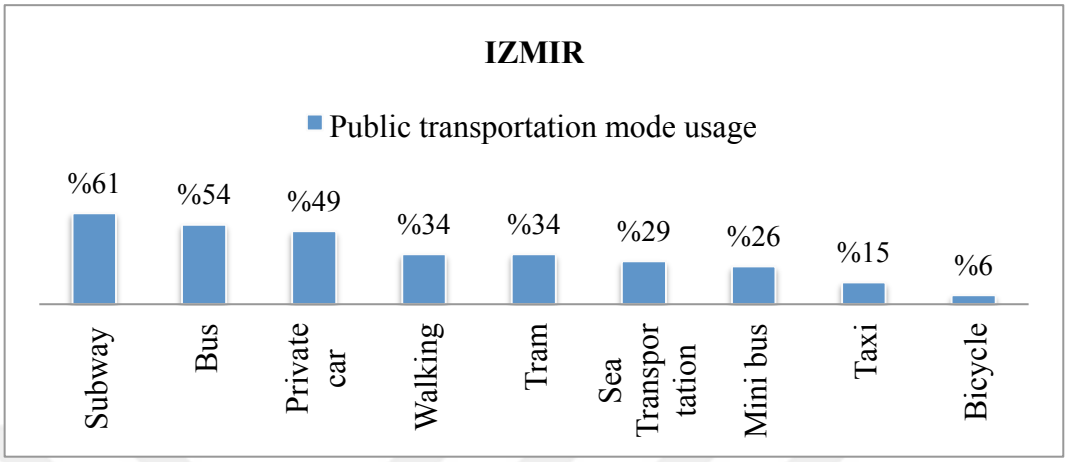


N: 384 respondents in Istanbul

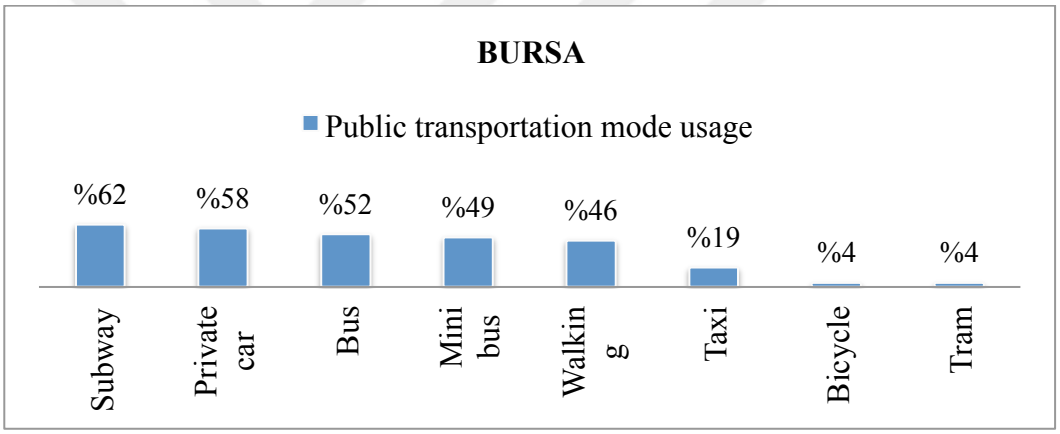


N: 443 respondents in Ankara

Table 6.4 (continued)



N: 149 respondents in Izmir



N: 165 respondents in Bursa

6.1. Smart mobility application awareness and usage

First of all the thesis examines the smart mobility application awareness and usage. According to the application awareness and usage survey results, there are interesting outcomes. It was expected that the awareness ratio would be higher or equal to the usage ratio because one cannot use the application that s/he is not aware of. Nevertheless, according to the survey results, awareness ratio is always lower than the usage ratio.

However, as seen in Figure 6.5 and Figure 6.6 public transportation information application awareness and the usage ratio does not reach up to 60%.

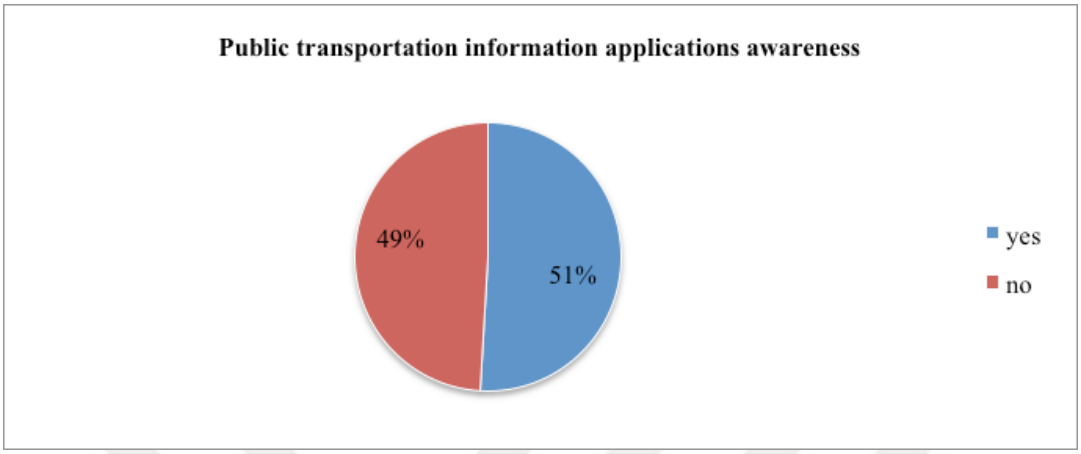


Figure 6.5: Public transportation information applications awareness among the 1141 respondents in four cities

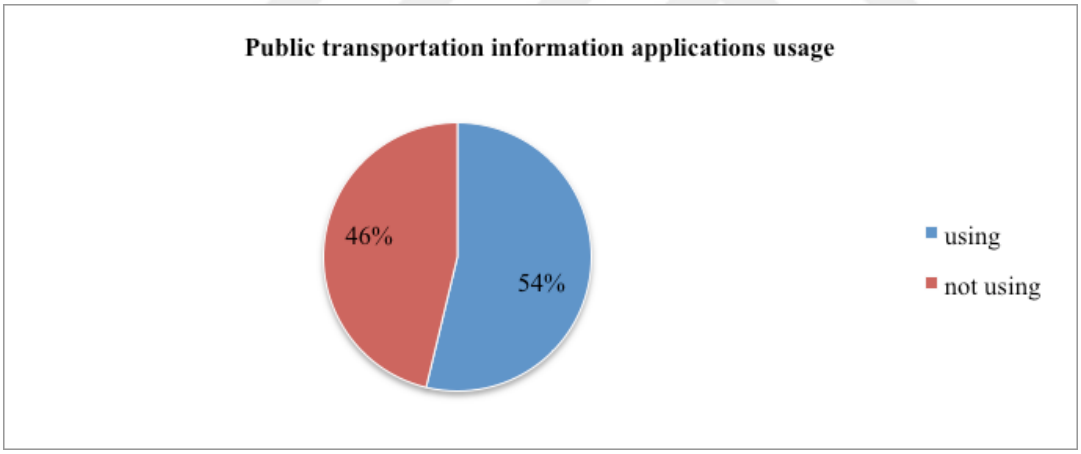


Figure 6.6: Public transportation information applications usage among the 1141 respondents in four cities

Even among the frequent users of public transportation, only 58% of the respondents are aware of the public transportation information applications. Yet, 64% of the respondents are using those applications.

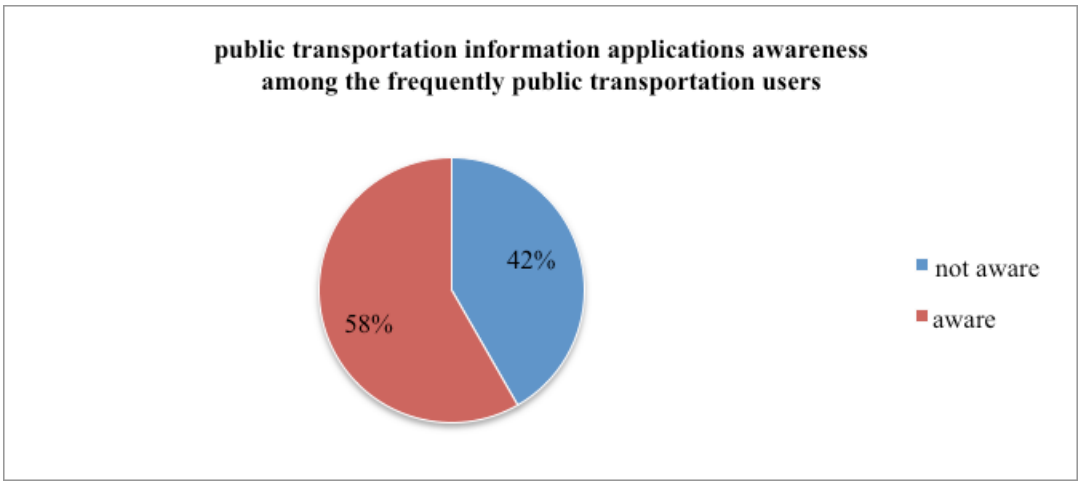


Figure 6.7: Public transportation information application awareness among the frequent users of public transportation among the 1141 respondents in four cities

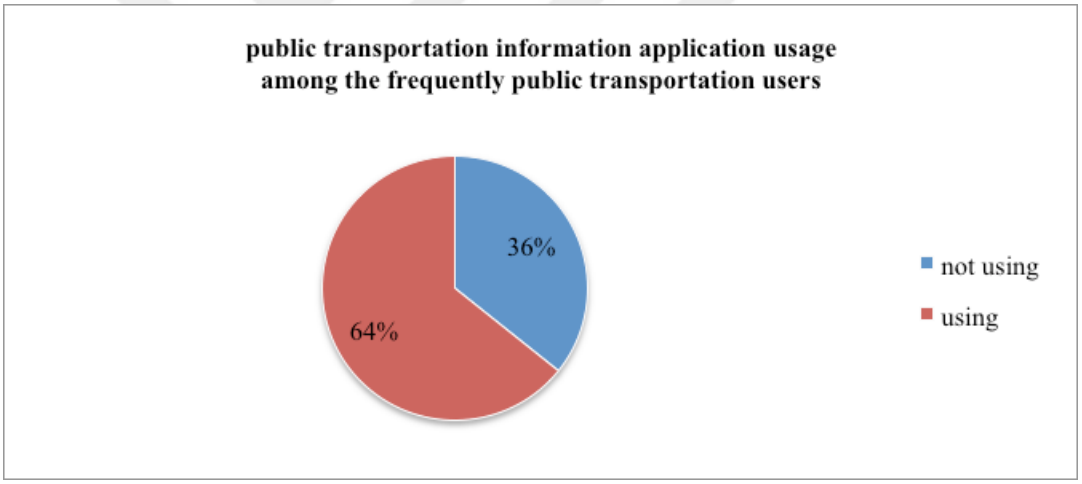


Figure 6.8: Public transportation information application usage among the frequent users of public transportation among the 1141 respondents in four cities

17% of the respondents are aware of the driver information applications and only 23% of the respondents are using those applications.

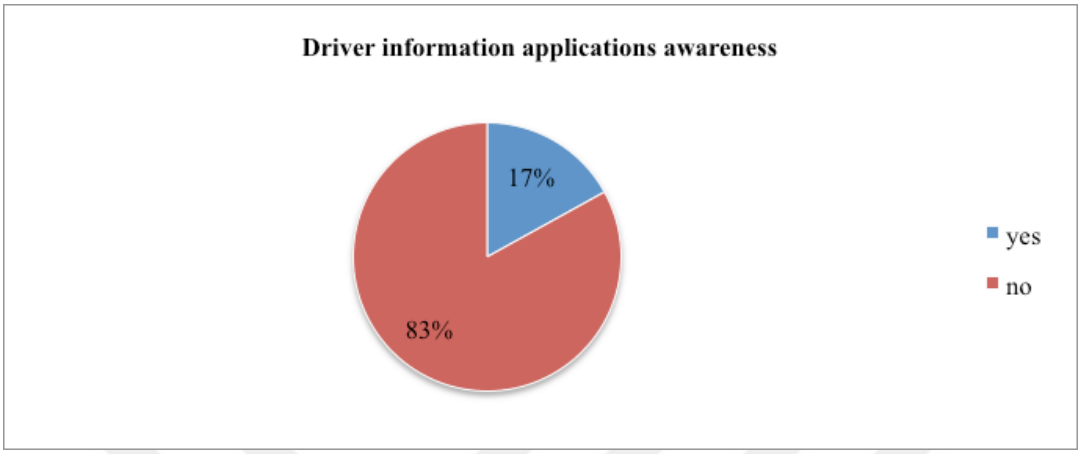


Figure 6.9: Driver information applications awareness among the 1141 respondents in four cities.

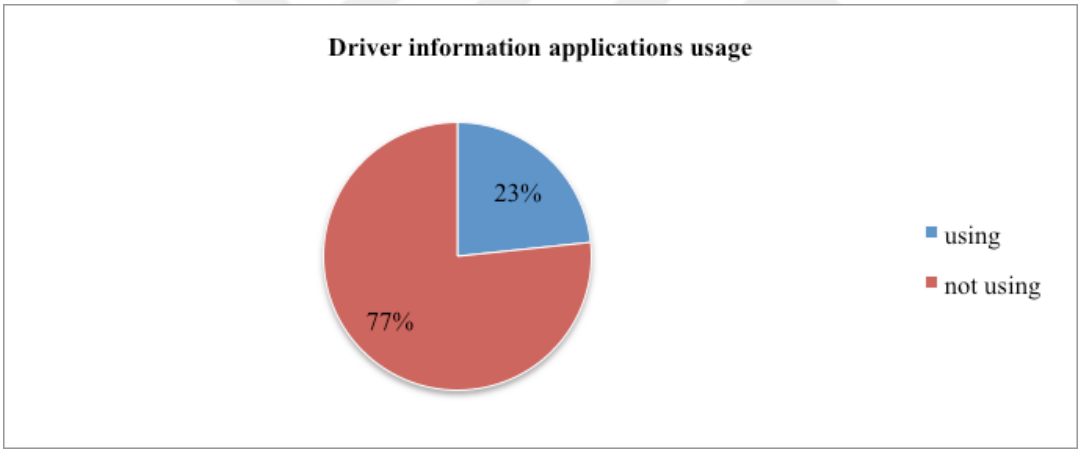


Figure 6.10: Driver information applications usage among the 1141 respondents in four cities

Even among the frequent users of private cars, only 18% of the respondents are aware of the driver information applications and only 23% of them are using those applications.

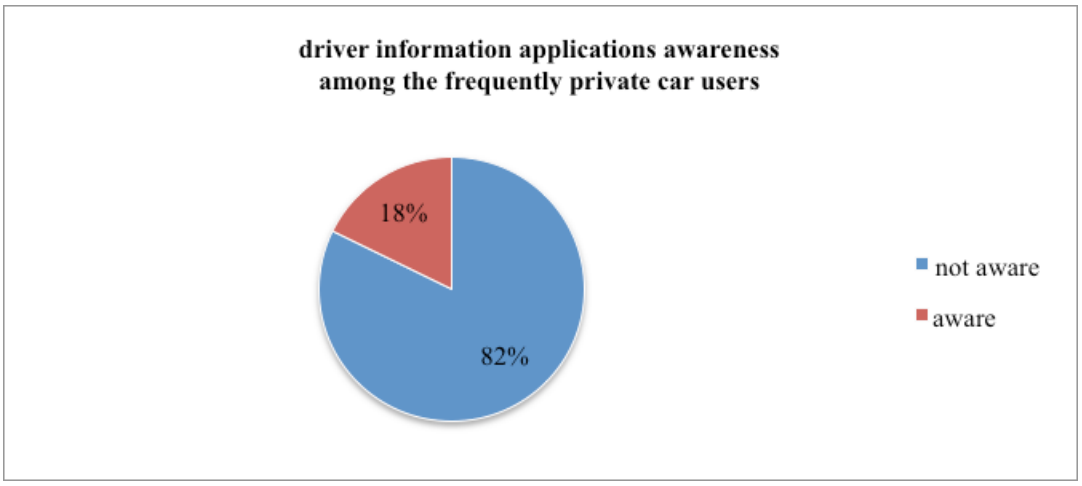


Figure 6.11: Driver information applications awareness among the frequent users of private car among the 1141 respondents in four cities

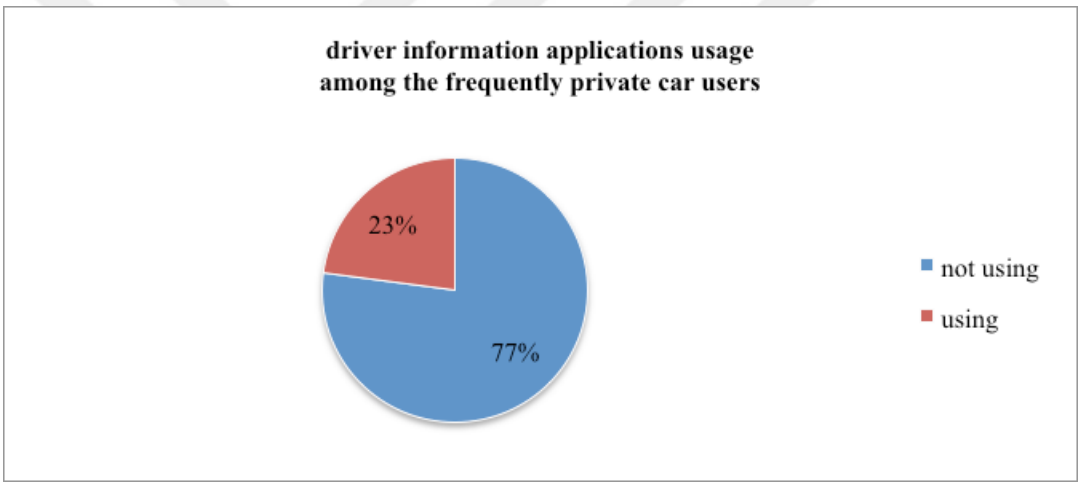


Figure 6.12: Driver information application usage among the frequent users of private car among the 1141 respondents in four cities

The results also show that people are not interested in digital municipality. Only 8% of the respondents are aware of the fact that the municipalities have the mobile application for all the services they provide and only 13% of the respondents are using that application.

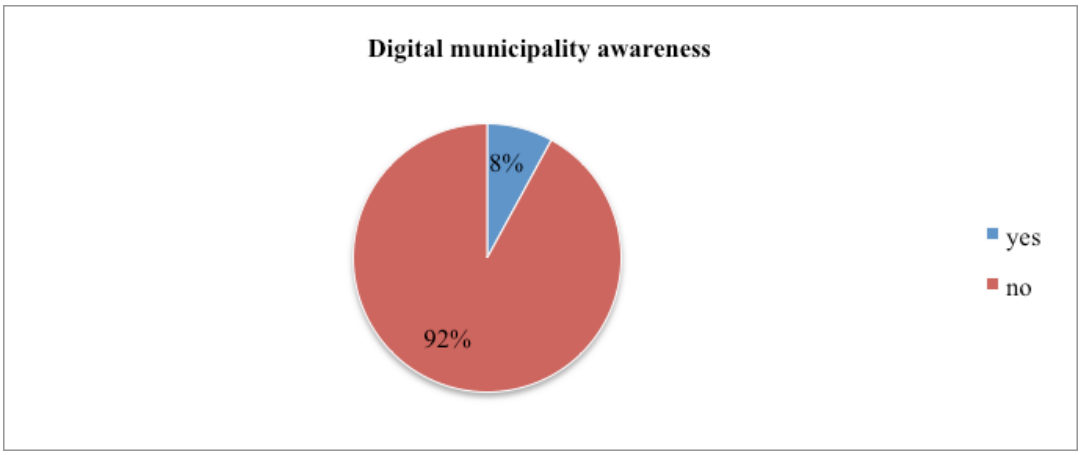


Figure 6.13: Digital municipality awareness among the 1141 respondents in four cities

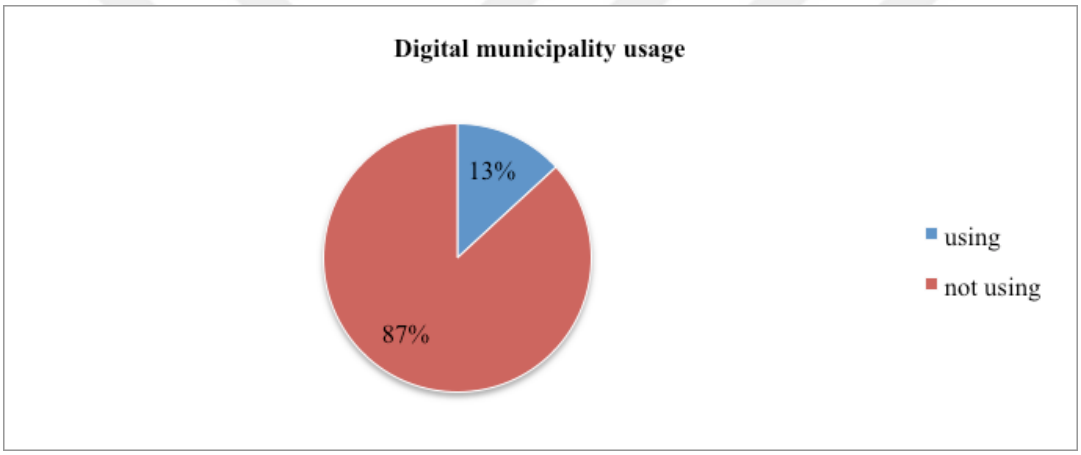
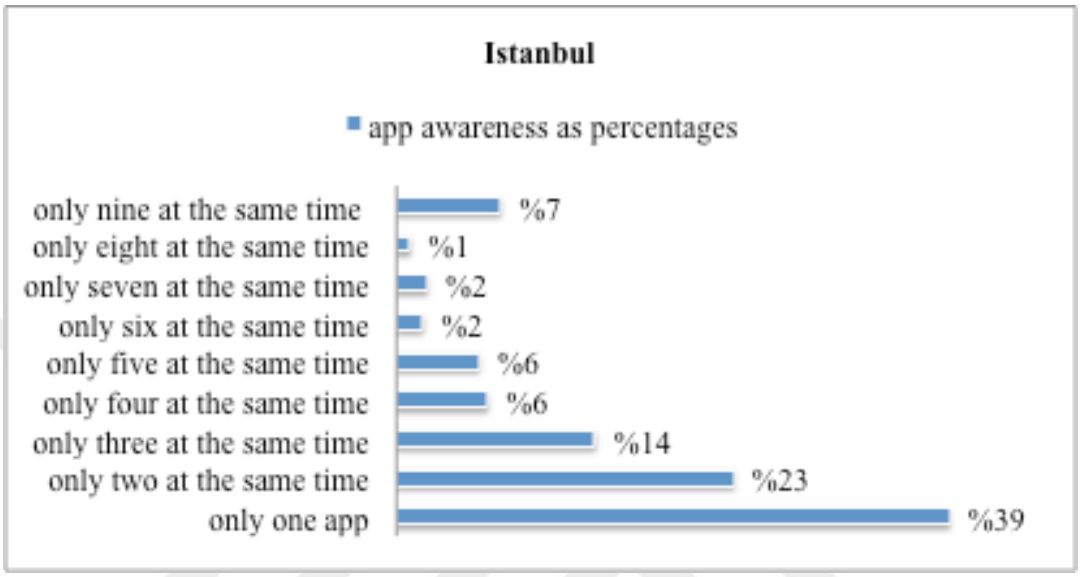


Figure 6.14: Digital municipality usage among the 1141 respondents in four cities

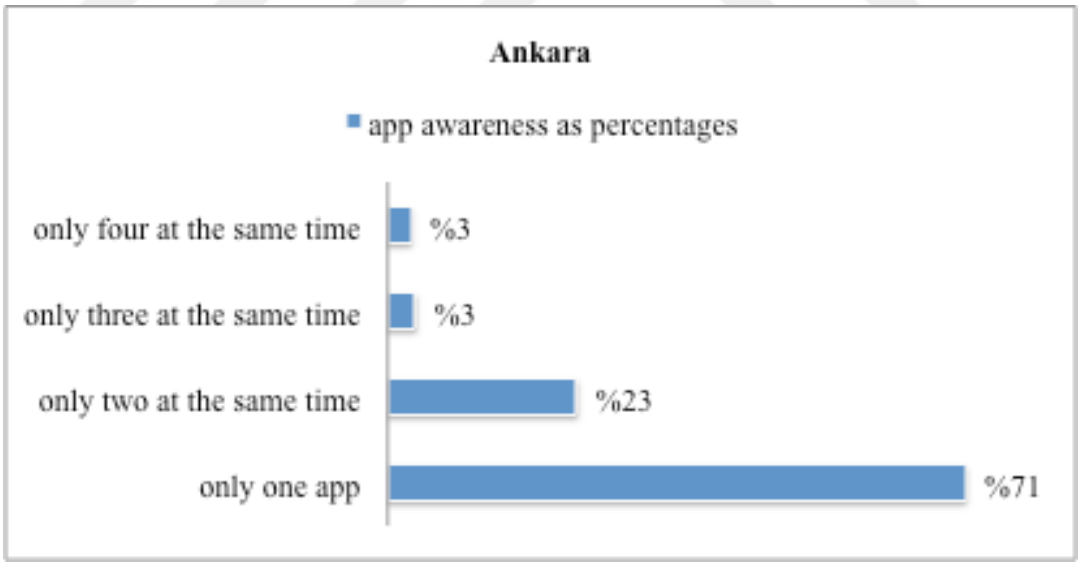
However, when the data is examined in detail, it can be seen that very few are aware of all or most of the existing applications at the same time. Among the smartphone users, the ratio of those who are aware of all the existing applications at the same time in the city they live (enacted by the government) in is 3% in Ankara, 15% in Bursa, %7 in Istanbul and 8% in Izmir.

Table 6.5: Application awareness city-by-city

Application awareness within smart phone users People who knows all the smart mobile applications exists in the city

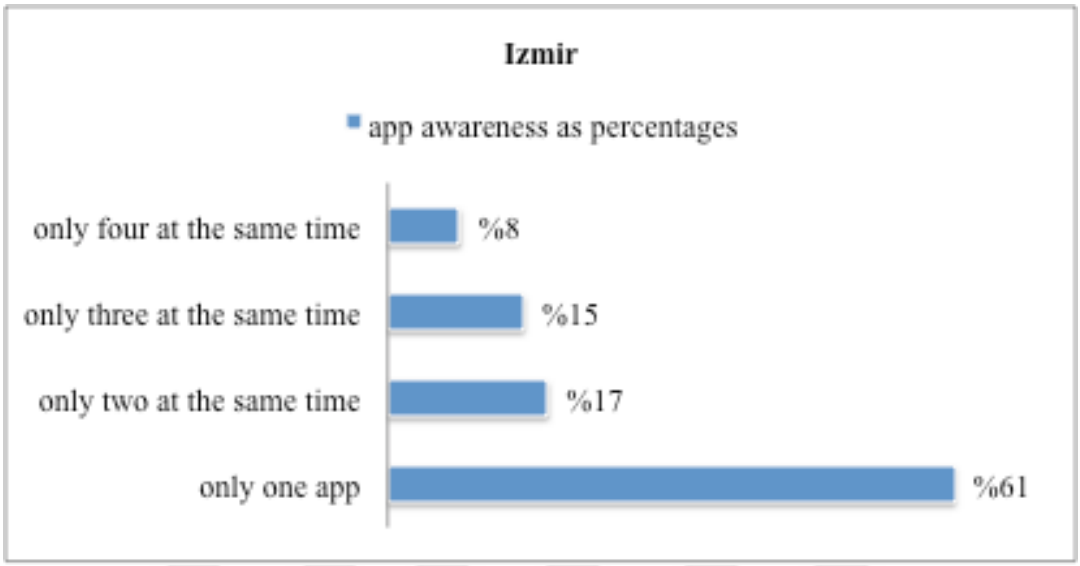


N: 9 mobile applications in total in Istanbul

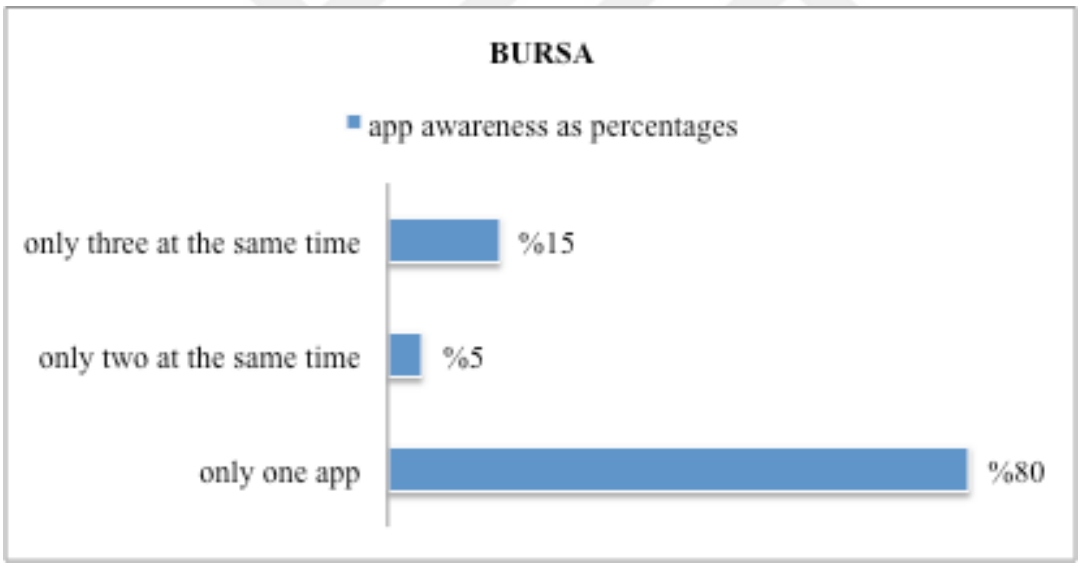


N: 4 mobile applications in total in Ankara

Table 6.5 (continued)



N: 4 mobile applications in total in Izmir



N: 3 mobile applications in total in Bursa

According to the literature, it has been seen that application usage is vital for the smart city applications. However, as also will be seen in chapter 7, application awareness is directly related with the application usage. However, Table 6.6 the cross tabulation of the application awareness and usage relationship showed that

majority of the respondents do not use the smart application as they do not know the application especially in driver information applications and digital municipality.

Table 6.6: Cross tabulation of awareness and usage relationship among the 1141 respondents with city-by city evaluation.

mobile applicaiton awareness and usage crosstabulation city-by-city in percentages		users	four cities selected for the case study		non-users	mobile applicaiton awareness and usage crosstabulation city-by-city in percentages		
Public transportation information applications	awares	45,1	Istanbul	10,1	0,7	5,8	awares	Public transportation information applications
			Ankara	25,7	3,5			
			Izmir	4,6	1,6			
			Bursa	4,7	0,0			
	non-awares	8,7	Istanbul	7,5	15,6	40,4	non-awares	
			Ankara	0,3	9,3			
			Izmir	0,6	6,1			
			Bursa	0,3	9,5			
Driver informaiton applications	awares	11,7	Istanbul	7,1	1,8	5,3	awares	Driver informaiton applications
			Ankara	1,9	1,9			
			Izmir	2,5	1,7			
			Bursa	0,2	0,0			
	non-awares	11,7	Istanbul	8,7	16,4	71,4	non-awares	
			Ankara	0,9	34,1			
			Izmir	1,1	7,7			
			Bursa	1,1	13,2			
Digital municipality (metropolitan municipality mobile applications)	awares	4,7	Istanbul	0,5	0,5	3,3	awares	Digital municipality (metropolitan municipality mobile applications)
			Ankara	0,6	1,2			
			Izmir	2,7	1,5			
			Bursa	0,9	0,0			
	non-awares	8,5	Istanbul	5,6	27,2	83,6	non-awares	
			Ankara	1,2	35,7			
			Izmir	0,9	7,9			
			Bursa	0,8	12,7			
Total respondents 1131 smart phone users								
33,9% from Istanbul								
38,8% from Ankara								
12,9% from Izmir								
14,6% from Bursa								

6.2. Citizen participation in city matters / interaction with government via ICT

As a result of smart government analysis it is seen that all the Municipalities have their own web sites and all the web sites are very good at providing information and well in interaction. However according to the citizen awareness survey the majority of the respondents do not visit Municipal websites although Municipal websites are considered easy and clear among the users (being complicated is not a reason for non-visitors).

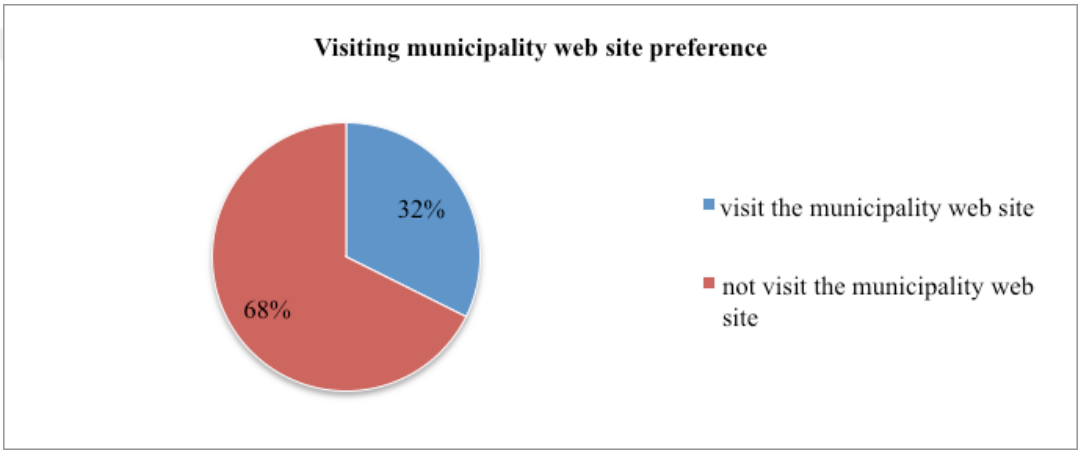


Figure 6.15: Visiting government's web site in percentages among the 1141 respondents in four cities

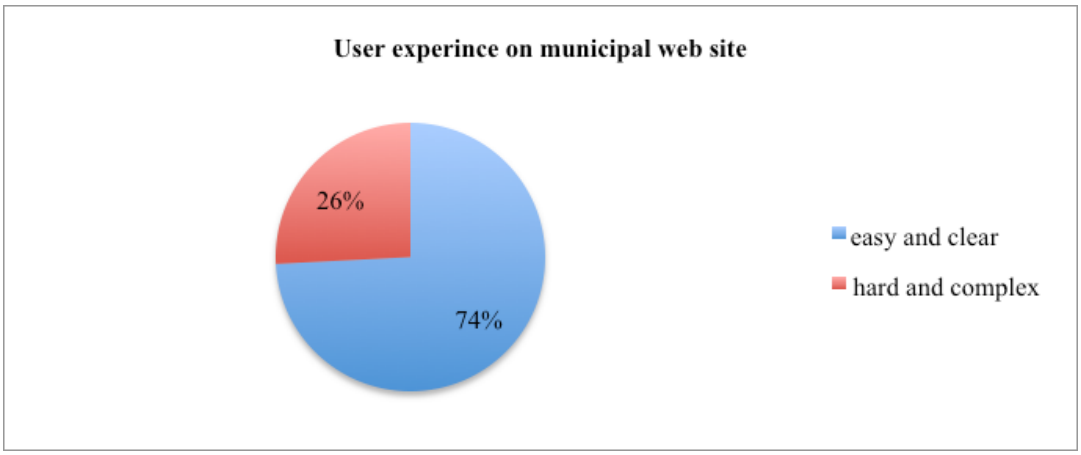


Figure 6.16: User experience on municipal web sites among the 1141 respondents in four cities

All Metropolitan Municipalities have various networks to let citizen contact to get information or deliver their claims or opinions. These networks include e-mail services; call centers, mobile applications and social media links. Also they have special departments, like Mavi Masa in Ankara, Beyaz Masa in Bursa and Istanbul and HİM in Izmir, which have their own e-mail services and call centers and social media accounts in order to receive all kind of claims and opinions.

According to the 'we are social 2020[19]' data, 64% of the population in Turkey are social media users. 94% of the population is using the Internet via smart phones. There are 11.8 million Twitter users in Turkey. Yet, when we look at the follow-up of municipalities on social media, especially on twitter, which the biggest interaction tool, those percentages are very low.

[19] is a global team of more than 850 people in 15 offices across 13 countries, united by a common purpose: to connect people and brands in meaningful ways.

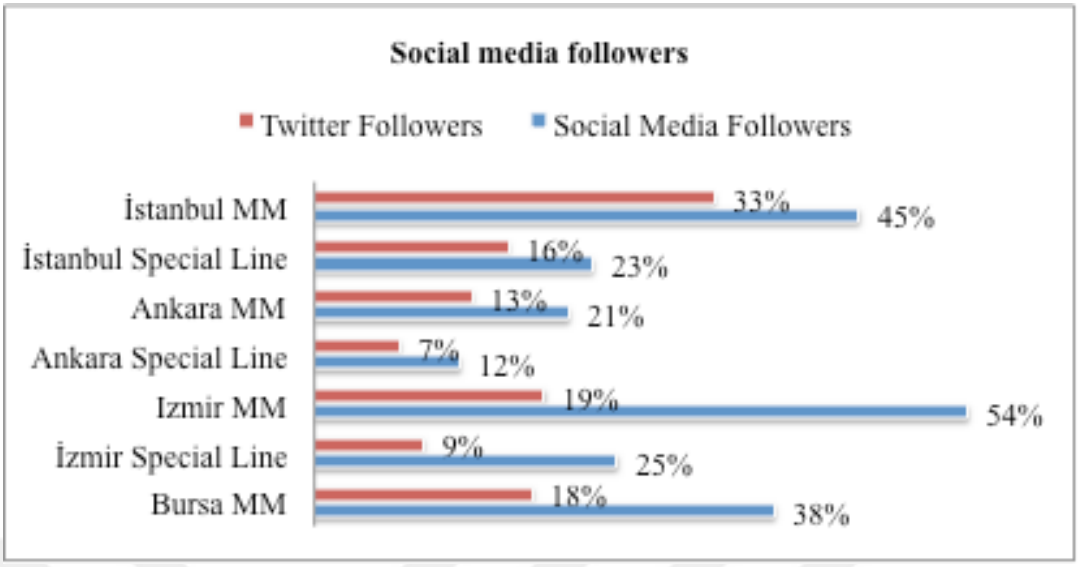


Figure 6.17: Social media followers for the municipalities city-by -city

Also according to the citizen survey majority of the respondents do not prefer to use the interaction tools that are provided for them to share their complaints and suggestions. In other words, they are not taking action in city matters and neither state their complaints or suggestions.

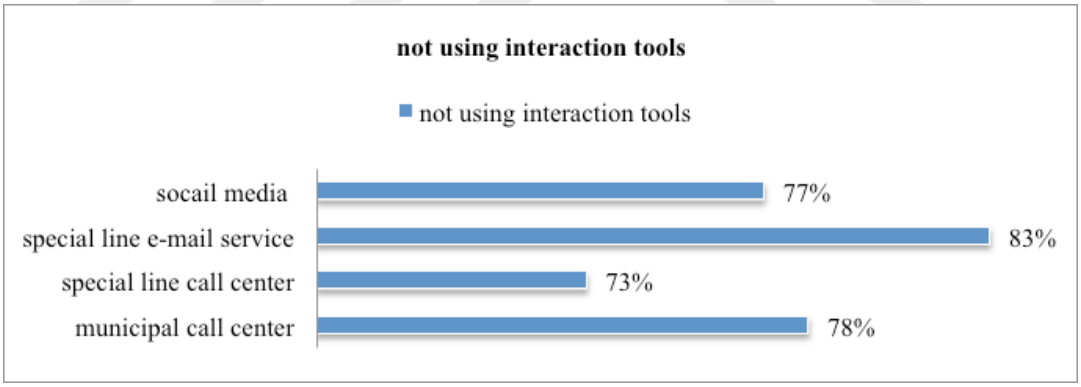


Figure 6.18: Non-use of Municipal interaction tools in percentages among the 1141 respondents in four cities

The results also show that people are not interested in digital municipality as seen in Figure 6.13 and Figure 6.14 with a very low rate of municipal mobile application awareness and usage. They are also not interested in visiting the municipality web pages as shown in Figure 6.15.

6.3. Citizen attitude towards smart mobility modes

Smart city idea is a new challenge to the problems of the 21st century. It is the way of thinking differently for the urban problems such as the congestion problems. Traditional ways of solving the congestion problem was to build up more lanes, but in time the ineffectiveness of this approach was proven and now widely-accepted policies to solve congestion are encouraging the use of public transportation, walking and cycling, as well as discouraging car usage through such measures as parking limitations. However, in the 21st century digital age, cities think transportation differently by asking the questions of "do we need to own cars" or "will cars drive themselves". For a sustainable urban area and obviously also for smart urban area the best way to commute is to walk or bike. However, even though there will be automobiles for long distances, the idea today is zero ownership for all the transportation modes. The new way of commute is to share the commute mode such as car sharing or bike sharing. As a result in a smart city it is important that people are willing to share.

According to the citizen survey almost half of the respondents do not know how to use bicycle. Only 2% of the respondents state that they are using bicycle as their commute mode. 11% do not prefer to use bicycle because of the unfriendly urban environment. 25% percent stated that they would be preferred if all the urban conditions are appropriate for biking.

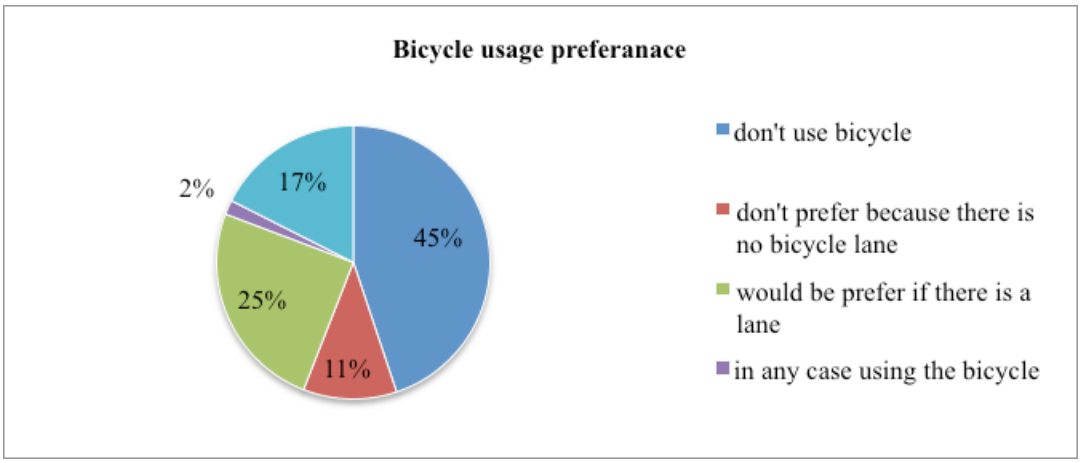


Figure 6.19: Bicycle usage preference among 1141 respondents

50% of the respondents think that car sharing is not safe. 35% found it unnecessary because there is public transportation. 38% do not like the idea of sharing their own car.

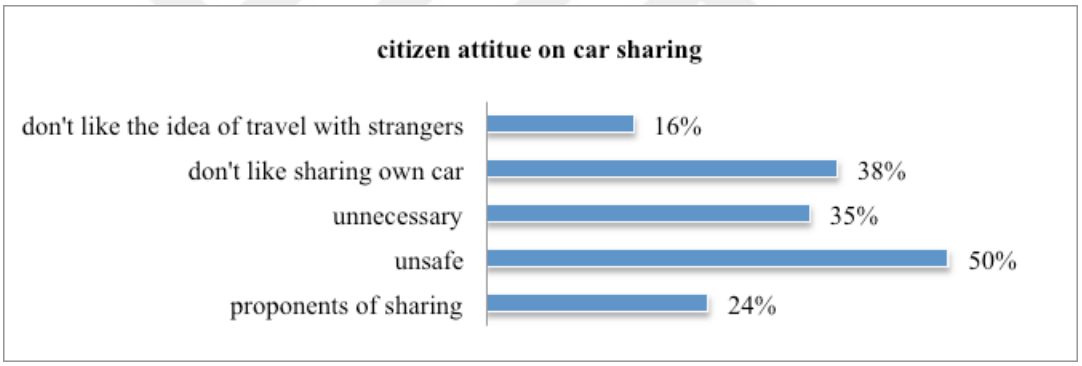


Figure 6.20: Citizen attitude on car sharing among 1141 respondents

As commute sharing or using eco-friendly transportation modes are important for achieving a smart city vision, citizens' positive attitude on those commute modes is a crucial factor. In Turkey, in that aspect there is lot to do.

6.4. Citizen awareness on smart city notion

Smart individuals who need to understand and use smart city technologies are required for continuity of smart cities, as explained in section 2.4. Since smart city products aim to increase the quality of life of individuals, it is very important for

individuals to understand the concept of smart city. Otherwise all this effort will be wasted.

For this reason, in the survey study, citizens were also asked about the concept of smart city. Accordingly, citizens were asked to write if they heard about the smart city concept and if they did, they were asked to write the three components of it. They were also asked about their opinions about whether it is necessary to invest in smart cities.

According to the results, 69% of the respondents either do not know about the smart city concept at all or have wrong knowledge. Among those who have the wrong information, it is seen that in figure 6.26, 75% of the respondents are from the higher education level. Also it is seen that 91% are from the younger age groups who are between 18-45 years of age groups.

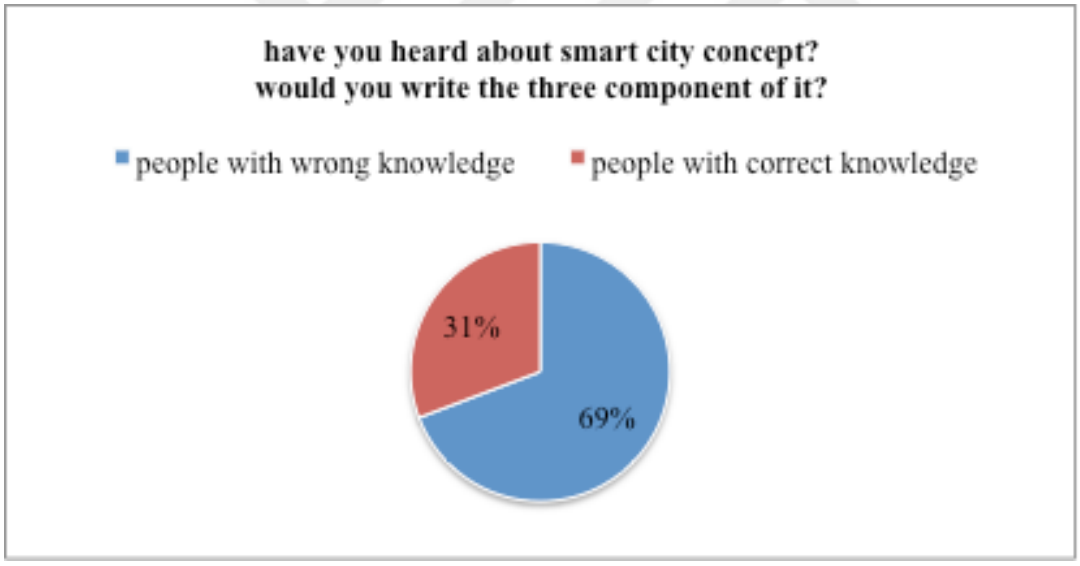


Figure 6.21: People either who do not know about the smart city or have wrong knowledge among 1141 respondents

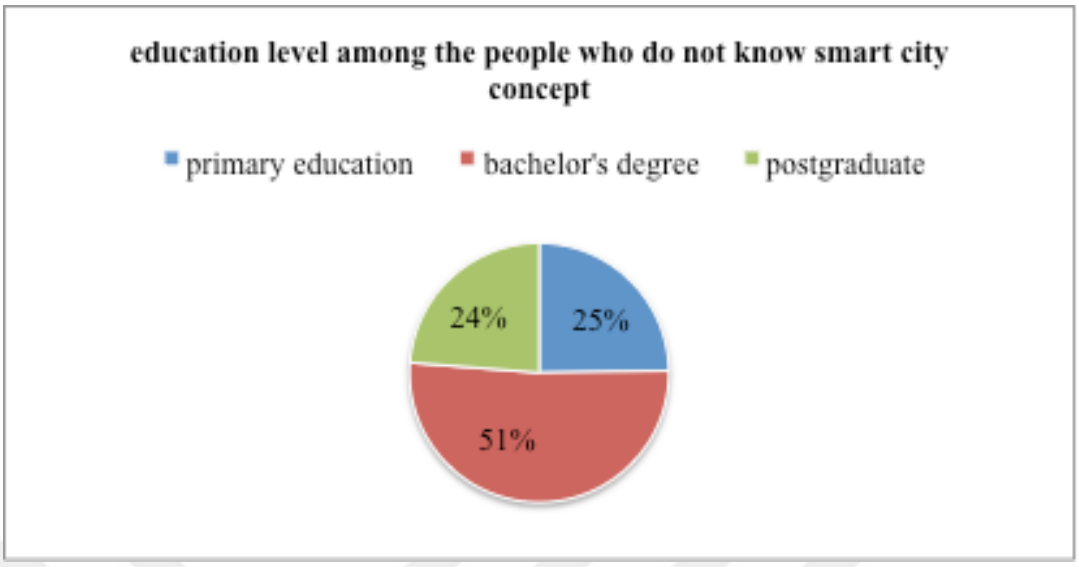


Figure 6.22: Education level among the people who do not know about smart city among 1141 respondents

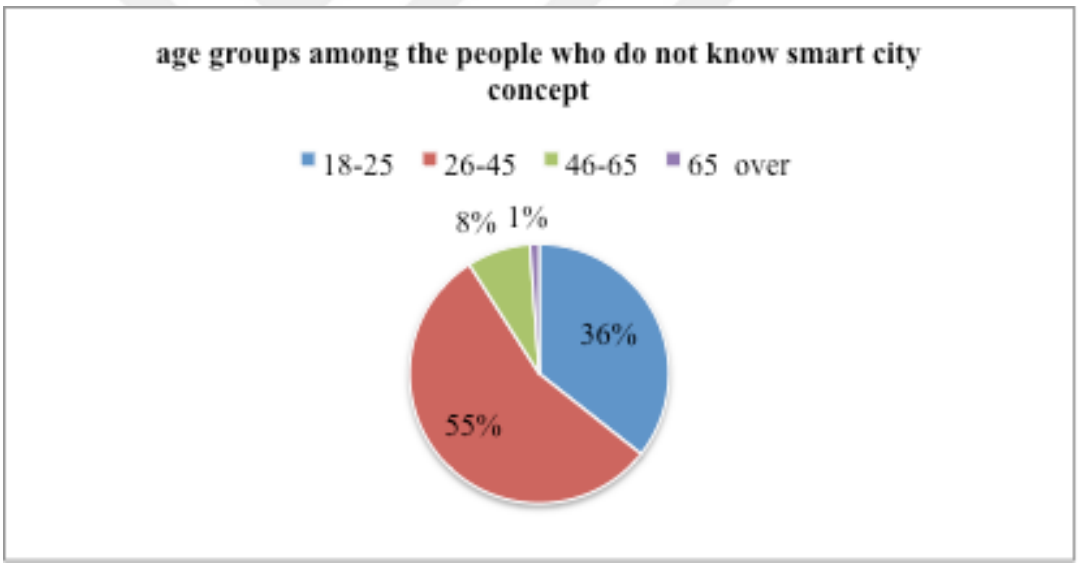


Figure 6.23: Age groups among the people who do not know about smart city among 1141 respondents

However, 90% of the respondents from all cities respond that it is necessary to invest for being a smart city. In other words, this issue has become a popular concept and although individuals do not have much information, we can say that it is commented according to its name and the positive effect it evokes.

CHAPTER 7

IN-DEPTH ANALYSIS OF THE FACTORS EFFECTING THE AWARENESS AND USAGE

In this section, factors affecting citizen awareness and usage are examined according to the citizen survey results. These factors include: the effect of age on smartphone use, the relationship between the existing mobile application awareness and the degree of education and smartphone use, the effect of mobile application awareness on the use of mobile applications, the effect of whether the application is user-friendly or not on the use of mobile application, the effect of whether the Municipalities websites are user-friendly or not on the use of Municipality's web site.

Statistical analysis was conducted via SPSS to understand the relationships between factors that affect the citizen awareness. This part of the study used two kinds of statistical analysis, The Chi Square of Independence and Binary Logistic Regression.

The statistical results, after examining 13 relations or factors for 19 applications, are given below also the detailed SPSS results of in-depth analysis by each relation with the entire table and graphic are presented in the appendices, yet evaluation of the main findings are given in the following section.

7.1. Factors affecting smart mobility mobile applications awareness and usage

As in the case study analysis the only personal questions are about the education level and age, and the factors affecting awareness and usage are mostly related with the education and age.
According to the study results it is seen that public transportation and driver information mobile application awareness seems to be related to education level.

It has been seen that those who have bachelor and postgraduate degree are more likely to be aware of public transportation information mobile application than those who have primary education degree. Also who have bachelor degree are more likely to be aware than the postgraduates.

It has been also seen that those who have bachelor and postgraduate degree more likely to be aware of driver information mobile application than those who have primary education degree. Also, on the contrary of the public transportation information application, postgraduates are more likely to be aware than the people who have bachelor degree.

It is not clear why those with a postgraduate degree are less likely to be aware of the application compared to those with a bachelor degree. It may be argued that those with a postgraduate degree correspond to relatively older and possibly relatively wealthier citizens, who do not use public transport, but use their own cars, and hence have no interest in, and awareness about, public transport related applications but have more interest in driver information related applications.

According to the study results it is seen that application awareness for all kind of mobile application seems to vary from age to age.

It seems that people who are between 26-45 and 46-65 years old are less likely to be aware of public transportation information mobile applications than those who

are between 18-25 years old. Also 46-65 years old are less likely to be aware than the 26-45.

We may assume that those who are between 18-25 are most probably the students and use public transportation more than those who are 26-45 and 46-65. And 26-45 year of age groups are relatively younger and more prefer to use public transportation that the 46-65 years of age groups. As a result they are more likely to be aware of the public transportation related applications.

To support this assumption above, the study resulted that people who are between 26-45 and 46-65 years old are more likely to be aware of driver information mobile application than those who are between 18-25 years old. And 46-65 years of age groups are more likely to be aware than the 26-45 years of age groups. This is clearly related with increasing car ownership and usage parallel to age. In other words, those between the ages of 18 and 45 may be less likely to be driving their cars, and hence lower level of awareness regarding these applications.

The study conducted that public and driver information mobile applications usage seems to be related to education level.

It has been concluded that those who have bachelor degree are more likely to use public transportation information mobile application than those who have primary education degree. But postgraduate degree is not significant for the public information mobile applications, probably the same reason explained for the awareness that they are the people who prefer to use private cars as even they know the public transport related applications the do not use it as they do not need it.

However, those who have bachelor degree and those who have primary education degree are more likely to use driver information mobile application then those who have bachelor and postgraduate degree.

Those applications used in the study are the applications produced with the municipalities. However, there is lots of driver information application produced by companies such as Google map, Maps by Apple, Moovit, Trafi and such. Here

we may assume that people who have higher education level are prefer to use those application as they aware of those applications and know the difference as a user where people who have lower education level either do not aware of those private applications and consequently do not use them, or they more likely to be fond of the government and prefer to use their applications.

In the citizen survey conducted as a scope of the study, citizens were asked to write the driver information application they use. The results are support the assumption that we did above. According to the result only 12% of the respondents named the private driver information applications and 99% of them are have either bachelor degree of post graduate degree.

According to the study results only public transportation information mobile application usage seems to be related to age. It seems that people who are between 26-45 and 46-65 years old are less likely to use public transportation information applications mobile application than those who are between 18-25 years old. Which is the most expected result after mobile application awareness relation with the age as seen in question 2. People who are in 18-25 years old are most probably the students and they are both aware the public transportation information applications and use it as they uses public transportation more than the other age groups.

Furthermore**,** public transportation information mobile application awareness seems to be affected from people's public transportation usage frequency. We can say that, those who are using public transportation 5-7 days a week and few times a week are much more likely to be aware of public transportation information mobile application.

Also, Public transportation information mobile application usage seems to be affected from people's public transportation usage frequency. We can say that, those who are using public transportation 5-7 times and several times in a week are much more likely to use public transportation information applications mobile application.

7.2. Factors affecting active citizenship attitude

There is no real evidence that digital municipality awareness is related with the education level.

It seems that people who are between 46-65 years old are more likely to be aware of digital municipality than those who are between 18-25 years old. Here, it can be assumed that people who are in old age are more likely to interested in city matters and the city officials.

However, there is an interesting result, which is that those who have who have primary education degree are more likely to use digital municipality than those who have bachelor and postgraduate degree.

As a citizen in a smart city it can be expected that while the education level increases interest of the city matters and participation in governance should increase too. However, it seems that while the education level increases people do not prefer to act as an active citizenship. In addition to the digital municipality as a mobile application we have the same results for the municipal web sites. It has been concluded that those who have primary education degree. Are more likely to visit municipality web site than those who have bachelor and postgraduate degree.

However, there is no real evidence that driver information mobile application and digital municipality usage have a relation with the age group. On the other hand municipality web site visiting preference seems to be related to age and it seems that people who are between 46-65 years old are more likely to visit municipality web site than those who are between 18-25 years old. We may say that people who are relatively older have more interest in municipal activities and are prepared to dedicate more time to visit the municipal web site.

As we have mentioned before all metropolitan municipalities have their own interaction tools for citizens to contact them.

The study has shown that those who have bachelor's degree and primary education are more likely to use interaction tools than those who have postgraduate degree. Here we again see the same result with question 3 that as the education level increases, interest in city matters decreases.

It seems that people who are between 46-65 years old are more likely to use special line e-mail service interaction tool than those who are between 18-25 years old. So people, who are from older age groups, are more likely to be interested in municipalities' work and to act as active citizens by using interaction tools.

7.3. Other factors affecting awareness and usage

It has been concluded that people who are aware of mobile applications are more likely to use the application. Survival of the smart city idea depends on the usage of the application it produces as we concluded in the literature. As usage is directly related with the awareness, then cities should act to increase the awareness on citizens.

User friendliness is important as the awareness. We can say that, those who find public transportation information mobile application easy to use are more likely to use public transportation and driver information mobile application, respectively than the people who find mobile application difficult to use.

However, there is no real evidence that use-friendliness have a relation with the digital municipality usage. So we may say that being an active citizenship have its own factors. But, metropolitan municipality web site visiting preference seems to be very much related to municipality web site user friendliness. We can say that, those who find web site easy to use are more likely to visit metropolitan municipality web site than the people who find it difficult to use.

Table 7.1: Comparison table

Applications		Education level			Age group			
		Primary	Bachelor	Postgraduate	18-25	26-45	46-65	65 over
Application awareness	Public transport infor.	3	1	2	1	2	3	0
	Driver information	3	2	1	3	2	1	0
	Digital municipality	0	0	0	2	0	1	0
Application usage	Public transport infor.	2	1	0	1	2	3	0
	Driver information	1	2	3	0	0	0	0
	Digital municipality	1	2	3	0	0	0	0
	Municipality web site	1	2	3	1	0	2	0
Municipality interaction tools usage	Municipality call center	1	2	3	0	0	0	0
	Special line call center	1	2	3	0	0	0	0
	Special line e-mail	1	2	3	1	0	2	0
	Social media	1	2	3	0	0	0	0

0: There is no significant relationship

1: More likely to be related

3: Less likely to be related

As a summary, according to the results, there is an inverse correlation between mobile application awareness and usage in terms of the education level. Mobile application awareness increases while the education level increases, yet the usage decreases. Having an action in city matters by using the municipalities' interaction tools also decreases while the education level increases.

Table 7.2: Awareness effect on usage (Rel.1)

	Awareness on usage	User friendliness on usage
Public transport information	Positive	Positive
Driver information	Positive	Positive
Digital municipality	Positive	None

However, there is a positive relationship between awareness and the usage of the mobile applications. People who are aware of the application are more likely to be using those applications. The user-friendliness of the mobile application also has a positive effect on using the application.

Table 7.3: Awareness effect on usage (Rel. 2)

	Awareness	Usage
5-7 days a week	1	1
Few times a week	2	2
Few times a month	3	3
Few times a year	4	4
0: There is no significant relationship		
1: More likely to be related		
4: Less likely to be related		

In addition, people are using the applications, which are useful for them. For example: frequent users of public transportation are more likely to use the public transportation information applications.

CHAPTER 8

CONCLUSION

Smart city is a very comprehensive and complex subject in which technological developments interconnect with sustainability. The concept of the smart city, which is seen in economic, environmental and social fields, is a concept that must be creative and open to innovation in order to ensure its sustainability. The smart city concept, which develops in direct proportion with technology, aims to reduce resource consumption in all areas with the information communication technologies and applications it produces. It aims to support and contribute to citizens' lives economically and socially by saving time and energy with technological applications such as automatic meter reading systems used in electricity and water consumption, automatic lighting systems used in the streets, public transport tracking systems produced for users, security camera systems, traffic management centers, city guide, health practices such as patient tracking systems and web browsing systems used to access information. As we cannot stop the advancement of technology, we do not stop the efforts of cities to be smart.

However, the important point for the sustainability of the smart cities is an effort to find out the factors affecting the success of the smart city practices. This thesis study aims to find out the vital components and approaches that will enable smart city applications to be effective and successful.

8.1. Summary of the literature survey

As a result of the extensive literature review carried out in this study, it has been observed that this is not only a matter of producing technology, but also the problem of adaptation of individuals to technology. Tools produced by rapidly

advancing information and communication technologies left individuals alone with technology dumpster. In cities where there are individuals who do not understand how they can benefit from existing smart city applications or who are not aware of existing practices, or even although being aware, who do not prefer to use it, achieving smart standards and being a smart city will remain only as an effort.

This thesis study, first of all, clarifies the context of the smart city, how it emerged and how it evolved. After examining all the different smart city typologies and definitions, which have occurred since its existence, it has been discussed that smart city idea cannot have one single definition as it has a very wide range of scope from technology to citizenship, from cloud systems to governance, from economy to environment. Smart city idea was named with lots of different terms like wired city, digital city, intelligent city and such, as described in Chapter 2. The main reason of why there are lots of terminologies to describe the smart city is that, every profession has its own description and perspective about smart city idea even though the main idea is that smart city uses ICT, namely, cloud systems, internet of things, wireless systems, etc. However, we may conclude that even the 'smart' label could change one day according to the cities need.

While researching about the smart city, it was obvious that the definition is not the main matter. The important thing is the characteristics of the smart city idea and what it consists of. The smart city idea, as described in section 2.5 has six characteristics, which are smart economy, smart environment, smart governance, smart mobility, smart people and smart living. Smart environment and smart economy were not included because of the scope of this study. Smart people, smart governance and smart mobility on the other hand are very much related with each other and form the thesis. Smart living is achieved when all the other five characters are achieved. Consequently, it is not directly included in the research.

This study, after a vast literature research, concluded that the smart people are the key characteristics for the smart city idea. Because the concept 'smart' is built on the survival of the human being and creating livable urban environments for the

human being. After examining several smart city attempts and practices in various cities such as Amsterdam, Genoa, Barcelona, London, Helsinki, South Korea as explained in section 2.4, the thesis concluded that unless there is an aware, active citizen in a smart city, it is almost impossible to achieve successful smart city implementation. As a result, the first thing that the thesis highlighted and re-defined is that smart people are crucial for smart cities and they are the people who are aware about the smart city concept and applications, willing to use smart applications and enthusiastic about participating and being active citizens for the city matters by collaborating with the authorities.

Smart cities mean smart applications. There are lots of smart city solutions regarding waste management, security, water, administrative works, and transportation or energy management. However, the most citizen centric smart city solutions are the ones produced for the smart mobility. While the other applications do not require an active citizen use, the smart mobility applications require an active citizen use. The main purpose of smart mobility applications is to promote smarter and sustainable modes of transport, to provide ease of transport to users, to help reduce the commute time by providing various driver and public transportation information applications, to minimize traffic and energy use by providing car parking applications, or to limit private car usage by providing car sharing applications. These applications will not survive unless individuals use them.

While smart mobility directly affects environmental and economical matters in the city, its main tools in doing so are ICT and IoT, namely all the advanced and smart technologies. Hence, it is the second important characteristics of the smart city concept. As a result the thesis uses smart mobility mobile applications in order to both measure the citizen awareness and technology capability of Turkey as a case study.

After all these features the thesis examined the governance of smart city, as it was seen that without government approval there is very little chance for a smart

application, let alone the smart city concept, to survive. The literature study, which reveals top-down or bottom-up management styles, with many studies arguing the benefits of either the former or the latter, showed that neither can be applied on its own to the concept of smart city, and that there should be multiple partnerships in smart city governance. Partnership models developed accordingly advocate that, in the first place, there should be the cooperation of governance, industry and university (triple-helix model). Then, as a result of the studies carried out, which believed that this cooperation was not sufficient, it became clear, that citizen as a user in this collaboration was crucial (quadruple-helix model).

According to the quadruple-helix model, the user can be defined in many ways. The user may be, for example, a leading user. Such users are composed of individuals who experience the needs before anyone else and produce solutions and know how to use ICT technologies. Or the user can be a consumer user. Such users are individuals who buy the latest technological products and use them with the least capacity. The user can also be a non-user. These users, who do not prefer to use even if they are aware of the technology, are the most dangerous form of user for the sustainability of the smart city.

If we reexamine the quadruple-helix model according to user types, the leading user may be someone from the university or industry. The consumer user can even be from the management because when we leave our professions aside, we are all consumers. Non-user can still be anyone. The children of the administrators in Silicon Valley go to schools without technology. Many university professors refuse to use smartphones or download any external applications, even when using them. However, since the basis of the smart city concept is the use of the technologies produced, 'user' is vital for the smart city concept, regardless of whoever it is.

Accordingly, this thesis proposed a new triple helix model that consists of government as smart governance for the sustainability of smart cities (because there can be no such macro transformation other than state approval), technology capability (because technology is the reason for the emergence of the smart city

concept) as ICT capability and the user as smart people (because all the effort is for the individuals) cooperation.

Technology capability is all the smart technologies that a city has with the strategy and action plans for the legislations, as smart city attempt is a macro level-planning problem and requires governmental approval. Within the scope of the thesis, besides the legislations it is mainly about having the ITS as a smart technology as the thesis deals with the smart mobility applications. As a result, technology capability refers to all the legislations about smart city practices as well as the technology and smart mobility practices in Turkey as a country.

Besides, the thesis re-defines the smart governance and the smart people concepts. According to the literature smart governance is only about the public and social services such as share of children in day care or satisfaction with quality of schools, city representatives per resident, share of female city representatives and etc. Also smart governance is evaluated in the literature with the e-government tools such as web sites of the authorities as it is about using the ICT, which encourages citizen to communicate and participate as it provides easy access to the government. However, according to the result of the citizen survey that the thesis conducted, as will be seen in section 5.2 and 6.3, providing ICT tools such as call centers, e-mail and social media accounts for citizens to communicate with the government, is not enough to encourage the citizens to be active and to achieve smart governance goals, unless the authorities respond to those tools properly and are enthusiastic about producing solutions. It is vital for the smart governance that authorities respond to these actions and attempt at having collaboration with the citizen. As a result, the thesis concluded that the maturity of the government is crucial factor for the smart governance. So the thesis defines the smart governance as, first of all, technologically capable and mature about the smart actions. Maturity here refers to, within the scope of the thesis, being responsive, active and interactive with the city and the citizen actions.

For the smart people evaluation the thesis argues that smart people indicators, defined in the literature, needs to be re-evaluated as they are all about having social rights and democracy, and related with level of education qualification, cosmopolitanism/open-mindedness, foreign language skills, book loans per resident, perception of getting a new job, share of people working in creative industries, attitude towards immigration and etc.

However, in this study, as seen in various examples, such as Amsterdam, Genoa, Helsinki, London, Barcelona as described in section 2.4, we learned that for a successful smart city awareness and usage attitute of the people is the key factor for the success of the smart applications, respectively to define smart people.

In addition, the thesis evaluates smart people as the people who take action, at least, in micro level urban design developments as in statement of the Paskaleva (2011) that smart city needs people who are active, dedicated and view their city as their own project not only for acting as a user but also identifying needs and developing solutions as seen in the "crappy curb" example described in section 2.10. As a result, the thesis also defines smart people as active citizens who are taking action in city matters, physically, although in the literature it is not considered as this. The thesis evaluates the active citizenship by using interaction tools that exist in the selected cities in Turkey.

According to the new triple helix model the thesis conducted three different analysis. Accordingly, four selected cities from Turkey were examined in terms of smart technologies capability and awareness, smart governance capability and maturity (as technologically capable and mature enough to respond to the citizen actions and willing to collaborate with them in city matters) and smart people (as aware, willing to use smart applications and active citizens).

As a method and data collection, first of all to investigate the smart technologies capability and awareness as mentioned in section 3.6, a vast inquiry has been held to find out all the legislations, policies and implementations about the smart city actions with the ITS capability as capability of producing the technology.

Then, for the smart governance capability and maturity analysis first of all e-government practices were examined as according to the literature, smart governance includes the online services offered by the state to citizens under the title of ‘e-government’. Consequently, while examining smart governance capability the metropolitan municipalities and district municipal websites of selected cities were examined one by one, according to the McMillan interaction model.

Furthermore as it is mentioned above, maturity of the governance was as important as having the smart technology. As a result, in addition to the e-government analysis, interviews with metropolitan municipalities were conducted to reveal the government's attitude towards the concept of smart city. In addition, citizen survey also included questions to determine the government’s attitude toward citizen’s smart actions.

Finally for the smart people analysis a citizen survey was conducted to discover the citizen's awareness and attitude towards smart city technologies. As mentioned above, smart mobility is one of the six characteristics of the smart city concept and it directly affects individuals' daily lives positively. Mobile applications accessible for the citizens to reduce the commute time were used as a tool to measure the citizen awareness over technology. Thus, the survey asked the citizen whether they were aware of the smart applications that were designed and produced for them and whether they were using those smart applications or not, and why/why not.

Aware citizenship does not only mean using the tech applications. As mentioned before, a smart citizen is the citizen who sees the city as his/her own project. As a result, taking an action and collaborating with the city officials is also crucial for being a smart citizen. Hence, the survey also measured citizens' approach to communicating with the government.

Furthermore as understood from the title the main scope of the thesis was to find out the most effective way of applying the “smart” to the city. As a result to determine the factors affecting awareness and usage of the smart applications as

well as the participation of the citizens was important for the scope of the thesis. Hence, some statistical analyses were conducted to examine the factors affecting awareness, usage and participation.

All the results were given in detail in Chapters 4, 5, 6 and 7. In addition to those detailed results, the next section also makes a critical evaluation of the main findings.

8.2. Main findings and discussion

According to three analyses mentioned above, main findings of the study can be listed as follows:

8.2.1. Smart technologies capability and awareness

As we have seen in Chapter 4, the Turkish government has been referring to smart cities and smart city solutions since the early 2000s. Number of goals, targets and actions for the use of smart systems are mainly found in the transport sector prepared by various public authorities. They mostly aim to produce applications to manage transportation demand by using ICT and establish and disseminate and effectively use urban traffic management systems to contribute to safety and energy efficiency. National Intelligent Transportation Systems Strategy Document 2014-2023 was published in 2014 by giving importance and priority to the improvement of traffic safety in all modes of transport, protection of existing infrastructure and efficient use of information and communication technologies at the highest level have been determined as smart transportation strategies.

However when examined in detail all those action plans are only to say that ‘we are, as a country, in it’. They just include recommendations and possible actions through such quotes, as ‘this will be done’. However, the municipalities survey conducted with 40 municipalities in 2013 concluded that there was no widely used

smart city application other than transportation and public transportation, emergency response and disaster services, and air quality monitoring; and that there were very few projects in areas such as smart water, energy and buildings. The first master plan for the smart cities started in 2016, in Istanbul under the title of Istanbul Smart City Master Plan, which is 4 years before, but today majority of the metropolitan municipalities in Turkey, as explained in section 4.5, take action to have smart applications in order to make their city smart. They are making cooperation with tech companies, like Vodafone, Turkcell, and Huawei to have the required smart technologies.

However, at the end, for the first time, a strategy and action plan only for the smart city studies was published at the end of 2019 as National Smart Cities Strategies and Action Plan 2020-2023.

We may conclude that Turkey has been taking actions in order to catch up with the smart city concept and the local governments are also eager to take actions in this field. Considering both central government interest and local governments' commitment, it becomes important to ensure the effective functioning of these smart city projects.

As mentioned in Section 2.5.1 and seen in Figure 2.7 Turkey has the capability to produce ITS technologies taking into consideration the smart mobility indicators based on literature by having the passenger information systems, traffic management systems, public transportation systems, electronic payment systems, driver support and security systems and fleet management systems.

It turned out that there are achievement and progress in terms of technology production as seen in the technology capability and awareness analysis in Chapter 4. It is seen that Turkey has the ability to produce smart technology, namely ITS, that is required for the smart city development. However, governmental surveys mentioned above showed that only 26% of the cities are using the ITS indicating that the ITS usage is not countrywide and it is not even close to the half of the country. Also smart mobility mobile applications, as travellers information systems

are not seen countrywide. Only few cities in Turkey, mostly in the selected four cities as a case study, have the smart mobility mobile applications and it is limited with the bus tracking and route planning applications.

8.2.2. Smart governance capability and maturity

It has been seen that, as a state, Turkey is performing well in e-government. One of the main factors of smart governance is the e-government application. Although in many studies in the literature, e-government only mean that the governmental the web site and provide information and interaction to the citizens, in Turkey, having e-government portal seems to be an effectively functioning system.

Furthermore, all ministries and municipalities provide web sites for the citizens to deliver information and interaction. However, the municipal web pages analysis, which is conducted in four metropolitan municipalities, in selected four cities, with their all district municipalities, and carried out according to the McMillan model of interactivity, shows that (Table 8.1) the Municipalities are quite good, with over 90%, at providing information about news and announcement to the citizens. However they are not good at providing plans/maps and online documents about rules and regulations, budget/final accounts, strategic plans, activity reports, council decisions and performance programs. All Municipalities are weak in offering Multilanguage.

Table 8.1: Information tools percentages, All Municipalities, in percentages

	İSTANBUL	ANKARA	İZMİR	BURSA
GIS Maps and Plans	90	26,9	6,5	16,7
Online Documents (PDF)	87,5	57,7	90,3	66,7
News and Announcements	97,5	100	96,8	94,4
Multimedia (video/images)	97,5	100	96,8	94,4
Multilanguage	30	7,7	16,1	22,5
$N_{İstanbul}: 40$ $N_{Ankara}: 26$ $N_{İzmir}: 31$ $N_{Bursa}: 18$				

When it comes to the interaction (Table 8.2) tools, all the Municipalities are good at providing corporate e-mail, online transactions, and call centers but they are weak at providing staff e-mail in private. They are also performing average in offering tools for requests and suggestions, which is very important for the participation. They are quite weak in providing chat rooms in live environment, which is very important for being interactive and available all or most of the time. However, all Municipalities are very active in social media, yet, responding through social media is controversial.

Table 8.2: Interaction tools percentages, All Municipalities, in percentages

		İSTANBUL	ANKARA	İZMIR	BURSA
FEEDBACK	Corporate E-Mail	72,5	69,2	87,1	88,9
	Staff E-Mail	62,5	11,5	6,5	27,8
RESPONSIVE DIALOGUE	Request Complaint Suggestions	92,5	65,4	51,6	66,7
	Online Transactions	95	73,1	90,3	66,7
MUTUAL DISCOURSE	Social Media Accounts	100	100	100	100
	Live Support	0	0	0	0
	Call Center	97,5	100	100	100

$N_{İstanbul}: 40$ $N_{Ankara}: 26$ $N_{İzmir}: 31$ $N_{Bursa}: 18$

As a summary we may say that they are performing quite well with over 90%, providing information about news and announcement to the citizens. In addition, all municipalities are good at providing online transactions, and call centers as an interaction tool with high percentages as seen in above.

Smart governance also requires the maturity of the government in smart city vision. In addition to having smart city technologies, the ability and awareness of using these technologies correctly is also important to achieve the smart city goal as mentioned in section 2.8 and 2.10 also in 8.1. Accordingly, the citizen survey results of the thesis showed that, as seen in section 5.1 only 30% of the respondents' claims resulted in solution and action by the government. So they

either do not respond or concluded with a solution. The results show that the government has the technological capability but they are not mature enough to use it.

However, based on the interview with the municipalities even if all of them agree that smart city studies are necessary to allocate resources and time, it is seen that the studies conducted on this issue by Municipalities are not carried out with great awareness, that there is no legislative execution, and that it is all about a tendency to keep up with a popular subject at the end.

8.2.3. Smart people

It was explained that the smart people refers to people who are aware, active people willing to use the smart city application.

According to the smart people awareness analysis, it was revealed that an important percentage of the respondents, almost 50%, were not aware of the smart applications that the metropolitan municipalities produced. Smart application usage ratio is also dramatic, that is to say, even among the frequent users of public transportation, 42% are not using any public transportation information applications. Driver information mobile applications awareness and usage is worse with its only 17% of awareness and 23% of usage. Even among the frequent private car users, 82% are not aware of those applications.

Also survey results show that citizens know only one application among the several existing applications. Awareness of all applications at the same time does not exceed 15%. In addition, even though they may be aware of the applications, they may not prefer to use it.

Dameri when comparing Amsterdam and Genoa digital and smart cities in 2014 concluded that the smart city could only create and produce a higher public, economic and social value for all with the strong active participation of all citizens. According to the citizen survey conducted in this thesis, it has been revealed that

even if there is the technology, such as governmental interaction tools, citizens do not use these interaction methods or even information tools extensively. As seen in Figure 6.15 the rate of visiting municipal web site does not exceed 30% of the respondents. Figure 6.18 also showed that 75% of the respondents do not use interaction tools.

Thus, even if there is the technology, unless both governance and individuals as users are consciously aware of what the smart city idea is all about, it cannot be said that there is 'smart city'.

When we look at the citizen attitude towards smart mobility modes, it is seen that almost half of the respondents do not know how to use bicycle. Only 2% stated that they are using bicycle as a commute mode. However, as stated in section 2.5, indeed there is not enough bicycle roads even in the biggest cities such as Istanbul and Ankara. Correspondingly, according to the survey results 30% respondents stated that this mode of transport would be preferred if there is a bike lane.

Sharing commute is an important outcome of the smart city idea, yet according to the results, half of the respondents think that car sharing is not safe.

Electrical vehicle is again important for the smart cities regarding its environmental effects on the city, yet, although Turkey has several companies producing electric buses, they are only seen in four cities namely Izmir, Elazığ, Manisa and Kayseri.

Citizen awareness on smart city notion is also very low. Most of the participants do not know about the smart city notion, yet almost all of them agree that it is valuable and should be funded. So we may say that smart city as a name create positive perception on people.

8.2.4. ICT in creating a relationship between authorities and citizen

Information communication technologies are expected to strengthen the relationship between citizens and government. Existing Municipal websites, which

have been examines under the smart governance analysis in Chapter 5, and mobile applications, which have been analyzed in Chapter 6 as part of the citizen awareness analysis, are the smart city tools for citizens to easily convey their opinions, requests and complaints to the government. However, as a result of the citizen survey, as seen in section 6.3 citizens mostly did not prefer to use these communication channels. It was also observed that they did not receive feedback or find solutions to their problems even if they use it, as seen in section 5.3. In this case, it is not possible for technology to create magic on by itself.

These results showed that no matter how advanced a city is in technology, it is not enough to make a city smart unless people together as designers, producers, managers or users are mature enough to understand and use all those technologies accurately.

8.2.5. Turkey in the smart city rankings

As a summary the smart city rankings also show that none of the cities in Turkey is considered as smart according to global evaluations. For example, the Eden Strategy Institute and ONG&ONG (OXD) (Eden Strategy Institute 2018) developed an independent ranking of the top 50 Smart City Governments, among 140 cities globally for 2018/19, and there are no Turkish cities in those rankings[20].

The new ranking research conducted by The IMD World Competitiveness Center (Smart City Index 2019), focuses on how citizens perceive the scope and impact of efforts to make their cities 'smart'. The only city among 102 cities from Turkey is Ankara, although Istanbul is the smartest city according to the local studies, and it is in 74th place and graded with CCC (from AAA[21] to D) according to the

[20] The smartest city is the London according to the ranking in the means of leadership, financial incentives and innovation ecosystem.

[21] The first city which is graded AAA is Singapore

structures and technology perspectives on health and safety, mobility, social activities, work and school opportunities, and governance.

To conclude, smart city attempt is a versatile subject that can be seen in every field of area such as economy, environment and social life. This study showed that although technology is the main element of smart cities, it would not be possible to reach smart cities without responsive and interactive governance and aware and active users. Even in environmental applications, even in sustainability, macro-scale applications will have no meaning without the awareness of users on micro-scale.

8.3. Contribution of the study to the literature

The main contribution of this thesis study to the literature is about new analysis framework, comprising the triple helix model as well as the analysis of relatively new concepts, such as capability in relation to technology and government, maturity in relation to government action and response to citizens, and aware and active citizen, in relation to the citizen's attitude towards technology and the government that produces this technology. These also correspond to the bilateral relations between the three pillars of the triple helix model proposed. This framework of analysis also helps develop a critical approach to the current understanding and evaluations regarding the smart city, as well as helping explore and find out what is necessary for the smart city applications and models to be successful.

For this reason, this study examined the concepts related to the smart city, identified the deficiencies and accordingly re-defined the most two cited characteristics of the smart city concept, which are smart governance and smart people as explained in the section 2.10. The thesis re-defined the smart governance as technologically capable and mature enough to respond to the citizen actions and willing to collaborate with them in city matters. Besides, smart people are re-

defined as people who are aware, willing to use smart applications and active citizens.

In addition, as mentioned above, this study also examined the smart city governance models discussed in the literature and revealed a new triple helix model accordingly for the successful smart city implementation.

Following this, the thesis puts forward an analysis based on new triple helix model including three crucial aspects, which are smart governance, smart people and smart technology with the new definitions of them proposed by the thesis. This analysis framework is adopted in observing smart mobility applications in order to find out smart city capability (from both governance and technology aspects) and smart city awareness (from particularly the citizen but also governance aspects) in Turkey.

Accordingly, the thesis provides results belonging to Turkey's current smart status corresponding to the three most important characteristics of the smart city concept. First of all, the thesis gives results about interaction capability of the municipal web sites of four major cities in the country. This can be considered the first study of this scope that was conducted in Turkey.

Moreover, the citizen survey, in order to find out the citizen awareness on smart applications, also provides important results and it can also be considered as first for Turkey. In addition to that another most crucial contribution of the thesis to the literature and to Turkey is that it exposes the factors affecting the smart application awareness and usage and also participation of the citizens on city matters. Various issues discussed in the literature, such as the effect of education and age on smart application awareness and usage, as well as the expected effect of awareness on usage have been verified by the findings of this study too.

For instance in Amsterdam and Genoa smart cities, it has been observed that age is an important factor on smart application awareness and correspondingly results of

the citizen survey in this study also showed that smart application awareness reduces while the age is increasing.

Also, as seen in London smart parking example smart city applications can not achieve their goals with low awareness and usage. The urbanists criticize even the leading smart city Barcelona that they did not include the ordinary citizens and no smart city can involve their citizens as mere recipients.

According to the citizen survey conducted with the 1141 citizens as a case study of this thesis, it was shown that application awareness has important effect on usage of the application.

Also the study shows that, as discussed in the literature, for the successful implementation of the smart to the city, it is not enough only to govern with either in top-down or bottom-up approach as discussed in section 2.6 and 2.7. Besides, it is important to have the collaboration especially with the users as smart people.

More importantly, the findings verified the vast literature on the importance of smart citizen for the effective functioning of the smart city. For example as defined by Professor Rudolf Giffinger, an expert in analytical research of urban and regional development, 'smart city is a city built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens' (Giffinger 2007).

Similarly, the findings support the study held by Gupta, Mustafa and Kumar (2017) about smart people for smart cities which concluded that '*the concept of the smart city varies from city to city and country to country. However, one thing that remains common …… is citizen engagement. Hence, human factors and human development in smart cities is a very important domain to analyze*'.

Another study, which is Evaluating the Performance of Smart Cities in the Global Economic Network (Wall, et al. 2015), also emphasize that in explaining external investment, only the smart people characteristic is important.

Hence, in order to ensure the success of smart cities, citizens must have the knowledge about smart city, its tools and applications as well as the ability to understand and innovate in order to participate as users as well as co-creators since the entire smart city applications are designed for them.

In Turkey too, the issue of smart citizen is a crucial factor if the smart applications developed by the governments are to have any effect on mobility specifically, and on the quality of life more generally.

8.4. Contribution of the study to the smart city practices for a successful implementation

For a successful smart city implementation, we talked about the importance of individuals as smart citizens with high awareness, willingness to use smart city applications, taking responsibility for city-related problems, and the concept of a smart government advanced in technology that will respond and cooperate with the smart citizens.

Through the researches conducted as a fieldwork, we see that Turkey has considerable achievements in terms of producing smart city technologies. Nevertheless, we see that this does not take place across the country and that these studies are carried out in only few big cities. The big cities in question are within the scope of the field study of the thesis and the aforementioned smart people and smart governance concepts have been examined through these cities to put forward the current situation in Turkey.

It has been seen that even in cities where smart city applications are seen most frequently, there is limited awareness of both the smart city concept and smart city applications. We also concluded that there is little preference for using smart city applications. Also there is very low interest in taking responsibility for the city as a active citizen.

With all these results explained in previous chapters, this study revealed an urban problem within the smart city context. For a successful smart city application, as in many examples we see in the literature, awareness and use of smart city applications should be increased.

How it can be increased has been tried to be revealed by in-depth analysis, which looked into 13 different relationships for 19 smart applications.

According to the survey results, there is a weak connection between users and the smart city applications. After analyzing citizen survey results, the thesis revealed various factors about the awareness and usage of smart city applications. Based on these, the following recommendations can be made on how the disconnection between users can be eliminated.

1. First of all, application of the smart practices depends on the smart technologies and these should not be limited in few cities. Smart city practices should be addressed nationwide.

2. In a smart city, citizens are expected to be active and to be individuals taking responsibility, participating as innovative individuals in city matters such as street design as we talk about the non-political participation as a scope of the thesis as explained in section 2.4. According to the survey results in Turkey there is very low interest in being an active citizenship. Hence, citizen must be encouraged to be active, participate and innovate for their city.

3. Additionally, authorities should be responsive and interactive for citizens to be encouraged. Smart city expects authorities to make collaboration with the active citizens. In the case of Turkey, municipalities, both metropolitan a district should be taking responsibility for the smart city practices and be interactive with the citizen.

4. Being aware of the application directly affects the usage of the application as clearly illustrated by the results of the citizen survey. People who are

aware of the application are more likely to use it. As a result, city authorities, in this case the municipalities, as they are the ones producing smart applications, should concentrate on the advertising of the smart application in order to increase awareness.

5. Also, the results showed that there is a strong relation between education level and the awareness of smart city application. People who have high education degree[22] are more likely to be aware of the city applications. Consequently, in order to raise awareness, city authorities should ensure that the product releases are adequate and available to everyone. They need to be engaged actively in the dissemination and promotion of the applications that they adopt.

6. The survey results showed that as the level of education increases, the rate of application usage decreases. Even if a high-educated person know the application they are less likely to prefer to use it. The usage of the smart city tools is vital for the sustainability of the smart cities, as a result, city authorities should be certain that the smart city tools they produce meet the needs and special requirements of all users.

7. User-friendliness is also has a positive effect on usage, if an application is easy to use and understandable it is more likely to be preferred to use. So they also should be concentrated on the user preference and make sure that the smart applications and tools are available and accessible for everyone

8. Also if people use a transport mode frequently they are more likely to use that transport related application, so people are using the application if they need it. As a result product releases must take attention of the users that it addresses.

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[22] high education degree refers to people who are graduated from university and have master or phd degree.

9. The results showed that there is a low interest on city matters from the younger age groups such as people who are between 18-25. However, those are the most creative and productive ages and could be very useful for the city matters. In this case, city authorities should work to attract the attention of young people and seek their support.

10. Also, the results revealed that as the education level increases interest on city matters decreases. However, it should be vice versa in the context of the smart people. In a smart city, as the level of education increases, awareness of smart city applications and responsibility for the city are expected to increase. Conversely, city authorities should reach out to the higher educated population and should be in cooperation with them, in designing and developing applications.

In the light of the all these results concluded from the data created, we may say that application producers, especially if it is the city authority (because private companies are doing their own research) should concentrate on the user preference. They should investigate whether the people who they produce for are using or satisfied with those applications or not. Otherwise it would be a city full of non-used smart applications, in other words a city full of smart application trash.

8.5. Contribution of the study to the urban planning studies

Since smart city studies are a macro-scale urban planning and design problem, they should also be taken into account in urban planning studies.

This thesis study revealed and redefined many problems related to smart city practices and implementations, conducted multiple analysis and reached out to many studies in order to collect data for the solutions and determined the affecting factors.

In particular, with an extensive research and three different analyses, the thesis revealed the current situation in Turkey regarding smart city practices,

shortcomings in smart city practices from technology, governance and citizens as users perspective, and made a proposal for the successful smart implementation.

Especially the necessities that are listed in the previous section for the successful smart implementation can help the urban planning policy in order to meet the civil engagement and create the environment for the citizen – government collaboration.

8.6. Contribution of the study to the city regarding increasing the awareness

It should also be noted that the study had a positive effect on the citizens of the cities in which surveys were conducted.

According to the citizen survey, 58% of the respondents stated that thanks to the survey, they became aware of many applications that they were not aware of and will start to use them as they consider them useful. Also, some, who did not know about the smart city concept, stated that they now know the smart city idea and will search it further.

Perhaps, any survey with citizens is likely to create such effects on the respondents, but regarding the main focus and claims of this thesis, this outcome is seen as important, as it shows that the survey conducted in the scope of the thesis created awareness in the city. As underlined throughout the thesis, citizens' awareness and participation is one of the three crucial factors in implementing the smart city, enhancing the expected benefits from technological capability and governmental action.

8.7. Limitations

There have been a number of limitations in carrying out the research. The biggest challenge was related with the citizen survey, i.e. delivering the survey to people and making them participate. Due to this challenge, it was not possible to balance

the education and age groups of the participants, which can be seen as a limitation when interpreting the survey results.

In addition, in Turkey, contacting metropolitan municipalities and asking statements on any subject has its difficulties since many municipal actions are politicized. Perhaps, related to this issue, metropolitan municipalities did not answer all the questions asked.

The concept of the smart city is a very broad subject, and any study that aims at analyzing this concept has to focus on certain aspects of it. If this study, it has been decided to start with the assumption that smart city applications are spreading and that there is a need to provide a better understanding of the factors that make these applications successful. Hence, the fact that smart city tools may create a digital divide, a well-known discussion in the literature, was not included in the analysis and citizen survey, although acknowledged in the thesis.

Since the main aim of the thesis is to explore factors that can help achieve successful implementation of the smart practices, the studies have been conducted based on the assumption that all citizens can access to the Internet and smart devices. This is a limitation obviously, but it helped focus the survey and implement it effectively.

Last but not least, the thesis only made research on the applications released by the metropolitan municipalities and in the field of smart mobility. This is not necessarily a limitation; however, including all existing applications from both governments and other institutions could enhance the research, as described amongst possible future studies listed below.

8.8. Future studies

A study can be done on all smart city applications both released by governments and launched by third party institutions. This can enrich the findings of this study. In addition, a separate study can be made on the features of these applications.

Thus, the citizen's stance against smart city practices can be truly revealed. These results may also reveal whether public or third party products are more suitable for the citizen. According to the results, application pollution can be eliminated.

Furthermore, expanding the study to encompass all possible fields of applications, and not just smart mobility, can help further enhance our understanding capability, government awareness/action and citizen awareness/usage, ie. the triology put forward in this study.

Moreover, including more cities in the analysis can help enrich the findings as well as help include different aspects, such as city size, different urban characteristics, and socio-economic differences accross cities. Additionally, enlarging the number of cities studied can help reveal differences in government practice, which may be linked too the political party and vision of the ruling government in each city.

Furthermore, within scope of the digital divide discussions, those who cannot access to the inetrnet and digital divices can be included in order to the find out the solutions for the ones who cannot access and enrich the city’s smartness value.

Finally international comparisons could also be considered amongst further studies. This could help analyse technological differences in countries, as well as differences in municipal awareness and action, and in citizen behaviours and awareness.

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APPENDICES

A. Citizen Survey Questions

1. Eğitim Durumunuz
2. Hangi Yaş grubundasınız?
3. Toplu taşımayı ne sıklıkta kullanıyorsunuz?
4. Yolculuklarınızda en sık kullandığınız ulaşım türlerinden en az üç tanesini işaretler misiniz?
5. Şehir Kartı kullanıyorsanız dolum kiosk'larını kullanım açısından nasıl buluyorsunuz??
6. Aktif olarak akıllı telefon kullanıyor musunuz?
7. Kentinizde var olan ulaşım ile ilgili mobil uygulamalarından en sık kullandıklarınızı yazar mısınız?
8. Kentinizde var olan, aşağıdaki mobil uygulamalardan haberdar mısınız?
9. Kentinizde var olan mobil uygulamalardan hangilerini ne sıklıkla kullanıyorsunuz?
10. Kentinizde var olan mobil uygulamaları kullanım açısından nasıl buluyorsunuz?
11. Büyükşehir Belediyesi web sitesini ne kadar sıklıkta ziyaret ediyorsunuz?
12. Aşağıdaki ulaşım hizmetlerinden hangilerini web sitesi üzerinden takip ediyorsunuz?
13. Belediye web sitesi yazılımını kullanım açısından nasıl buluyorsunuz?
14. Aşağıdakileri kurum veya hizmetleri hangi sosyal medya platformları üzerinden takip ediyorsunuz?
15. Belediye ile iletişime geçmek, sorun ve önerilerinizi iletmek için tercih ettiğiniz kanallarla il değerlendirmelerinizi işaretler misiniz?
16. Bisiklet kullanıyorsanız, bisikleti ana ulaşım aracı olarak tercih eder misiniz / ediyor musunuz

17. Herhangi bir yere seyahat ederken, aracınızı aynı güzergahı kullanan başka yolcularla paylaşmak konusunda ne düşünüyorsunuz?
18. Daha önce akıllı şehir kavramını duydunuz mu? Sizce akıllı şehirde olması gereken en öne 3 şeyi yazar mısınız?
19. Bildiğiniz akıllı şehir(ler) varsa adlarını yazar mısınız?
20. Sizce Akıllı Şehir kriterlerine ulaşmak için yatırım yapılmalı mıdır?
21. Ankete katıldığınız için teşekkür ederiz. Son soru olarak anketin size katkısı ile ilgili değerlendirme yapabilirseniz çok seviniriz.

B. Interview with Municipalities

1. Büyükşehir Belediyesi olarak;
    a. Akıllı Şehir ile ilgili görüşleriniz nelerdir?
    b. Sizin için / kurumunuz için Akıllı Şehir kriterlerine ulaşmak ne anlam ifade etmektedir / ne tür uygulamaları kapsamaktadır?
    c. Sizce/kurumunuzca Akıllı Şehir çalışmalarına ne kadar kaynak ve zaman ayrılmalıdır?
    d. Şimdiye kadar Büyükşehir Belediyesi işleri içerisinde Akıllı Şehirlere ayrılan kaynakları diğer işlerle karşılaştırırsak; belediye işlerinin tahmini yüzde kaçı Akıllı Şehir çalışmalarını kapsamaktadır?
2. Akıllı Şehir uygulamalarıyla ilgili en çok hangi alanlarda, ne tür çalışmalar yapılmaktadır?
3. Ulaşım ile ilgili;
    a. Yapılmış mevcut uygulamalar nelerdir?
    b. Mevcut durumda en sık kullanılan uygulamalar nelerdir?
    c. Akıllı Kavşaklarla ilgili olarak;
        i. Akıllı Kavşak sayısının toplam kavşak sayısına göre tahmini yüzdesi nedir?
        ii. Akıllı Kavşak Sistemlerinin hangi kavşaklara uygulanması gerektiğine nasıl karar veriliyor?
    d. Trafik kameraları ne kadar bir alanı kapsamaktadır?
    e. Diğer
4. Akıllı Şehirlerle ilgili yapılan uygulamaların/çalışmaların;
    a. Karar, tasarım ve devreye alınması aşamasında yetkiler kime/hangi kuruma aittir?
    b. Bu süreçler;
        i. Büyükşehir Belediyesi bünyesinde kurulmuş ekiplerce mi yürütülmektedir?

ii. Dışarıdan danışmanlık alınarak veya alt yüklenicilerle mi yürütülmektedir?
iii. Her ikisi söz konusu ise genel olarak ne oranda iş paylaşımı yapılmaktadır?

5. Büyükşehir Belediyesi tarafından yapılmış ulaşım ile ilgili vatandaşlara yönelik X akıllı telefon uygulaması bulunmaktadır. uygulamaların hepsinden aynı anda haberdar olanların oranı %X. Uygulamaların yarısından haberdar olanların oranı %X çıkmıştır. Kısaca anket sonuçlarına göre vatandaşlar uygulamalardan yeterince haberdar değil sonucu çıkmıştır. Buna göre;

a. Vatandaşları uygulamalardan haberdar etmek için yapılan çalışmalar var mıdır? Varsa ne tür çalışmalar yapılmaktadır?

6. Akıllı Şehir yolunda ilerlerken;

a. Karşılaşılan en büyük zorluklar, engeller nelerdir? (Belediye web sitesi geliştirilmesi açısından - Mobil uygulamaların geliştirilmesi açısından - Akıllı Ulaşım sistemlerinin kurulması açısından)
b. Bu engelleri aşmak/çözmek için ne tür çalışmalar yapılmaktadır?

7. Akıllı Şehir uygulamalarının;

a. Sağladığı en büyük faydalar nelerdir?
b. Bilgi İletişim Teknolojileri, Belediye ile vatandaşlar arasındaki iletişimi nasıl etkilemektedir? Daha güçlendirdiği söylenebilir mi? (Örneğin Büyükşehir Belediye web sitesinin oluşması ve belediye ile iletişim kanalları olan e-posta servisi ve sosyal medya kanallarının varlığı vatandaşlarla iletişim – bilgi verme, alma, karşılıklı iletişim halinde olma gibi - açısından nasıl bir etki yaratmaktadır?)

8. Vatandaşları,

a. Toplu taşımayı kullanmaya, bisiklete binmeye, yürümeye teşvik etmek için ne gibi çalışmalar yapılmaktadır?
b. Bunlar yapılırken karşılaşılan zorluklar nelerdir?

9. Büyükşehir Belediyesi web sitesi;

a. Ne kadar sıklıkta güncellenmektedir?

b. Büyükşehir Belediyesi web sitesi tasarımı, yönetimi, geliştirilmesi Belediye bünyesinde çalışan ekiplerce mi yapılmaktadır?

c. Dışarıdan danışmanlık, alt yüklenici veya dış kaynak temin edilmekte midir?

d. Ediliyorsa tahmini bir oran belirtebilir misiniz?

10. Büyükşehir Belediyesi İletişim Kanalları (çağrı merkezi, e-posta servisi, online işlemler, sosyal medya) üzerinden gelen şikayet, öneri gibi çağrılar;

a. Nasıl değerlendirilmektedir?

b. Ne kadar geri dönüş sağlanmaktadır?

c. Yapılan anket sonucu çeşitli iletişim kanallarını kullanarak Büyükşehir Belediyesi ile iletişime geçenlerin oranı %12,2 çıkmıştır. İletişime geçenlerin %34'ü hiç cevap alamadığını, %35'i cevap alsa bile sorunlarına çözüm üretilmediğini belirtmiştir. Bu durumu nasıl değerlendirirsiniz?

11. Büyükşehir Belediyesi Sosyal Medya hesaplarının

a. Yönetimini kimler tarafından yürütülmektedir?

b. Bu hesaplar üzerinden yazılan şikayet ve öneriler nasıl değerlendirilmektedir?

c. Her gelen iletiye cevap veriliyor şeklinde bir politika mı izleniyor yoksa belli konuları içeren iletiler mi yanıtlanıyor? Açıklayabilir misiniz?

12. Belediye tarafından gelen şikayet ve önerilerin hangi kanallar üzerinden geldiği ile ilgili olarak bir öncelik söz konusu mudur? Örneğin Belediye çağrı merkezi veya e-posta servisi mi yoksa sosyal medya hesapları üzerinden gelen şikayet ve öneriler mi önceliklidir?

13. Genel olarak Türkiye'de Akıllı Şehir çalışmaları ve mevcut durum ile ilgili olarak eklemek istediğiniz görüşlerinizi paylaşabilirseniz sevinirim.

C. SPSS results

By using SPSS the study examined 13 relations based on 19 mobile applications produced by the metropolitan municipalities in four cities selected as case study to find out the factors affecting awareness and usage based on smart mobility mobile applications and interaction tools usage to communicate the metropolitan municipalities.

Two types of statistical analyses have been applied to the survey result in order to understand the relationships between factors that affect the citizen awareness. The Chi Square of Independence and Binary Logistic Regression methods have been used for the analysis.

1. The Chi Square of Independence

A research question that frequently arises is whether two variables are associated. For example, a sociologist may wish to know whether level of formal education is associated with income. If there is no association between two variables, we say that they are independent. We use the chi square test of independence as to decide whether two variables in a population are independent. In cases of small samples, Fisher Exact Test Statistic is more appropriate to analyze the association.

Hypothesis:

H_0: The two criteria of classification are independent

H_1: The two criteria of classification are not independent

We may reject the null hypothesis of independence at the alpha level of significance if the computed value of the test statistic exceeds the tabulated value. Through the thesis we accept the alpha value as 0.05.

When you choose to analyze your data using a chi-square test for independence, you need to make sure that the data you want to analyze satisfy two assumptions.

Your two variables should be measured at an ordinal or nominal level (i.e., categorical data).

Your two variables should consist of two or more categorical, independent groups.

For our data it is clear that we have categorical data and our all variables consist of two or more categorical independent groups.

2. Binary Logistic Regression

The goal of an analysis using logistic regression to describe the relationship between outcome (dependent or response) variable and a set of independent variables which can be either continuous or categorical. Examples of categorical variables in our study include age groups and education level. In binary logistic regression the outcome (dependent) variable is binary or dichotomous and should have mutually exclusive categories. Example of dichotomous variables in our study includes being aware of the mobile application (yes or no).

Question 1: Is there an association between mobile application awareness and education level?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Education level * Public transportation information mobile app awareness	1131	100.0%	0	0.0%	1131	100.0%
Education level * Driver information mobile app awareness	1131	100.0%	0	0.0%	1131	100.0%
Education level * Digital municipality awareness	1131	100.0%	0	0.0%	1131	100.0%

1. **Education level*public transportation information mobile application awareness**

H_0: Public transportation information applications mobile application awareness is not related to (associated with) education level

H_1: Public transportation information applications mobile application awareness is related to (associated with) education level

Crosstab

			Public transportation information mobile app awareness		
			non- aware	aware	Total
Education level	Primary education	Count	149	98	247
		Expected Count	121.2	125.8	247.0
		% within education level	60.3%	39.7%	100.0%
		% within public transportation information mobile app awareness	26.8%	17.0%	21.8%
		% of Total	13.2%	8.7%	21.8%
	Bachelor's degree	Count	257	331	588
		Expected Count	288.5	299.5	588.0
		% within education level	43.7%	56.3%	100.0%
		% within public transportation information mobile app awareness	46.3%	57.5%	52.0%
		% of Total	22.7%	29.3%	52.0%
	Postgraduate	Count	149	147	296
		Expected Count	145.3	150.7	296.0
		% within education level	50.3%	49.7%	100.0%
		% within public transportation information mobile app awareness	26.8%	25.5%	26.2%
		% of Total	13.2%	13.0%	26.2%
Total		Count	555	576	1131
		Expected Count	555.0	576.0	1131.0
		% within education level	49.1%	50.9%	100.0%
		% within public transportation information mobile app awareness	100.0%	100.0%	100.0%
		% of Total	49.1%	50.9%	100.0%

Respondents were classified in terms of whether they are aware of public transportation information mobile applications or not and in terms of education level (having primary education (*İlköğretim*) and bachelor's degree (*Lisans*) and postgraduate degree (*Lisansüstü*)).

Data of this type are usually summarized by counting the number of subjects in each mobile application awareness/education level and presented in the form of a table (cross-tabulation), sometimes called a contingency table.

Chi-Square Tests

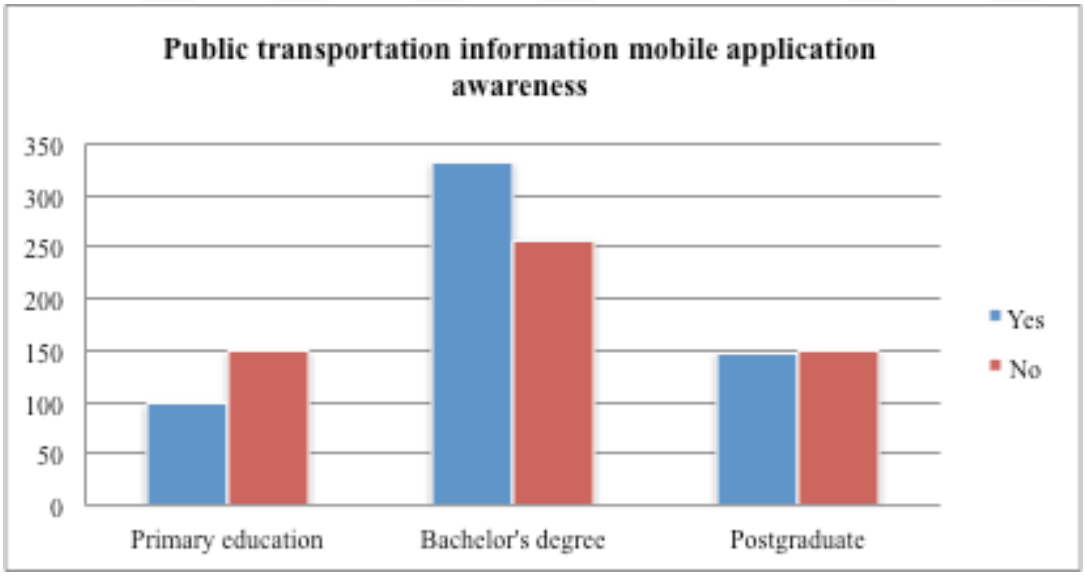
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	19.474[a]	2	.000	.000		
Likelihood Ratio	19.568	2	.000	.000		
Fisher's Exact Test	19.513			.000		
Linear-by-Linear Association	4.273[b]	1	.039	.039	.021	.004
N of Valid Cases	1131					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 121.21.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 19.474, and $p < 0.05$; ie., a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Public transportation information mobile application awareness seems to be related to education level.



Binary Logistic Regression

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			19.232	2	.000			
	Bachelor's degree	.672	.154	18.953	1	.000	1.958	1.447	2.650
	Postgraduate	.405	.174	5.403	1	.020	1.500	1.066	2.111
	Constant	-.419	.130	10.378	1	.001	.658		

a. Variable(s) entered on step 1: education level.

Result:

'Variables in the Equation' table summarizes the importance of the explanatory variables individually whilst controlling for the other explanatory variables.

The table compares people`s education levels in terms of being aware of public transportation information applications mobile application. Education level is tested as a whole and then having 'post graduate' and 'bachelor' is compared to the reference category having 'primary education'. In the sig column, the p-values are below apart from the test for the variables having bachelors and postgraduate degree as an education level. This means there is a strong enough relationship between these variables and public transportation information applications mobile application awareness.

It can be seen easily from the table that those who have bachelor's degree are 1.958 times and who have postgraduate degree are 1.500 times more likely to be aware of public transportation information mobile application than those who have primary education degree.

2. Education level*driver information mobile application awareness

H_0: Driver information mobile application awareness is not related to (associated with) education level

H_1: Driver information mobile application awareness is related to (associated with) education level

Crosstab

			Driver information mobile application awareness		
			non-aware	aware	Total
Education level	Primary education	Count	216	31	247
		Expected Count	205.1	41.9	247.0
		% within education level	87.4%	12.6%	100.0%
		% within digital municipality awareness	23.0%	16.1%	21.8%
		% of Total	19.1%	2.7%	21.8%
	Bachelor's degree	Count	489	99	588
		Expected Count	488.2	99.8	588.0
		% within education level	83.2%	16.8%	100.0%
		% within digital municipality awareness	52.1%	51.6%	52.0%
		% of Total	43.2%	8.8%	52.0%
	Postgraduate	Count	234	62	296
		Expected Count	245.8	50.2	296.0
		% within education level	79.1%	20.9%	100.0%
		% within digital municipality awareness	24.9%	32.3%	26.2%
		% of Total	20.7%	5.5%	26.2%
Total		Count	939	192	1131
		Expected Count	939.0	192.0	1131.0
		% within education level	83.0%	17.0%	100.0%
		% within digital municipality awareness	100.0%	100.0%	100.0%
		% of Total	83.0%	17.0%	100.0%

Respondents were classified in terms of whether they are aware of driver information mobile application or not and in terms of education level (having primary education (*İlköğretim*) and bachelors degree (*Lisans*) and postgraduate degree (*Lisansüstü*)).

Chi-Square Tests

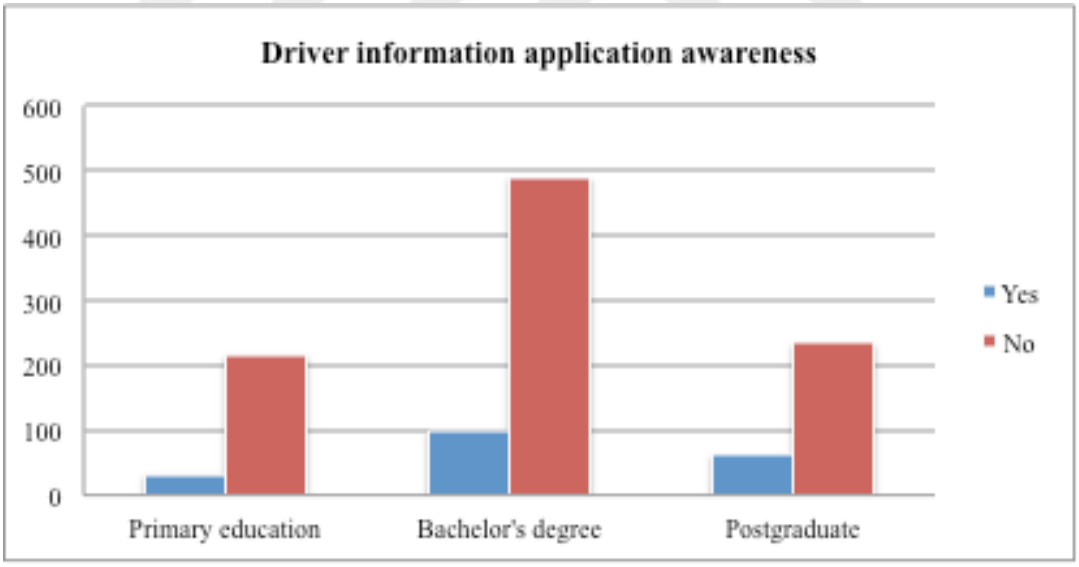
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	6.750[a]	2	.034	.033		
Likelihood Ratio	6.843	2	.033	.034		
Fisher's Exact Test	6.757			.034		
Linear-by-Linear Association	6.743[b]	1	.009	.010	.005	.002
N of Valid Cases	1131					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 41.93.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 6.750, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Driver information mobile application awareness seems to be related to education level.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			6.663	2	.036			
	Bachelor's degree	.344	.221	2.414	1	.120	1.411	.914	2.177
	Postgraduate	.613	.239	6.561	1	.010	1.846	1.155	2.951
	Constant	-1.941	.192	102.164	1	.000	.144		

a. Variable(s) entered on step 1: education level.

Result:

In the sig column, the p-value is below apart from the test for the variable having postgraduate degree as an education level. This means there is a strong enough relationship between that variable and municipal mobile application awareness.

It can be seen easily from the table that those who have bachelor's degree are 1411 times and who have postgraduate degree are 1.846 times more likely to be aware of driver information mobile application than those who have primary education degree.

3. Education level*digital municipality awareness

H_0: Digital municipality awareness is not related to (associated with) education level

H_1: Digital municipality awareness is related to (associated with) education level

Crosstab

			Digital municipality awareness		
			non-aware	aware	Total
Education level	Primary education	Count	229	18	247
		Expected Count	227.3	19.7	247.0
		% within education level	92.7%	7.3%	100.0%
		% within driver information mobile app awareness	22.0%	20.0%	21.8%
		% of Total	20.2%	1.6%	21.8%
	Bachelor's degree	Count	545	43	588
		Expected Count	541.2	46.8	588.0
		% within education level	92.7%	7.3%	100.0%
		% within driver information mobile app awareness	52.4%	47.8%	52.0%
		% of Total	48.2%	3.8%	52.0%
	Postgraduate	Count	267	29	296
		Expected Count	272.4	23.6	296.0
		% within education level	90.2%	9.8%	100.0%
		% within driver information mobile app awareness	25.6%	32.2%	26.2%
		% of Total	23.6%	2.6%	26.2%
Total		Count	1041	90	1131
		Expected Count	1041.0	90.0	1131.0
		% within education level	92.0%	8.0%	100.0%
		% within driver information mobile app awareness	100.0%	100.0%	100.0%
		% of Total	92.0%	8.0%	100.0%

Respondents were classified in terms of whether they are aware of digital municipality or not and in terms of education level (having primary education (İlköğretim) and bachelors degree (Lisans) and postgraduate degree (Lisansüstü)).

Chi-Square Tests

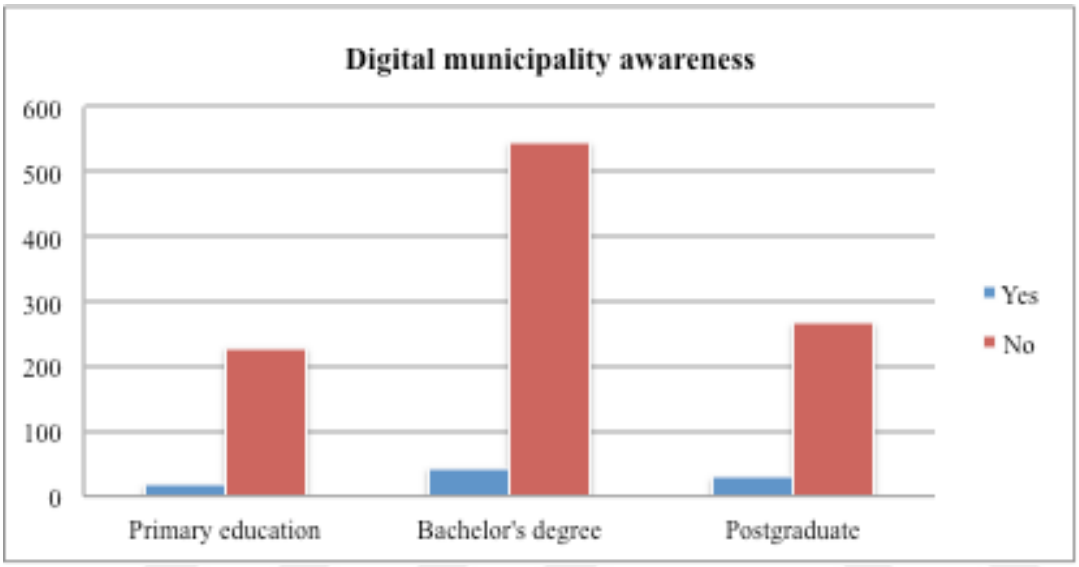
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.853[a]	2	.396	.407		
Likelihood Ratio	1.779	2	.411	.416		
Fisher's Exact Test	1.826			.402		
Linear-by-Linear Association	1.272[b]	1	.259	.267	.147	.034
N of Valid Cases	1131					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 19.66.

Results:

From the first row of the last table, Pearson Chi-Square statistic is 1.853 and □> *0.05*.

Hence, there is no real evidence that the digital municipality awareness is different for people who have different education levels.



Question 2: Is there an association between mobile application awareness and age?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Age group * public transportation informaiton mobile app awareness	1131	100.0%	0	0.0%	1131	100.0%
Age group * driver information mobile app awareness	1131	100.0%	0	0.0%	1131	100.0%
Age group * digital municipality awareness	1131	100.0%	0	0.0%	1131	100.0%

1. **Age group * public transportation information mobile application awareness**

H_0: Public transportation information applications mobile application awareness is not related to (associated with) age

H_1: Public transportation information applications mobile application awareness is related to (associated with) age

Crosstab

			Public transportation information mobile app awareness		
			non-aware	aware	Total
Age group	18-25	Count	173	220	393
		Expected Count	192.9	200.1	393.0
		% within age group	44.0%	56.0%	100.0%
		% within public transportation information mobile app awareness	31.2%	38.2%	34.7%
		% of Total	15.3%	19.5%	34.7%
	26-45	Count	317	313	630
		Expected Count	309.2	320.8	630.0
		% within age group	50.3%	49.7%	100.0%
		% within public transportation information mobile app awareness	57.1%	54.3%	55.7%
		% of Total	28.0%	27.7%	55.7%
	46-65	Count	59	38	97
		Expected Count	47.6	49.4	97.0
		% within age group	60.8%	39.2%	100.0%
		% within public transportation information mobile app awareness	10.6%	6.6%	8.6%
		% of Total	5.2%	3.4%	8.6%
	65 over	Count	6	5	11
		Expected Count	5.4	5.6	11.0
		% within age group	54.5%	45.5%	100.0%
		% within public transportation information mobile app awareness	1.1%	0.9%	1.0%
		% of Total	0.5%	0.4%	1.0%
Total		Count	555	576	1131
		Expected Count	555.0	576.0	1131.0
		% within age group	49.1%	50.9%	100.0%
		% within public transportation information mobile app awareness	100.0%	100.0%	100.0%
		% of Total	49.1%	50.9%	100.0%

Respondents were classified in terms of whether they are aware of public transportation information applications mobile application or not and in terms of age groups (18-25, 26-45, 46-65, 65 and over).

Chi-Square Tests

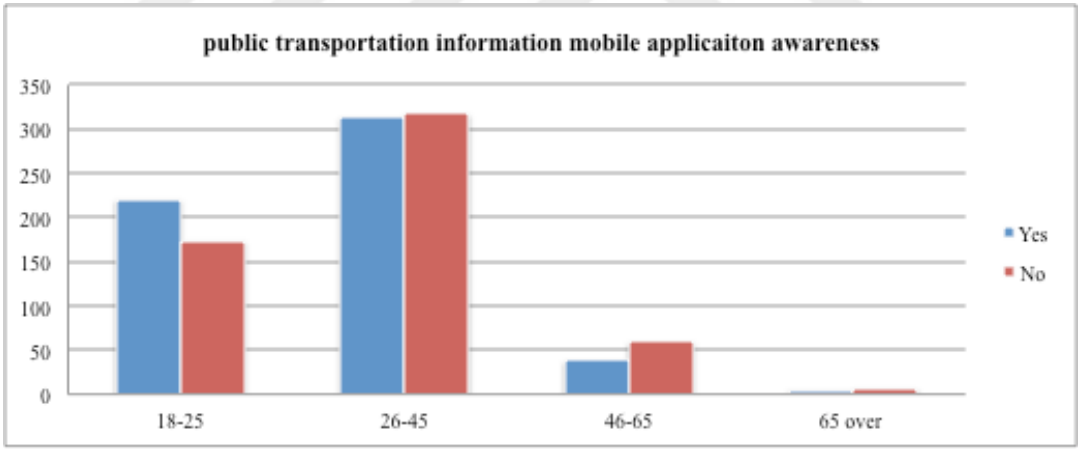
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	9.897[a]	3	.019	.018		
Likelihood Ratio	9.943	3	.019	.021		
Fisher's Exact Test	9.927			.018		
Linear-by-Linear Association	9.006[b]	1	.003	.003	.002	.000
N of Valid Cases	1131					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.40.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 9.897, and $p< 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p< 0.05$.

Public transportation information applications mobile application awareness seems to vary from age to age.



Logistic Regression

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	18-25			9.782	3	.021			
	26-45	-.253	.129	3.840	1	.050	.776	.603	1.000
	46-65	-.680	.231	8.636	1	.003	.506	.322	.797
	65 over	-.423	.614	.474	1	.491	.655	.197	2.183
	Constant	.240	.102	5.594	1	.018	1.272		

a. Variable(s) entered on step 1: age group.

Result:

The table compares people's awareness in terms of their age groups. That contrast was significant.

It seems that people who are between 26-45 and 46-65 years old are less likely to be aware of public transportation information mobile applications than those who are between 18-25 years old.

2. Age group * driver information mobile application awareness

Hypotheses:

H_0: Driver information mobile application awareness is not related to (associated with) age

H_1: Driver information mobile application awareness is related to (associated with) age

Crosstab

			Driver information mobile application awareness		
			non-aware	aware	Total
Age group	18-25	Count	343	50	393
		Expected Count	326.3	66.7	393.0
		% within age group	87.3%	12.7%	100.0%
		% within digital municipality awareness	36.5%	26.0%	34.7%
		% of Total	30.3%	4.4%	34.7%
	26-45	Count	515	115	630
		Expected Count	523.1	106.9	630.0
		% within age group	81.7%	18.3%	100.0%
		% within MUNICIP mobile app awareness	54.8%	59.9%	55.7%
		% of Total	45.5%	10.2%	55.7%
	46-65	Count	70	27	97
		Expected Count	80.5	16.5	97.0
		% within age group	72.2%	27.8%	100.0%
		% within digital municipality awareness	7.5%	14.1%	8.6%
		% of Total	6.2%	2.4%	8.6%
	65 over	Count	11	0	11
		Expected Count	9.1	1.9	11.0
		% within age group	100.0%	0.0%	100.0%
		% within digital municipality awareness	1.2%	0.0%	1.0%
		% of Total	1.0%	0.0%	1.0%
Total		Count	939	192	1131
		Expected Count	939.0	192.0	1131.0
		% within age group	83.0%	17.0%	100.0%
		% within digital municipality awareness	100.0%	100.0%	100.0%
		% of Total	83.0%	17.0%	100.0%

Respondents were classified in terms of whether they are aware of driver information mobile application or not and in terms of age groups (18-25, 26-45, 46-65, 65 and over).

Chi-Square Tests

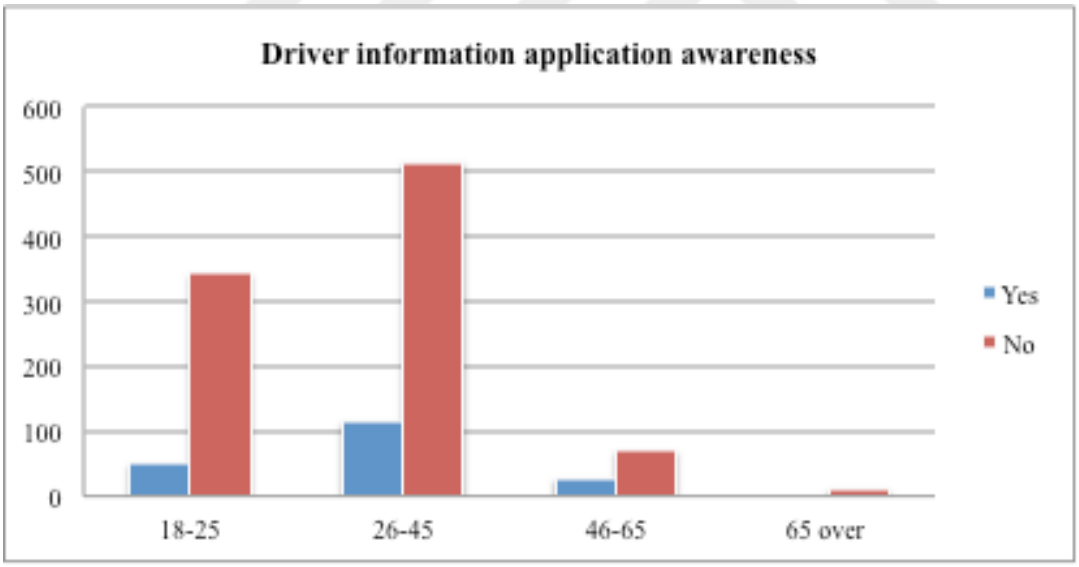
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	16.139[a]	3	.001	.002		
Likelihood Ratio	17.319	3	.001	.001		
Fisher's Exact Test	15.226			.001		
Linear-by-Linear Association	8.382[b]	1	.004	.004	.002	.001
N of Valid Cases	1131					

a.1 cells (12.5%) have expected count less than 5. The minimum expected count is 1.87.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 16.139, and $p< 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p< 0.05$.

Driver information mobile application awareness seems to be related to age.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	18-25			13.355	3	.004			
	26-45	.426	.183	5.421	1	.020	1.532	1.070	2.193
	46-65	.973	.272	12.754	1	.000	2.646	1.551	4.514
	65 over	-19.277	12118.636	.000	1	.999	.000	.000	.
	Constant	-1.926	.151	161.827	1	.000	.146		

a. Variable(s) entered on step 1: age group.

Result:

The table compares people awareness in terms of their age groups.

It seems that people who are between 26-45 and 46-65 years old are more likely to be aware of driver information mobile application than those who are between 18-25 years old.

3. Age group * digital municipality awareness

H_0: Digital municipality awareness is not related to (associated with) age

H_1: Digital municipality awareness is related to (associated with) age

Crosstab

			Digital municipality awareness		
			non-aware	aware	Total
Age group	18-25	Count	370	23	393
		Expected Count	361.7	31.3	393.0
		% within age group	94.1%	5.9%	100.0%
		% within driver information mobile app awareness	35.5%	25.6%	34.7%
		% of Total	32.7%	2.0%	34.7%
	26-45	Count	579	51	630
		Expected Count	579.9	50.1	630.0
		% within age group	91.9%	8.1%	100.0%
		% within driver information mobile app awareness	55.6%	56.7%	55.7%
		% of Total	51.2%	4.5%	55.7%
	46-65	Count	81	16	97
		Expected Count	89.3	7.7	97.0
		% within age group	83.5%	16.5%	100.0%
		% within driver information mobile app awareness	7.8%	17.8%	8.6%
		% of Total	7.2%	1.4%	8.6%
	65 over	Count	11	0	11
		Expected Count	10.1	.9	11.0
		% within age group	100.0%	0.0%	100.0%
		% within driver information mobile app awareness	1.1%	0.0%	1.0%
		% of Total	1.0%	0.0%	1.0%
Total		Count	1041	90	1131
		Expected Count	1041.0	90.0	1131.0
		% within age group	92.0%	8.0%	100.0%
		% within driver information mobile app awareness	100.0%	100.0%	100.0%
		% of Total	92.0%	8.0%	100.0%

Respondents were classified in terms of whether they are aware of digital municipality or not and in terms of age groups (18-25, 26-45, 46-65, 65 and over).

Chi-Square Tests

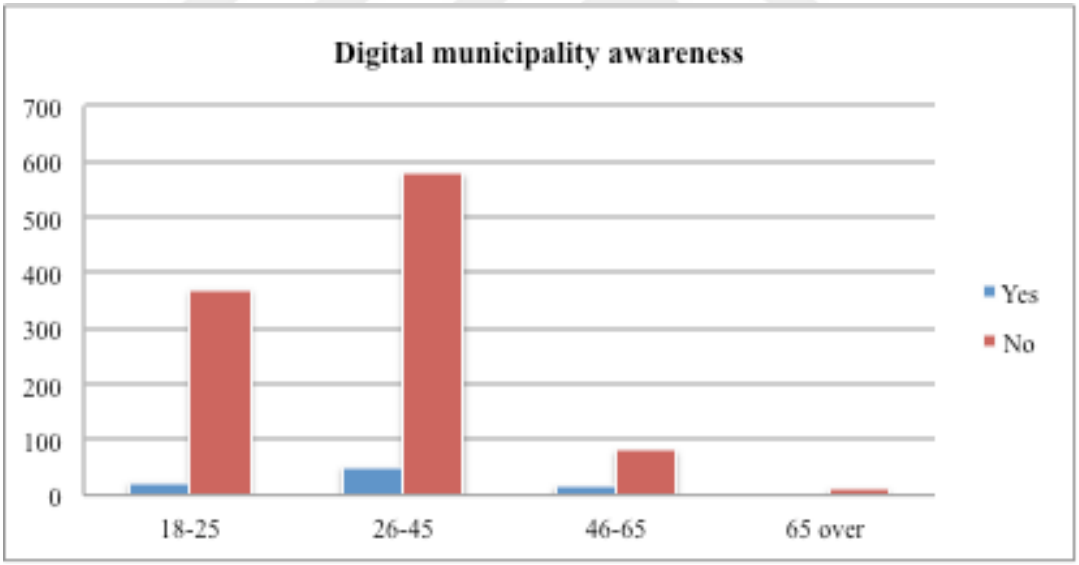
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	12.998[a]	3	.005	.009		
Likelihood Ratio	11.997	3	.007	.007		
Fisher's Exact Test	10.757			.011		
Linear-by-Linear Association	6.393[b]	1	.011	.013	.008	.003
N of Valid Cases	1131					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is .88.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 12.998, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Digital municipality awareness seems to be related to age.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	18-25			11.216	3	.011			
	26-45	.349	.260	1.799	1	.180	1.417	.852	2.358
	46-65	1.156	.348	11.045	1	.001	3.178	1.607	6.284
	65 over	-18.425	12118.636	.000	1	.999	.000	.000	.
	Constant	-2.778	.215	167.111	1	.000	.062		

a. Variable(s) entered on step 1: age group.

Result:

The table compares people awareness in terms of their age groups.

It seems that people who are between 46-65 years old are more likely to be aware of digital municipality than those who are between 18-25 years old.

Question 3: Is there an association between mobile application usage and education level?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Education level * public transportation information mobile app usage	1072	94.8%	59	5.2%	1131	100.0%
Education level * driver information mobile app usage	1091	96.5%	40	3.5%	1131	100.0%
Education level * digital municipality usage	1091	96.5%	40	3.5%	1131	100.0%

1. **Education level * public transportation information mobile application usage**

Hypotheses:

H_0: Public transportation information mobile application usage is not related to (associated with) education level

H_1: Public transportation information mobile application usage is related to (associated with) education level

Crosstab

			Public transportation information mobile app usage		
			non-users	users	Total
Education level	Primary education	Count	118	111	229
		Expected Count	111.7	117.3	229.0
		% within education level	51.5%	48.5%	100.0%
		% within public transportation information mobile app usage	22.6%	20.2%	21.4%
		% of Total	11.0%	10.4%	21.4%
	Bachelor's degree	Count	248	315	563
		Expected Count	274.7	288.3	563.0
		% within education level	44.0%	56.0%	100.0%
		% within public transportation information mobile app usage	47.4%	57.4%	52.5%
		% of Total	23.1%	29.4%	52.5%
	Postgraduate	Count	157	123	280
		Expected Count	136.6	143.4	280.0
		% within education level	56.1%	43.9%	100.0%
		% within public transportation information mobile app usage	30.0%	22.4%	26.1%
		% of Total	14.6%	11.5%	26.1%
Total		Count	523	549	1072
		Expected Count	523.0	549.0	1072.0
		% within education level	48.8%	51.2%	100.0%
		% within public transportation information mobile app usage	100.0%	100.0%	100.0%
		% of Total	48.8%	51.2%	100.0%

Respondents were classified in terms of whether they are using public transportation information applications mobile application or not and in terms of education level (having primary education (*İlköğretim*) and bachelor's degree (*Lisans*) and postgraduate degree (*Lisansüstü*)).

Chi-Square Tests

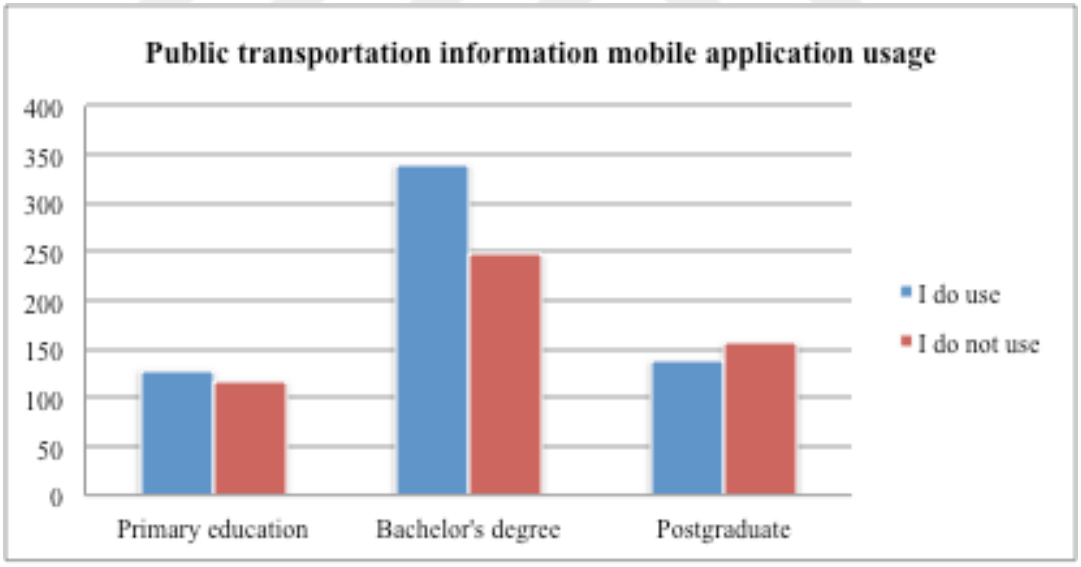
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.692[a]	2	.003	.003		
Likelihood Ratio	11.714	2	.003	.003		
Fisher's Exact Test	11.691			.003		
Linear-by-Linear Association	1.573[b]	1	.210	.214	.113	.016
N of Valid Cases	1072					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 111.72.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 11.692, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Public transportation information mobile application usage seems to be related to education level.



Logistic Regression

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			11.634	2	.003			
	Bachelor's degree	.300	.157	3.652	1	.046	1.350	.992	1.837
	Postgraduate	-.183	.179	1.046	1	.306	.833	.587	1.182
	Constant	-.061	.132	.214	1	.644	.941		

a. Variable(s) entered on step 1: education level.

Result:

The table compares people`s education levels in terms of their use of public transportation information applications mobile application. Education level is tested as a whole and then having graduate and 'bachelor' degree was compared to the reference category of having 'primary education'. In the sig column, the p-values are below apart from the test for the variable having bachelor's degree as an education level. This means there is a strong enough relationship between that variable and public transportation information applications mobile application usage.

It can be easily seen from the table that those who have bachelor degree are 1.350 times more likely to use public transportation information applications mobile application than those who have primary education degree.

2. Education level * driver information mobile application usage

Hypotheses:

H_0: Driver information mobile application usage is not related to (associated with) education level

H_1: Driver information mobile application usage is related to (associated with) education level

Crosstab

			Driver information mobile application usage		
			non-users	users	Total
Education level	Primary education	Count	176	64	240
		Expected Count	190.7	49.3	240.0
		% within education level	73.3%	26.7%	100.0%
		% within digital municipality usage	20.3%	28.6%	22.0%
		% of Total	16.1%	5.9%	22.0%
	Bachelor's degree	Count	453	111	564
		Expected Count	448.2	115.8	564.0
		% within education level	80.3%	19.7%	100.0%
		% within digital municipality usage	52.2%	49.6%	51.7%
		% of Total	41.5%	10.2%	51.7%
	Postgradute	Count	238	49	287
		Expected Count	228.1	58.9	287.0
		% within education level	82.9%	17.1%	100.0%
		% within digital municipality usage	27.5%	21.9%	26.3%
		% of Total	21.8%	4.5%	26.3%
Total		Count	867	224	1091
		Expected Count	867.0	224.0	1091.0
		% within education level	79.5%	20.5%	100.0%
		% within digital municipality usage	100.0%	100.0%	100.0%
		% of Total	79.5%	20.5%	100.0%

Respondents were classified in terms of whether they are using driver information mobile application or not and in terms of education level (having primary education (*İlköğretim*) and bachelors degree (*Lisans*) and postgraduate degree (*Lisansüstü*)).

Chi-Square Tests

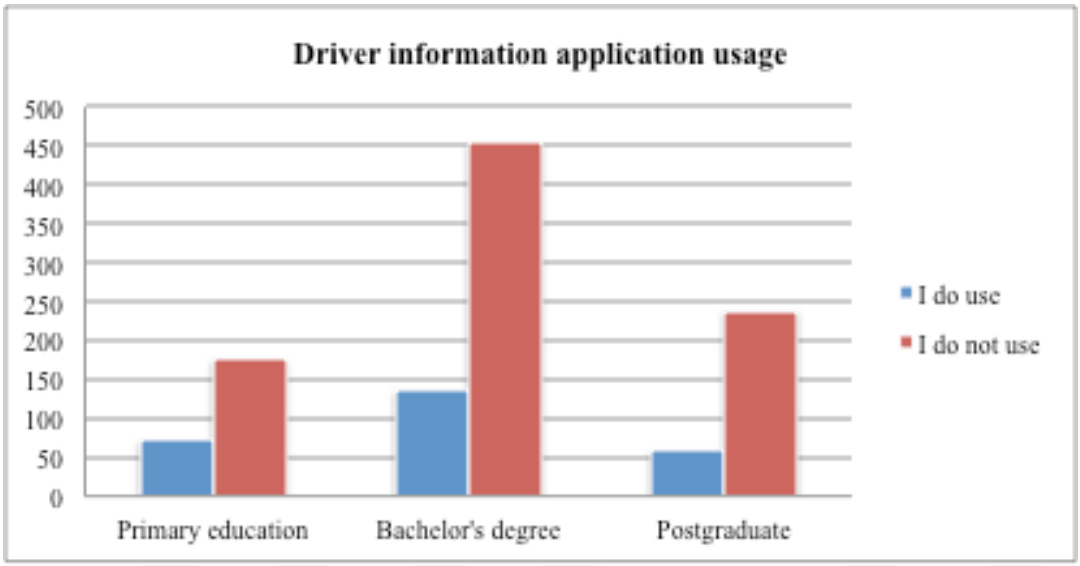
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.891[a]	2	.019	.019		
Likelihood Ratio	7.638	2	.022	.023		
Fisher's Exact Test	7.652			.022		
Linear-by-Linear Association	7.087[b]	1	.008	.008	.005	.001
N of Valid Cases	1091					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 49.28.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 7.891, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Driver information mobile application usage seems to be related to education level.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			7.803	2	.020			
	Bachelor's degree	-.395	.180	4.792	1	.029	.674	.473	.960
	Postgraduate	-.569	.214	7.047	1	.008	.566	.372	.862
	Constant	-1.012	.146	48.029	1	.000	.364		

a. Variable(s) entered on step 1: education level

Result:

It can be easily seen from the table that those who have bachelor degree are 0.674 times less likely to use driver information mobile application and those who have postgraduate degree are 0.566 less likely to use driver information mobile application than those who have primary education degree.

3. Education level * digital municipality usage

Hypotheses:

H_0: Digital municipality usage is not related to (associated with) education level

H_1: Digital municipality usage is related to (associated with) education level

Crosstab

			Digital municipality usage non-users	users	Total
Education level	Primary education	Count	194	44	238
		Expected Count	214.2	23.8	238.0
		% within education level	81.5%	18.5%	100.0%
		% within TRAFIC mobile app usage	19.8%	40.4%	21.8%
		% of Total	17.8%	4.0%	21.8%
	Bachelor's degree	Count	523	45	568
		Expected Count	511.3	56.7	568.0
		% within education level	92.1%	7.9%	100.0%
		% within TRAFIC mobile app usage	53.3%	41.3%	52.1%
		% of Total	47.9%	4.1%	52.1%
	Postgraduate	Count	265	20	285
		Expected Count	256.5	28.5	285.0
		% within education level	93.0%	7.0%	100.0%
		% within TRAFIC mobile app usage	27.0%	18.3%	26.1%
		% of Total	24.3%	1.8%	26.1%
Total		Count	982	109	1091
		Expected Count	982.0	109.0	1091.0
		% within education level	90.0%	10.0%	100.0%
		% within TRAFIC mobile app usage	100.0%	100.0%	100.0%
		% of Total	90.0%	10.0%	100.0%

Respondents were classified in terms of whether they are using digital municipality or not (Yes or No) and in terms of education level (having primary education (*İlköğretim*) and bachelors degree (*Lisans*) and postgraduate degree (*Lisansüstü*)).

Chi-Square Tests

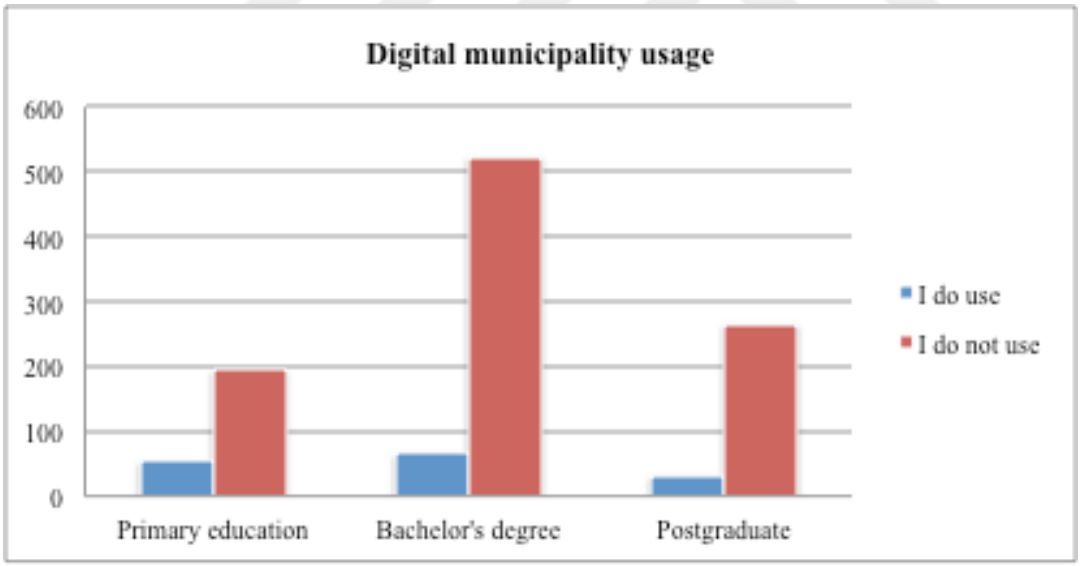
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	24.610[a]	2	.000	.000		
Likelihood Ratio	21.667	2	.000	.000		
Fisher's Exact Test	21.668			.000		
Linear-by-Linear Association	17.560[b]	1	.000	.000	.000	.000
N of Valid Cases	1091					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 23.78.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 24.610, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Digital municipality usage seems to be related to education level.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			23.117	2	.000			
	Bachelor's degree	-.969	.228	18.061	1	.000	.379	.243	.593
	Postgraduate	-1.100	.286	14.827	1	.000	.333	.190	.583
	Constant	-1.484	.167	78.950	1	.000	.227		

a. Variable(s) entered on step 1: education level.

Result:

The table compares people`s education levels in terms of their use of traffic mobile application.

It can be easily seen from the table that those who have bachelor degree are 0.379 times and those who have postgraduate degree are 0.333 times less likely to use digital municipality than those who have primary education degree.

Question 4: Is there an association between mobile application usage and age group?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
age group * public transportation information mobile app usage	1072	94.8%	59	5.2%	1131	100.0%
age group * digital municipality usage	1091	96.5%	40	3.5%	1131	100.0%
age group * driver information mobile app usage	1091	96.5%	40	3.5%	1131	100.0%

1. **Age group * public transportation information applications mobile app usage**

Hypotheses:

H_0: Public transportation information mobile application usage not related to (associated with) age

H_1: Public transportation information mobile application usage is related to (associated with) age

Crosstab

			Public transportation informaiton mobile app usage		
			non-users	users	Total
Age group	18-25	Count	159	230	389
		Expected Count	189.8	199.2	389.0
		% within age group	40.9%	59.1%	100.0%
		% within public transportation information mobile app usage	30.4%	41.9%	36.3%
		% of Total	14.8%	21.5%	36.3%
	26-45	Count	300	287	587
		Expected Count	286.4	300.6	587.0
		% within age group	51.1%	48.9%	100.0%
		% within public transportation information mobile app usage	57.4%	52.3%	54.8%
		% of Total	28.0%	26.8%	54.8%
	46-65	Count	58	27	85
		Expected Count	41.5	43.5	85.0
		% within age group	68.2%	31.8%	100.0%
		% within public transportation information mobile app usage	11.1%	4.9%	7.9%
		% of Total	5.4%	2.5%	7.9%
	65 over	Count	6	5	11
		Expected Count	5.4	5.6	11.0
		% within age group	54.5%	45.5%	100.0%
		% within public transportation information mobile app usage	1.1%	0.9%	1.0%
		% of Total	0.6%	0.5%	1.0%
Total		Count	523	549	1072
		Expected Count	523.0	549.0	1072.0
		% within age group	48.8%	51.2%	100.0%
		% within public transportation information mobile app usage	100.0%	100.0%	100.0%
		% of Total	48.8%	51.2%	100.0%

Chi-Square Tests

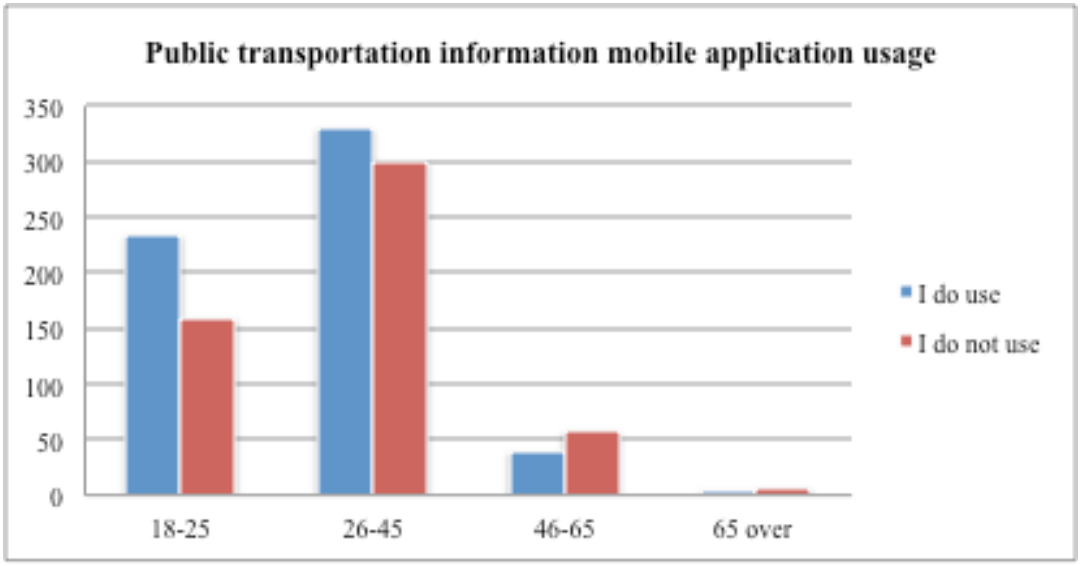
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	24.027[a]	3	.000	.000		
Likelihood Ratio	24.351	3	.000	.000		
Fisher's Exact Test	24.223			.000		
Linear-by-Linear Association	21.263[b]	1	.000	.000	.000	.000
N of Valid Cases	1072					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.37.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 24.027, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Public transportation information mobile application usage seems to be related to age.



Logistic Regression

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	age group			23.253	3	.000			
	age group(1)	-.413	.132	9.795	1	.002	.661	.510	.857
	age group(2)	-1.134	.255	19.802	1	.000	.322	.195	.530
	age group(3)	-.551	.614	.806	1	.369	.576	.173	1.920
	Constant	.369	.103	12.813	1	.000	1.447		

a. Variable(s) entered on step 1: age group.

Result:

The table compares people in terms of their age groups. That contrast was significant.

It seems that people who are between 26-45 and 46-65 years old are less likely to use public transportation information applications mobile application than those who are between 18-25 years old.

2. Age group * driver information mobile application usage

Hypotheses:

H_0: Driver information mobile application usage is not related to (associated with) person's age

H_1: Driver information mobile application usage is related to (associated with) person's age

Crosstab

			Driver information mobile application usage		
			non-users	users	Total
Age group	18-25	Count	320	72	392
		Expected Count	311.5	80.5	392.0
		% within age group	81.6%	18.4%	100.0%
		% within digital municipality usage	36.9%	32.1%	35.9%
		% of Total	29.3%	6.6%	35.9%
	26-45	Count	474	132	606
		Expected Count	481.6	124.4	606.0
		% within age group	78.2%	21.8%	100.0%
		% within digital municipality usage	54.7%	58.9%	55.5%
		% of Total	43.4%	12.1%	55.5%
	46-65	Count	63	19	82
		Expected Count	65.2	16.8	82.0
		% within age group	76.8%	23.2%	100.0%
		% within digital municipality usage	7.3%	8.5%	7.5%
		% of Total	5.8%	1.7%	7.5%
	65 over	Count	10	1	11
		Expected Count	8.7	2.3	11.0
		% within age group	90.9%	9.1%	100.0%
		% within digital municipality usage	1.2%	0.4%	1.0%
		% of Total	0.9%	0.1%	1.0%
Total		Count	867	224	1091
		Expected Count	867.0	224.0	1091.0
		% within age group	79.5%	20.5%	100.0%
		% within digital municipality usage	100.0%	100.0%	100.0%
		% of Total	79.5%	20.5%	100.0%

Chi-Square Tests

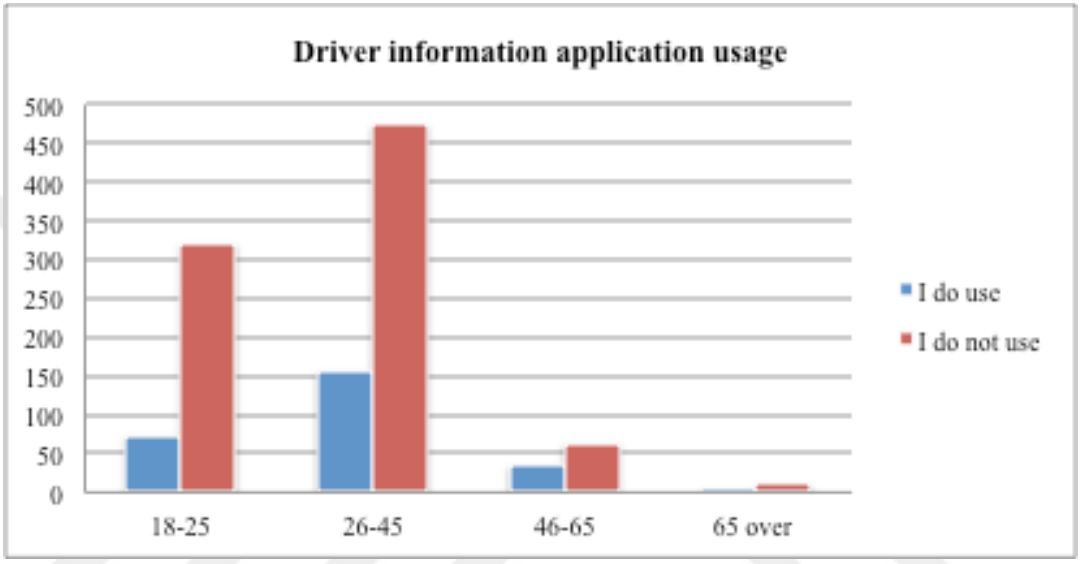
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.939[a]	3	.401	.408		
Likelihood Ratio	3.129	3	.372	.390		
Fisher's Exact Test	2.671			.451		
Linear-by-Linear Association	.916[b]	1	.339	.347	.184	.029
N of Valid Cases	1091					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 2.26.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 2.939 and $p > 0.05$.

Hence, there is no real evidence that the driver information mobile application usage is different for people who have different age.



3. Age group * digital municipality usage

H_0: Digital municipality usage not related to (associated with) age

H_1: Digital municipality usage is related to (associated with) age

Crosstab

			Digital municipality usage		
			non-users	users	Total
Age group	18-25	Count	349	44	393
		Expected Count	353.7	39.3	393.0
		% within age group	88.8%	11.2%	100.0%
		% within driver information mobile app usage	35.5%	40.4%	36.0%
		% of Total	32.0%	4.0%	36.0%
	26-45	Count	548	53	601
		Expected Count	541.0	60.0	601.0
		% within age group	91.2%	8.8%	100.0%
		% within driver information mobile app usage	55.8%	48.6%	55.1%
		% of Total	50.2%	4.9%	55.1%
	46-65	Count	75	11	86
		Expected Count	77.4	8.6	86.0
		% within age group	87.2%	12.8%	100.0%
		% within driver information mobile app usage	7.6%	10.1%	7.9%
		% of Total	6.9%	1.0%	7.9%
	65 over	Count	10	1	11
		Expected Count	9.9	1.1	11.0
		% within age group	90.9%	9.1%	100.0%
		% within driver information mobile app usage	1.0%	0.9%	1.0%
		% of Total	0.9%	0.1%	1.0%
Total		Count	982	109	1091
		Expected Count	982.0	109.0	1091.0
		% within age group	90.0%	10.0%	100.0%
		% within driver information mobile app usage	100.0%	100.0%	100.0%
		% of Total	90.0%	10.0%	100.0%

Chi-Square Tests

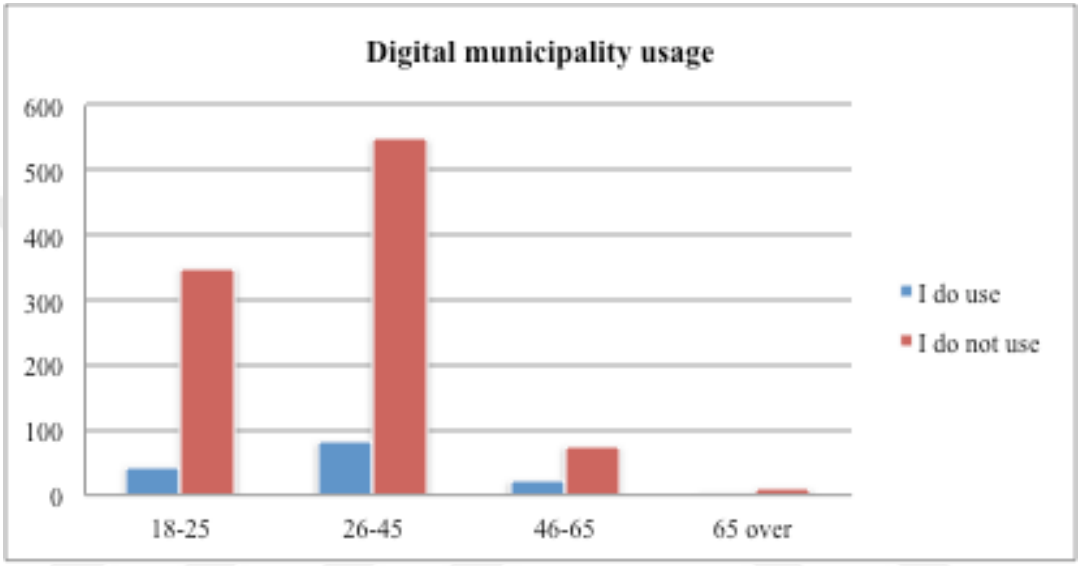
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.313[a]	3	.510	.495		
Likelihood Ratio	2.271	3	.518	.625		
Fisher's Exact Test	2.575			.420		
Linear-by-Linear Association	.158[b]	1	.691	.695	.377	.058
N of Valid Cases	1091					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 1.10.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 2.939 and $p > 0.05$.

Hence, there is no real evidence that the digital municipality usage is different for people who have different age.



Question 5: Does being aware of the mobile application have an effect on using the mobile application?

Hypotheses:

H_0: Public transportation information mobile application usage not related to (associated with) Public transportation information mobile application awareness

H_1: Public transportation information mobile application usage is related to (associated with) Public transportation information mobile application awareness

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Public transportation information mobile app awareness(1)	3.551	.175	413.274	1	.000	34.849	24.746	49.077
	Constant	-1.614	.115	197.647	1	.000	.199		

a. Variable(s) entered on step 1: Public transportation information mobile app awareness.

Hypotheses:

H_0: Driver information mobile application usage not related to (associated with) driver information mobile application awareness

H_1: Driver information mobile application usage is related to (associated with) driver information mobile application awareness

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Digital municipality awareness(1)	2.456	.189	168.217	1	.000	11.657	8.043	16.895
	Constant	-1.906	.098	379.441	1	.000	.149		

a. Variable(s) entered on step 1: Digital municipality awareness.

Hypotheses:

H_0: Digital municipality usage not related to (associated with) digital municipality awareness

H_1: Digital municipality usage is related to (associated with) digital municipality awareness

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Driver information mobile app awareness(1)	1.921	.288	44.378	1	.000	6.831	3.881	12.022
	Constant	-2.397	.113	452.844	1	.000	.091		

a. Variable(s) entered on step 1: Driver information mobile app awareness.

Results:

In the sig column, the p-values are below apart from the test for the variable public transportation information/driver information mobile application/digital municipality awareness. This means there is a strong enough relationship between that variable and mobile application usage.

It can be seen easily from the tables that people who are aware of mobile applications are 34.849, 11.657 and 6.831 times more likely to use public transportation information/driver information mobile applications/digital municipality respectively.

Question 6: Can mobile application usage be predicted based on mobile application user friendliness?

Hypotheses:

H_0: Public transportation information applications mobile application usage is not related to (associated with) mobile application user friendliness

H_1: Public transportation information applications mobile application usage is related to (associated with) mobile application user friendliness

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Difficult to use			365.507	2	.000			
	Do not use	-4.992	.411	147.428	1	.000	.007	.003	.015
	Easy to use	1.708	.515	11.013	1	.001	5.519	2.012	15.136
	Constant	2.290	.371	38.095	1	.000	9.875		

Hypotheses:

H_0: Driver information mobile application usage is not related to (associated with) mobile application user friendliness

H_1: Driver information mobile application usage is related to (associated with) mobile application user friendliness

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Difficult to use			347.730	2	.000			
	Do not use	-5.028	.459	119.997	1	.000	.007	.003	.016
	Easy to use	1.044	.473	4.863	1	.027	2.840	1.123	7.181
	Constant	1.288	.399	10.400	1	.001	3.625		

Result:

In the sig column, the p-values are below apart from the test for the variable public transportation and driver information mobile application user friendliness. This means there is a strong enough relationship between these variables and public transportation and driver information mobile application usage, respectively. Mobile application user-friendliness is tested as a whole and then ‘being easy’ and ‘not use’ were compared to the reference category of ‘being difficult’.

We can say that, those who find public transportation information mobile application easy to use are 5.519 times and who find driver information mobile application easy to use are 2.840 times more likely to use public transportation and driver information mobile application, respectively, than the people who find mobile application difficult to use. There is not a significant relationship between digital municipality usages and user-friendliness.

Question 7: Is there an association between municipality web site visiting preference and municipal web site user-friendliness?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Municipality web site user friendliness * Municipality web site visiting	1128	99.7%	3	0.3%	1131	100.0%

1. **Municipal web site user-friendliness * municipality web site visiting**

Hypotheses:

H_0: Municipality web site visiting is not related to (associated with) municipality web site user-friendliness

H_1: Municipality web site visiting is related to (associated with) municipality web site user-friendliness

Crosstabulation

			Municipality web site visiting		
			non-visiters	visiters	Total
Municipality web site user-friendliness	I do not visit	Count	683	135	818
		Expected Count	554.0	264.0	818.0
		% within Municipality web site user friendliness	83.5%	16.5%	100.0%
		% within Municipality web site visiting	89.4%	37.1%	72.5%
		% of Total	60.5%	12.0%	72.5%
	Easy and clear	Count	50	180	230
		Expected Count	155.8	74.2	230.0
		% within Municipality web site user friendliness	21.7%	78.3%	100.0%
		% within Municipality web site visiting	6.5%	49.5%	20.4%
		% of Total	4.4%	16.0%	20.4%
	Hard and complex	Count	31	49	80
		Expected Count	54.2	25.8	80.0
		% within Municipality web site user friendliness	38.8%	61.3%	100.0%
		% within Municipality web site visiting	4.1%	13.5%	7.1%
		% of Total	2.7%	4.3%	7.1%
Total		Count	764	364	1128
		Expected Count	764.0	364.0	1128.0
		% within Municipality web site user friendliness	67.7%	32.3%	100.0%
		% within Municipality web site visiting	100.0%	100.0%	100.0%
		% of Total	67.7%	32.3%	100.0%

Respondents were classified in terms of whether they are using visiting municipality web site or not (Yes or No) and whether they think municipality web site is user friendly, not user friendly or they do not use.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	346.358[a]	2	.000	.000		
Likelihood Ratio	338.284	2	.000	.000		
Fisher's Exact Test	337.665			.000		
Linear-by-Linear Association	254.895[b]	1	.000	.000	.000	.000
N of Valid Cases	1128					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 25.82.

Result:

From the first row of the last table, Pearson Chi-Square statistic $p< 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p< 0.05$.

Municipality web site visiting preference seems to be very much related to municipality web site user friendliness.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Do not use			274.555	2	.000			
	Easy to use	-2.079	.248	70.241	1	.000	.125	.077	.203
	Difficult to use	.823	.280	8.661	1	.003	2.278	1.316	3.940
	Constant	.458	.229	3.980	1	.046	1.581		

Result:

In the sig column, the p-values are below apart from the test for the variable municipal web site user friendliness. This means there is a strong enough relationship between that variable and municipality web site visiting. Web site user-friendliness is tested as a whole and then 'being easy' and 'not use' were compared to the reference category of 'being difficult'.

We can say that, those who find web site easy to use are 2.278 times more likely to use Municipality web site than the people who find it difficult to use.

Question 8: Is there an association between municipality web site visiting preference and education level?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Education level * municipality web site visiting	1131	100.0%	0	0.0%	1131	100.0%

1. Education level * municipality web site visiting

Hypotheses:

H_0: Municipality web site visiting is not related to (associated with) education level

H_1: Municipality web site visiting is related to (associated with) education level

Crosstab

			Municipality web site visiting		
			non-visiters	visiters	Total
Education level	Primary education	Count	148	99	247
		Expected Count	167.1	79.9	247.0
		% within education level	59.9%	40.1%	100.0%
		% within municipality web site visiting	19.3%	27.0%	21.8%
		% of Total	13.1%	8.8%	21.8%
	Bachelor's degree	Count	410	178	588
		Expected Count	397.7	190.3	588.0
		% within education level	69.7%	30.3%	100.0%
		% within municipality web site visiting	53.6%	48.6%	52.0%
		% of Total	36.3%	15.7%	52.0%
	Postgraduate	Count	207	89	296
		Expected Count	200.2	95.8	296.0
		% within education level	69.9%	30.1%	100.0%
		% within municipality web site visiting	27.1%	24.3%	26.2%
		% of Total	18.3%	7.9%	26.2%
Total		Count	765	366	1131
		Expected Count	765.0	366.0	1131.0
		% within education level	67.6%	32.4%	100.0%
		% within municipality web site visiting	100.0%	100.0%	100.0%
		% of Total	67.6%	32.4%	100.0%

Respondents were classified in terms of whether they are visiting municipal web site or not (visiting or not visitinig) and in terms of education level (having primary education (*İlköğretim*) and bachelors degree (*Lisans*) and postgraduate degree (*Lisansüstü*)).

Chi-Square Tests

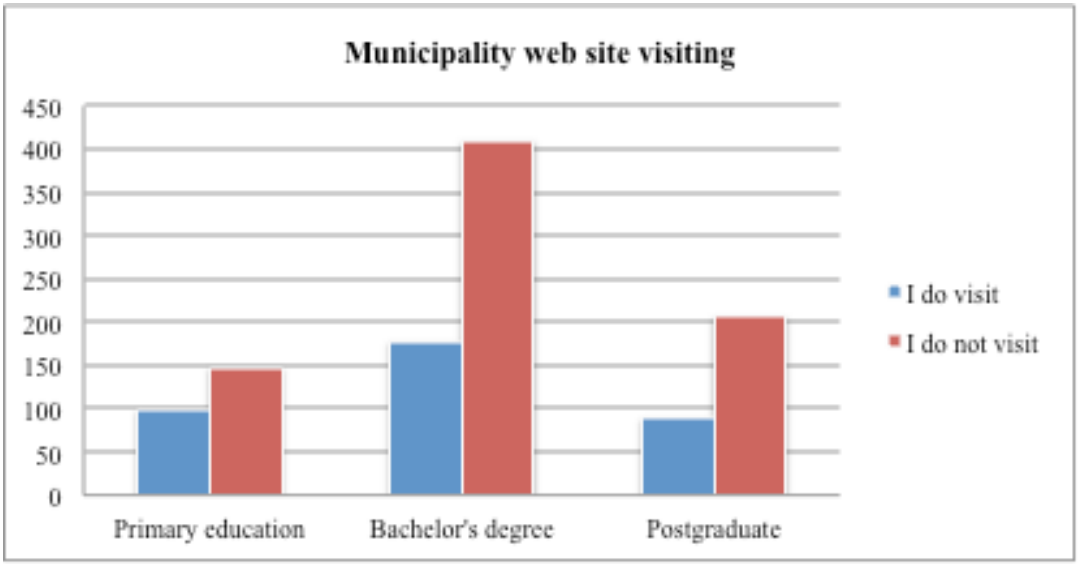
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	8.609[a]	2	.014	.014		
Likelihood Ratio	8.396	2	.015	.015		
Fisher's Exact Test	8.417			.015		
Linear-by-Linear Association	5.642[b]	1	.018	.019	.010	.002
N of Valid Cases	1131					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 79.93.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 8.609, and $p< 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p< 0.05$.

Municipality web site visiting preference seems to be related to education level.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			8.539	2	.014			
	Bachelor's degree	-.432	.158	7.500	1	.006	.649	.476	.884
	Postgraduate	-.442	.181	5.933	1	.015	.643	.450	.917
	Constant	-.402	.130	9.591	1	.002	.669		

a. Variable(s) entered on step 1: education level.

Result:

The table compares people`s education levels in terms of visiting municipality web site. Education level is tested as a whole and then having 'post graduate' and 'bachelor's' degree were compared to the reference category having 'primary education'. In the sig column, the p-values are below apart from the test for the variable having bachelor's degree and postgraduate degree as an education level. This means there is a strong enough relationship between these variables and municipal web site visiting preference.

It can be seen easily from the table that those who have bachelor's degree are 0.649 times and who have postgraduate degree are 0.643 times less likely to visit municipality web site than those who have primary education degree.

Question 9: Is there an association between municipal web site visiting preference and age?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
age group * municipality web site visiting	1131	100.0%	0	0.0%	1131	100.0%

1. **Age group * municipality web site visiting**

Hypotheses:

H_0: Municipality web site visiting is not related to (associated with) age

H_1: Municipality web site visiting is related to (associated with) age

Crosstab

			Municipality web site visiting		
			non-visiters	visiters	Total
Age group	18-25	Count	282	111	393
		Expected Count	265.8	127.2	393.0
		% within age group	71.8%	28.2%	100.0%
		% within municipality web site visiting	36.9%	30.3%	34.7%
		% of Total	24.9%	9.8%	34.7%
	26-45	Count	421	209	630
		Expected Count	426.1	203.9	630.0
		% within age group	66.8%	33.2%	100.0%
		% within municipality web site visiting	55.0%	57.1%	55.7%
		% of Total	37.2%	18.5%	55.7%
	46-65	Count	52	45	97
		Expected Count	65.6	31.4	97.0
		% within age group	53.6%	46.4%	100.0%
		% within municipality web site visiting	6.8%	12.3%	8.6%
		% of Total	4.6%	4.0%	8.6%
	65 over	Count	10	1	11
		Expected Count	7.4	3.6	11.0
		% within age group	90.9%	9.1%	100.0%
		% within municipality web site visiting	1.3%	0.3%	1.0%
		% of Total	0.9%	0.1%	1.0%
Total		Count	765	366	1131
		Expected Count	765.0	366.0	1131.0
		% within age group	67.6%	32.4%	100.0%
		% within municipality web site visiting	100.0%	100.0%	100.0%
		% of Total	67.6%	32.4%	100.0%

Respondents were classified in terms of whether they visiting municipal web site or not (visiting or not visiting) and in terms of age groups (18-25, 26-45, 46-65, 65 and over).

Chi-Square Tests

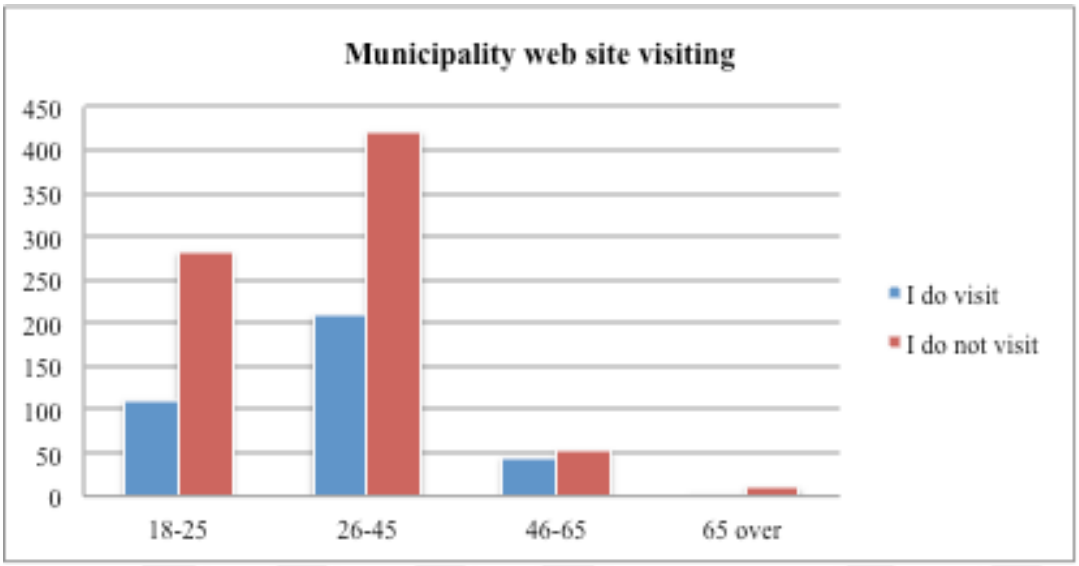
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	14.679[a]	3	.002	.002		
Likelihood Ratio	14.918	3	.002	.002		
Fisher's Exact Test	14.178			.002		
Linear-by-Linear Association	5.940[b]	1	.015	.015	.009	.002
N of Valid Cases	1131					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.56.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 14.679, and $p< 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p< 0.05$.

Municipality web site visiting preference seems to be related to age.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	18-25			13.899	3	.003			
	26-45	.232	.140	2.732	1	.098	1.261	.958	1.661
	46-65	.788	.232	11.491	1	.001	2.199	1.394	3.467
	65 over	-1.370	1.055	1.688	1	.194	.254	.032	2.008
	Constant	-.932	.112	69.241	1	.000	.394		

a. Variable(s) entered on step 1: age group.

Result:

The table compares people in terms of their age groups.

It seems that people who are between 46-65 years old are 2.199 times more likely to visit municipality web site than those who are between 18-25 years old.

Question 10: Is there an association between using municipal interaction tools and education?

Hypotheses:

H_0: Municipality call center interaction tool preference is not related to (associated with) education level

H_1: Municipality call center interaction tool preference is related to (associated with) education level

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			24.555	2	.000			
	Bachelor's degree	1.045	.215	23.563	1	.000	2.844	1.865	4.337
	Postgraduate	.480	.195	6.070	1	.014	1.616	1.103	2.368
	Constant	-1.800	.167	116.728	1	.000	.165		

a. Variable(s) entered on step 1: education level.

Hypotheses:

H_0: Special line e-mail service interaction tool preference is not related to (associated with) education level

H_1: Special line e-mail service interaction tool preference is related to (associated with) education level

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			10.425	2	.005			
	Bachelor's degree	.742	.232	10.252	1	.001	2.100	1.333	3.307
	Postgraduate	.361	.207	3.031	1	.082	1.434	.956	2.153
	Constant	-1.946	.176	122.590	1	.000	.143		

a. Variable(s) entered on step 1: education level.

Hypotheses:

H_0: Special line call center interaction tool preference is not related to (associated with) education level

H_1: Special line call center interaction tool preference is related to (associated with) education level

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			13.628	2	.001			
	Bachelor's degree	.728	.198	13.502	1	.000	2.070	1.404	3.052
	Postgraduate	.441	.172	6.555	1	.010	1.554	1.109	2.177
	Constant	-1.391	.145	91.341	1	.000	.249		

a. Variable(s) entered on step 1: education level.

Hypotheses:

H_0: Social media preference is not related to (associated with) education level

H_1: Social media preference is related to (associated with) education level

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Primary education			10.011	2	.007			
	Bachelor's degree	.650	.212	9.432	1	.002	1.915	1.265	2.899
	Postgraduate	.464	.184	6.366	1	.012	1.590	1.109	2.280
	Constant	-1.618	.156	106.986	1	.000	.198		

a. Variable(s) entered on step 1: education level.

Result:

The table compares people`s education levels in terms of being aware of Using Municipalities interaction tools. Education level is tested as a whole and then having primary education and bachelor degree are compared to the reference category having postgraduate degree in the sig column, the p-values are below

apart from the test for the variable having bachelor's degree and primary education as an education level. This means there is a strong enough relationship between these variables and using Municipalities interaction tools.

It can be seen easily from the tables that those who have bachelor degree and primary education are more likely to use interaction tools than those who have postgraduate degree.

Question 11: Is there an association between using municipalities' interaction tools and age?

Hypotheses:

H_0: Special line e-mail service interaction tool preference is not related to (associated with) age

H_1: Special line e-mail service interaction tool preference is related to (associated with) age

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	18-25			10.219	3	.017			
	26-45	.012	.175	.005	1	.946	1.012	.718	1.426
	46-65	.754	.263	8.227	1	.004	2.126	1.270	3.558
	65 over	-.647	1.058	.374	1	.541	.524	.066	4.164
	Constant	-1.656	.137	145.064	1	.000	.191		

a. Variable(s) entered on step 1: age group.

Result:

The table compares people in terms of their age groups.

It seems that people who are between 46-65 years old are more likely to use special line e-mail service interaction tool than those who are between 18-25 years old.

Question 12: Is there an association between public transportation usage frequency and public transportation information mobile application awareness?

1. **Public transport usage frequency * public transportation information mobile application awareness**

Hypotheses:

H_0: Public transportation information mobile application awareness is not related to (associated with) public transportation usage frequency

H_1: Public transportation information mobile application awareness is related to (associated with) public transportation usage frequency

Crosstab

			Public transportation information mobile app awareness		
			non-aware	aware	Total
Public transport usage freq	Several times a week	Count	118	154	272
		Expected Count	133.5	138.5	272.0
		% within public transport usage freq	43.4%	56.6%	100.0%
		% within public transportation information mobile app awareness	21.3%	26.7%	24.0%
		% of Total	10.4%	13.6%	24.0%
	5-7 day a week	Count	134	198	332
		Expected Count	162.9	169.1	332.0
		% within public transport usage freq	40.4%	59.6%	100.0%
		% within public transportation information mobile app awareness	24.1%	34.4%	29.4%
		% of Total	11.8%	17.5%	29.4%
	Few times a month	Count	141	114	255
		Expected Count	125.1	129.9	255.0
		% within public transport usage freq	55.3%	44.7%	100.0%
		% within public transportation information mobile app awareness	25.4%	19.8%	22.5%
		% of Total	12.5%	10.1%	22.5%
	Few times a year	Count	162	110	272
		Expected Count	133.5	138.5	272.0
		% within public transport usage freq	59.6%	40.4%	100.0%
		% within public transportation information mobile app awareness	29.2%	19.1%	24.0%
		% of Total	14.3%	9.7%	24.0%
Total		Count	555	576	1131
		Expected Count	555.0	576.0	1131.0

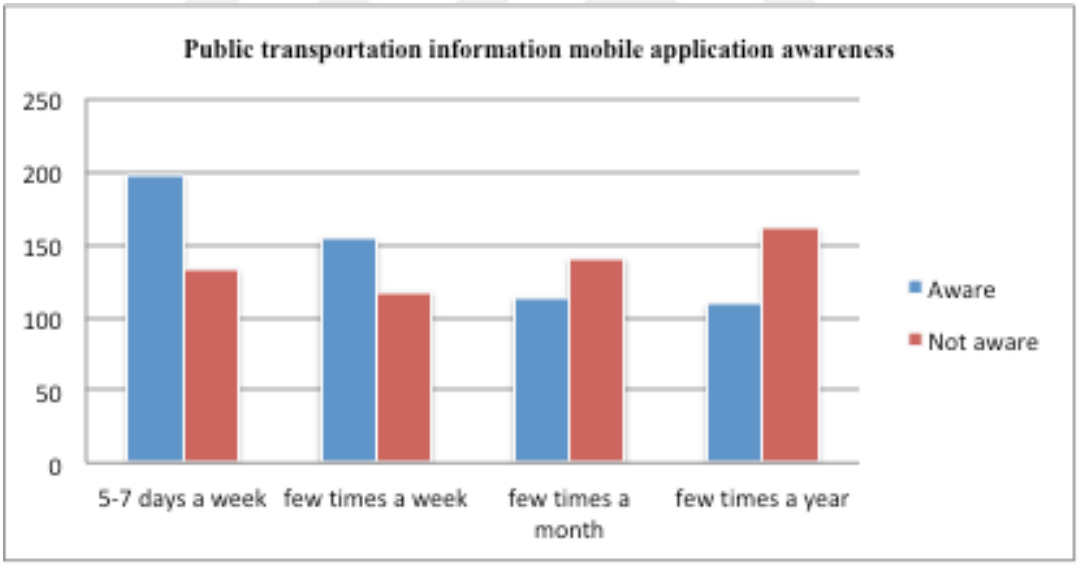
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	29.522[a]	3	.000	.000		
Likelihood Ratio	29.671	3	.000	.000		
Fisher's Exact Test	29.575			.000		
Linear-by-Linear Association	22.809[b]	1	.000	.000	.000	.000
N of Valid Cases	1131					

Result:

From the first row of the last table, Pearson Chi-Square statistic is 29.522, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Public transportation information mobile application awareness seems to be affected from people's public transportation usage frequency.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Few times a year			29.204	3	.000			
	Few times a week	.653	.174	14.121	1	.000	1.922	1.367	2.702
	5-7 days a week	.778	.167	21.765	1	.000	2.176	1.570	3.017
	Few times a month	.175	.176	.979	1	.322	1.191	.843	1.683
	Constant	-.387	.124	9.818	1	.002	.679		

Result:

In the sig column, the p-values are below apart from the test for the variable public transportation usage frequency. This means there is a strong enough relationship between that variable and mobile application awareness. Public transport usage frequency is tested as a whole and then '5-7 days a week' and 'few times a week', and 'few times a month' were compared to the reference category of 'few times a year'.

We can say that, those who are using public transportation 5-7 days a week and few times a week are much more likely to be aware of public transportation information mobile application.

Question 13: Is there an association between using public transportation usage frequency and mobile application usage?

1. **Public transport usage frequency * public transportation information mobile application usage**

Hypotheses:

H_0: Public transportation information mobile application usage is not related to (associated with) public transport usage frequency

H_1: Public transportation information mobile application usage is related to (associated with) public transport usage frequency

Crosstab

			Public transportation information mobile app usage		
			non-users	users	Total
Public transport usage freq	Several times a week	Count	92	161	253
		Expected Count	123.4	129.6	253.0
		% within public transport usage freq	36.4%	63.6%	100.0%
		% within BUSTRACK mobile app usage	17.6%	29.3%	23.6%
		% of Total	8.6%	15.0%	23.6%
	5-7 days a week	Count	124	191	315
		Expected Count	153.7	161.3	315.0
		% within public transport usage freq	39.4%	60.6%	100.0%
		% within BUSTRACK mobile app usage	23.7%	34.8%	29.4%
		% of Total	11.6%	17.8%	29.4%
	Few times a month	Count	136	105	241
		Expected Count	117.6	123.4	241.0
		% within public transport usage freq	56.4%	43.6%	100.0%
		% within BUSTRACK mobile app usage	26.0%	19.1%	22.5%
		% of Total	12.7%	9.8%	22.5%
	Few times a year	Count	171	92	263
		Expected Count	128.3	134.7	263.0
		% within public transport usage freq	65.0%	35.0%	100.0%
		% within BUSTRACK mobile app usage	32.7%	16.8%	24.5%
		% of Total	16.0%	8.6%	24.5%
Total		Count	523	549	1072
		Expected Count	523.0	549.0	1072.0
		% within public transport usage freq	48.8%	51.2%	100.0%
		% within BUSTRACK mobile app usage	100.0%	100.0%	100.0%
		% of Total	48.8%	51.2%	100.0%

Chi-Square Tests

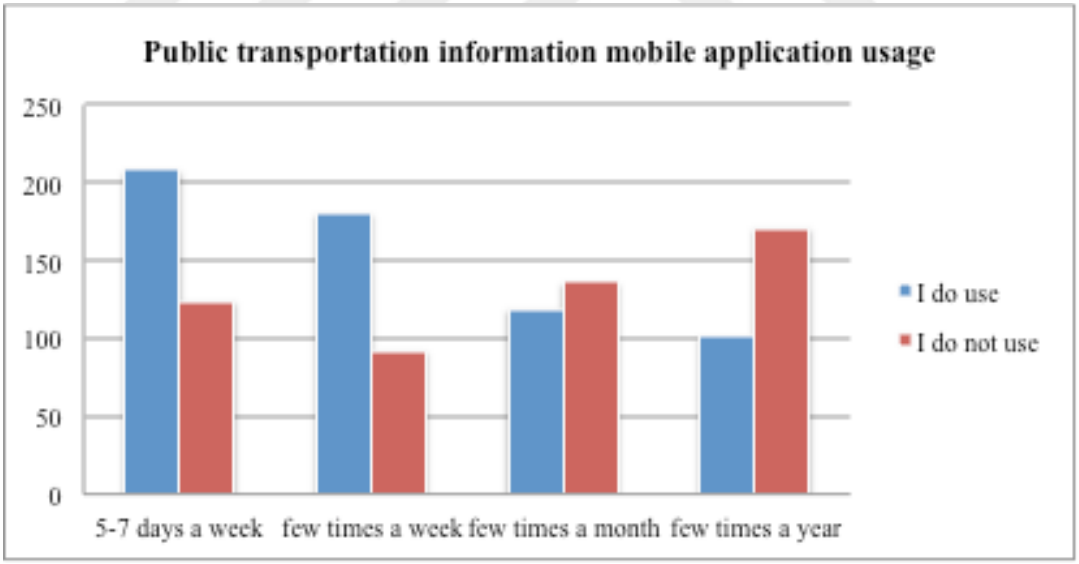
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	60.191[a]	3	.000	.000		
Likelihood Ratio	60.887	3	.000	.000		
Fisher's Exact Test	60.663			.000		
Linear-by-Linear Association	56.271[b]	1	.000	.000	.000	.000
N of Valid Cases	1072					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 117.58.

Result:

From the first row of the last table, Pearson Chi-Square statistic is 60.191, and $p < 0.05$; ie, a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$.

Public transportation information mobile application usage seems to be affected from people's public transportation usage frequency.



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	public transport usage freq			58.664	3	.000			
	public transport usage freq(1)	1.179	.184	41.162	1	.000	3.253	2.269	4.664
	public transport usage freq(2)	1.052	.173	36.859	1	.000	2.863	2.039	4.021
	public transport usage freq(3)	.361	.183	3.883	1	.049	1.435	1.002	2.055
	Constant	-.620	.129	22.985	1	.000	.538		

Result:

In the sig column, the p-values are below apart from the test for the variable public transportation usage frequency. This means there is a strong enough relationship between that variable and mobile application usage. Public transport usage frequency is tested as a whole and then '5-7 day per week' and 'several times in a week', and 'several times in a month' are compared to the reference category of 'several times in a year'.

We can say that, those who are using public transportation 5-7 times and several times in a week are much more likely to use public transportation information applications mobile application.