DIGITAL DIVIDE FROM THE PERSPECTIVE OF SMART MOBILITY APPLICATIONS: A CASE STUDY OF METU, ANKARA

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ABSTRACT

DIGITAL DIVIDE FROM THE PERSPECTIVE OF SMART MOBILITY APPLICATIONS: A CASE STUDY OF METU, ANKARA

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Digital divide concept has been drawing attention in the world since the first appearance of the internet. It explains the inequality between people caused by their ability to access any technology and interpret this technology to be able to use it. The concept emerged as a consequence of technology diffusion, and related information and communication technologies that came into people's life. Since there is a huge population living in different countries and cities who is affecting from digital divide, it become a multi-dimensional complex phenomenon which have different types and dimension. The increasing role of smart phones in daily life triggered mobile apps to become one of the most popular ICT-based services and the process of using public transport is intended to be supported and eased by mobile applications in smart phones. However, whether these services are able to be accessed and used by every person in population is rather unclear. The case study conducted in the thesis analyzes this ability to access and use of the mobile public transport applications.

In this context, digital divide is approached from two different perspectives; the types and the dimensions. As a case, METU campus were selected in the frame of mobile public transport applications of Ankara, to investigate the validity of access and social

digital divide, and the effect of income, education level, occupation, age and gender on digital divide.

Keywords: Digital Divide, Smart Mobility, ICT- Based Services, Public Transport

ÖZ

AKILLI ULAŞIM UYGULAMALARI PERSPEKTİFİNDEN DİJİTAL AYRIM: ODTÜ, ANKARA ALAN İNCELEMESİ

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Dijital ayrım kavramı internetin ilk ortaya çıkışından bu yana tüm dünyada dikkat çeken bir kavram olmuştur. Bu kavram, insanlar arasında herhangi bir teknolojiye erişme ve bu teknolojiden anlam çıkarıp kullanabilme kabiliyetinden kaynaklanan eşitsizliğe dayanır. Dijital ayrım, teknolojinin yayılmasının ve insan hayatının her boyutuna entegre olmasının bir sonucu olarak ortaya çıkmış, günümüzde ise farklı tür ve bileşenlere sahip çok boyutlu karmaşık bir olgu haline gelmiştir. Akıllı telefonların günlük yaşamdaki artan rolü, mobil uygulamaların en yaygın BİT tabanlı hizmetlerden biri olmasını sağlamış, böylece toplu taşıma kullanma süreci akıllı telefonlardaki mobil uygulamalar tarafından desteklenmesi ve kolaylaştırılmıştır. Fakat bu hizmetlere toplumdaki tüm bireyler tarafından erişilip erişilemediği ve bunların ardındaki sebepler günümüz teknoloji dünyasında giderek daha da önem kazanan bir konudur. Tez içerisinde yürütülen örnek alan araştırması, bireylerin mobil toplu taşıma uygulamalarına erişme ve kullanma yeteneğini analiz etmektedir.

Bu bağlamda, dijital ayrım kavramına dijital ayrımın türleri ve boyutları açılarındn yaklaşılmıştır. Örnek alan araştırması olarak ODTÜ kampüsü Ankara'da geçerli olan mobil toplu taşıma uygulamaları temelinde incelenmiş, seçilen alanda erişim ve sosyal

dijital ayrımın geçerliliği; ve gelir, eğitim düzeyi, meslek, yaş ve cinsiyet faktörlerinin dijital ayrım üzerindeki etkileri incelenmiştir.

Anahtar Kelimeler: Dijital Ayrım, Akıllı Ulaşım, BİT tabanlı hizmetler, Toplu Taşıma

To Naci Özgür

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CHAPTER 1

INTRODUCTION

1.1. Problem Definition

"One should not stop at a particular point in time and say that a particular technology or application will be available to everybody within a couple of years or at any projected date in the future" (Dijk et al, p.325).

Do the services based on information and communication technologies (ICT) and more specifically smart mobility systems and applications create new inequalities between people or deepen the existing divisions that have emerged since the first appearance of the internet? This is the core question of this study, which focuses on the issue of ‘digital divide’ as a possible side-effect of advancements in digital technologies and smart city applications.

Although the starting point of the digital divide concept was the ability to access a computer and internet, over the years it evolved to comprise a wider set of issues, because even though people may have easy access to computers and the internet, they still may not be able or willing to use smart applications, hence contributing to this divide. ICT have evolved and changed considerably since the beginning of the 21st century. Mobile phones evolved to smart phones; computers are now available in various types; the internet is now accessible via laptops, smart phones, tablets, televisions, and many other devices. At this point, the essential question is whether those various devices and the high ability to access the internet will be enough to overcome the digital divide? As Norris (2001) stated, in the future when the Internet connectivity normalizes, will digital inequality be an old problem which has faded over time, or will there be permanent division between info-haves and have-nots?

1.2. The Aim of the Study and Research Questions

Since the digital divide concept has first appeared, many researches claimed that access to technology can prevent digital inequalities and help overcome digital divide. Thus, most governmental initiatives about preventing digital divide is based on providing access to technology for everyone, since many scholar and officials believed that physical access is the key factor to overcome the divide. However, this may not be as straightforward; and the aim of the study is to investigate whether providing access to new smart mobility technologies, creating circumstances for its initial usage and expecting people to be connected are enough for people's intention to use these ICT-based services or not. As stated by Hsieh at al. (2008, p.98), post-implementation acceptance is a crucial factor since the benefits from ICT occur through sustained use; and hence government initiatives to implement ICT will not change the issue of digital inequality unless there is continued use. Thus, the main research question of the thesis is that do the services based on ICT, and more specifically smart mobility applications create new or existing inequalities between people that have emerged since the first appearance of the internet? Second research question is do the drivers for the intention to use smart mobility services are the same for all people despite their different circumstances, and do these people react in the same way when the access to these services is provided?

1.3. Research Methodology

This study is designed as a research based on an important but not well-enquired topic, digital divide. Although digital divide is studied deeply in world literature, it is new and low-enquired topic which has very little research in the Turkish literature. Therefore, the design of the thesis is based on an in-depth literature review, specifying the criteria for a survey and evaluate them in Turkey context. As a research methodology, single case study is conducted covering all mobile smart mobility applications which include different modes of public transport in the Middle East Technical University (METU) so that the study covers all dimensions of digital divide.

METU has been selected because it both presented a variety of transport options and provided an opportunity to include people with different socio-economic and demographic characteristics: students, academics, administrative staff, as well as Teknokent staff. It has been assumed that this diversity could help analyse people with different mobility patterns and different attitudes towards smart technologies.

As a survey method, questionnaire is used to answer the thesis question. The literature review revealed two different kinds of criteria for digital divide: the ones based on types of digital divide and the ones based on dimensions of digital divide. These two kinds provided different data which help to understand whether access to mobile applications is enough, whether there are any types of digital divide, and what kind of dynamics are there to explain a possible digital divide.

1.4. The Structure of the Thesis

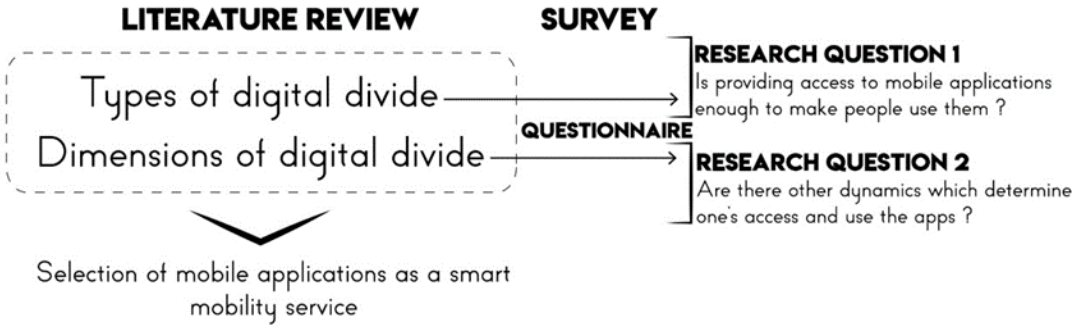

Figure 1.1. Overall design of the research

The figure above demonstrates the design of the research to answer the two research questions via the relation between the criteria coming from the literature and the research tool. Based on these research questions, this thesis starts with a review of the smart city concept, the emergence of smart mobility technologies and the current applications both in the world and Turkey, presented in Chapter 2.

Then in Chapter 3, the key concept which this thesis depends on, Digital Divide is analyzed. The background, the reasons for its emergence, difficulties about measuring the concept, dimensions and types of digital divide are investigated.

After that, in Chapter 4, the methodology of the study is described. In order to explore the issues, problems and questions rose above; a questionnaire has been applied in METU campus with 145 participants. The questionnaire is based on three mobile applications of Ankara: Ego Cepte with 76 users among 145, Moovit with 22 users among 145 and ABB Trafik with 18 users among 145. In the survey, Google Maps and Yandex maps applications were not included, since they are not totally public transport applications, but map services.

The results of the questionnaire are described in Chapter 5. The findings are discussed in the light of the literature review.

Finally, in Chapter 6, conclusions are presented, and recommendations are made for both addressing digital divide and performing further scientific research on this topic.

1.5. Limitations

The study has some limitations both in theory and practice processes. Since the issue of digital divide is an area that is not researched thoroughly in Turkey yet, the literature review could not provide a satisfactory level of understanding regarding the current situation in Turkey. Another limitation is people's reaction to the questionnaire. Some people have prejudices about participating a questionnaire, even if it does not include sensitive questions. Another important limitation is the scope of mobile public transport applications of Ankara as a base of the survey. Although all valid apps, that is Ego Cepte, Moovit and ABB Trafik, were studied, the scope of these apps has been observed to be insufficient in some points; for example, there is no application which contains the rail system of public transport, i.e. metro and Ankaray. Similarly, dolmush, a highly-used public transport mode, is not included in these applications. Notwithstanding these limitations, the study helps improve our understanding of the usage of smart technologies in public transport and the issue of digital divide with regards to the use of these technologies.

CHAPTER 2

TECHNOLOGY AS A BASE FOR SMART CITY

Today's world is changing quicker than ever before and our knowledge about the distribution of wealth, technology, innovation, and production is becoming obsolete day by day. A whole new world that is fueled by information technologies, knowledge flows, communication networks, innovation, and globalization is rising. Due to these rising phenomena, a new generation of cities appears which depends on knowledge, innovation, and intelligence.

2.1. The Technological Background of Smart City

At the beginning of the twenty-first century, countries of the developed world were marked by a major turn towards the knowledge-based economy. In leading countries and regions, competition and growth are taking place mainly in terms of Research and Development (R&D) and technological innovation. Most dynamic sectors of industry draw their competitive advantage from knowledge, research, and innovation. Countries have fully embraced the target of becoming the most competitive and dynamic knowledge-based economy in the world. Thus, a new model of development and prosperity based on knowledge, technology, and innovation has arisen (Komninos, 2008).

The path to knowledge-based cities has been accelerated by the globalization of the economy and capital accumulation. In developed countries, global flows of knowledge-intensive services, supply chains, and research networks become the new milestones. "Information technology has powerfully boosted the system, contributing to increasing rates of profit, accelerating internationalization, and engendering a new policy agenda on the part of governments, to foster capital accumulation at the expense of social redistribution." (Hall, 2014, p.445)

As a result, a new urban geography is characterized by sharp spatial divisions of labor, with the decentralization of production functions, but with informational industries remaining concentrated highly in innovative urban areas. (Hall, 2014) More specifically, in the new division of labor, traditional industries, such as textiles, metals, shipbuilding with highly standardized work practices and low know-how are moving to developed countries. As Komninos (2008) states, research, design, and development of new products, knowledge-intensive manufacturing, and knowledge-intensive services remain mainly in the core regions and a small number of selected metropolises and innovative hubs in developing countries. This new division of labor with further segregation of manufacturing and services and the location of segments of production all over the world has created major needs for the global supply chain management (Komninos, 2008).

Today, knowledge and innovation become the golden keys for managing and controlling the global economy. Technological intelligence, innovation, and transfer of them are built on global networks that bring capabilities and creativity from around the world into partnership with each other. This new global setting triggered a new development triad, including knowledge-based and innovation-led economies, international regulation, and smart agglomerations (Komninos, 2008).

This new development has resulted in a change of paradigm in the 21st century, with the concept of becoming smart. With the integration of technology in all aspects of people's lives, cities started to address such challenges as climate change, energy consumption and economic inequality through increasing usage of digital technologies. The Smart City concept gained importance to connect different operations and processes with a view to provide effective solutions to these complex systemic challenges. The whole process is thought to be starting with smaller, target-oriented, department-level projects, and in time, reaching to a unified city ecosystem (Yesner, 2017).

In the following sections, the emergence of the Smart City concept is described from a historical perspective and through a better understanding of related concepts.

2.2. Emerging Concepts Related with Smart City

After industrialization, urban places gained more importance throughout the world. As an important result of industrialization, an increasing proportion of the world population started to live in places that can be defined as urban, which brought the term 'urbanization'. Urban areas started to change so that they can respond to the growing population and changing living conditions of them. Consequently, natural areas began to be used enormously to satisfy rising living standards. However, this caused ecological, economic, and spatial problems such as urban sprawl, the loss of green space and biodiversity, environmental pollution, a huge traffic problem parallel to the introduction of growth of automobile use, and inadequate infrastructure (Rezafar&Koramaz, 2014).

2.2.1. Sustainability Concept

After the 1970s, particularly with the petrol crisis and environmental degradation, a term related to the future urban development has arisen, which is 'Sustainable City'. It became the major theme for planners by the early 1990s. The widely accepted definition came from the United Nations Brundtland Commission Report (1987) – "development which meets present needs without compromising the ability of future generations to achieve their own needs and aspirations." In general, sustainability's target is to meet the economic, environmental, and social needs of the community without harming to the living conditions of future generations (Brundtland et al. 1987). There were three important components of sustainability: economic, social, and environmental. Some of the aims were developing urban forms and transport patterns that help contain spatial growth, protect natural and agricultural land, conserve energy and minimize emissions.

From transport planning point of view, this meant increasing accessibility without creating dependence on the automobiles, and hence improving non-motorized transport modes, i.e. walking and cycling, and developing public transport, as well as supporting urban forms that make walking, cycling and public transport more viable options. The actual difficult part was that it was not clear how this mapped into actual everyday decisions in an urban context. (Hall, 2014). However, today, the concept of sustainability takes an important part in planning in the world. In the sections below, it will be seen that the tools introduced by the smart city approach mostly aim at effectively achieving the goals of sustainable city.

2.2.2. City-based Concepts

One of the emerging concepts related with smart city is eco-city and green city, which promotes the idea of producing energy from clean resources eliminating all carbon waste and creating a nature-friendly city with a balance with nature (Eremia&Toma&Sanduleac, 2017). The terms are in line with the environmental sustainability objectives, which aims to help control and reduce waste, energy consumption and negative environmental effect, and minimizing emissions and impact on the nature.

Another term, digital city, became popular concept in the 1990s. Generally, its basis is the growing information and telecommunication technology as well as a large information system. The European Commission founded the 'European Digital Cities' program (1996-1999), which was the first action that inspired the literature. The idea was supporting the complex structure of a city with information platforms and digital networks by providing participation of the citizens.

Finally, another emerged term intelligent city, refers to territories with a high capacity for learning and innovation. Komninos (2008) states that an intelligent city is built-in with the creativity of its population; together with their institutions for knowledge creation; and their digital infrastructure and services for communication and knowledge management.

Many other terms have appeared in the literature and planning practice for defining the ideal city or ideal planning approaches, as shown in Table 2.1, which is based on a study by Eremia, Toma, and Sanduleac (2017).

Table 2.1. *Geographic trends in city term usage*

Term	Trend	Regional Popularity
Future cities	Stable	Global
Eco City	Stable	Asia
Intelligent cities	Stable	Northern America
Sustainable cities	Stable	Commonwealth
Digital cities	Stable after a decreasing interest	USA, UK, Ireland, Philippine
Innavative cities	Stable	USA, UK, India

According to this table and its based study, many different terms have appeared in different parts of the world through time. While some of them have rarely been using, some others have a stable trend since their first appearance. In reviewing some of these different terms, it is clear that in the future, cities must adapt to climate change and address such problems as; energy shortage, environmental degradation, population aging and growth, geopolitical changes, human mobility needs and accessibility issues, social conflicts and inequality, security problems and so on. While various planning approaches and movements continue addressing these issues, the smart city concept emerged as an approach that makes the most of available digital technologies as a tool in solving these problems.

2.3. Smart City: Definition and Components

According to the United Nation's Population Facts Report (2018), only 30 per cent of the world's population lived in urban areas in 1950 while this proportion grew to 55 per cent by 2018.

The report illustrates that as of 2018, America is the most urbanized region with 82 per cent, while Asia is approximately 50 per cent and Africa remains the most rural continent with its 43 per cent.

As the main outcome, urban areas have been facing significant challenges due to the rapid urbanization and consequences of climate change related to this, as described in sections above. The incomparable rate of growth of urban areas causes an urgency to find ways to manage the risks and concerns (Papa&Gargiulo&Russo, 2017). Therefore, policymakers, officials and planners have been working hard to find out strategies and actions aimed at reducing these consequences related to climate change while promoting sustainability, economic growth and higher quality of life. The ideas about how ICT provide new solutions to improve the functioning of cities and enhance their efficiency have been increasing. ICT-based new technologies, which are the main course of the 21st century, created broad and wide communication networks between cities and caused the cities to adopt these innovative means along with sustainable strategies (Rezafar, Koramaz, 2014). Modern-day cities with a high urban density that rely on transportation linkages, mixed land uses, and high-quality urban services created a new urban paradigm 'smart city' (Nam&Pardo, 2011).

2.3.1. Definition of Smart City

There are many definitions of a smart city in the literature as well as a wide range of conceptual terms that have been suggested to replace ‘smart’ with other alternative adjectives, such as the intelligent or digital city.

The smart city definition was given for the first time in 2007 when 70 European cities’ degree of innovation was measured for a study and since then, a lot of experiences have been carried out in many countries (Sanseverino, 2017). A smart city uses new methods of innovation and creativity, and new sources of information to enhance experiences, increase sustainability and resilience, and improve financial and operational performance.

As the central promise, the combination of mobility and cloud data used by smart technologies has the power to provide unique solutions to long-standing urban challenges that concern the whole population (Yesner, 2017).

"The label smart city is a fuzzy concept and is used in ways that are not always consistent. There is neither a single template of framing smart city nor a one-size-fits-all definition of a smart city." (Albino&Berardi&Dangelico, 2015, p.1725).

Basically, "in the context of Internet computing, the simplest definition is that a smart city can effectively process networked information to improve outcomes on any aspect of city operations." (Celino&Kotoulas, 2013, p.8).

Due to the discussion of what smart city is, Nam and Pardo (2011) enlarge the meaning and identify critical conceptual components of smart city, simplifying them into three categories as core: technology (infrastructures of hardware and software), people (creativity, diversity, and education), and institution (governance and policy). Albino et al, (2015, p.1728) argue that from the technology perspective, smart city has been defined as a city with increasing presence of ICT [information and communication technologies], which comprise "commercial application of intelligent-acting products and services, artificial intelligence, and thinking machines." They also discuss that from the people perspective, creativity is the key driver of smart city, and that people, education, learning, and knowledge have a central role in smart cities. Therefore, smart city development requires the creation of a climate that is suitable for an emerging creative class (Albino et al., 2015, p.1729). In this case, being smart is to take the user perspective as a base. As a third perspective, governments and public agencies adopt the notion of being smart to distinguish their policies and programs to realize sustainable development, economic growth, and better quality of life for their citizens (Albino et al., 2015). Gathering these three perspectives, a smart city is the combination of these three dimensions: technology, people and governments.

One comprehensive definition characterizing a city as smart is as follows: "… when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and high quality of life, with a wise management of natural resources, through participatory governance" (Caragliu&DelBo&Nijkamp, 2011, p.70). As Nam and Pardo (2011, p.288) claim, "leading a smart city initiative requires a comprehensive understanding of the complexities and interconnections among social and technical factors of services and physical environments in a city."

Smart cities are envisioned as creating sustainable cities with intelligent management of natural resources, high quality of life and livability through participatory governance. New solutions that utilize technology, including ICT and efficient service delivery, decided to be necessary to better address emerging requirements in urban environments. To that end, making a city smart is a new approach to urban development. However, according to Nam and Pardo (2011), while researchers tend to spotlight the technology and innovation side of a smart city, its governance and policy issues have not gained much attention. The meaning of smartness in the urban context does not only indicate utilizing the information and communication technologies, but also important management of policy concerns.

2.3.2. Smart City Components and Main Dimensions

Batty et al. (2012) claim that the urban environments that are created in the light of ICT are quite different from anything that we have experienced. "Cities are becoming smart not only in terms of the way we can automate routine functions serving individual persons, buildings, traffic systems but in ways that enable us to monitor, understand, analyze and plan the city to improve the efficiency, equity and quality of life for its citizens in real time" (Batty et al., 2012, p.482).

The evolution of the smart city concept is shaped by a complex mix of social and economic factors with technology, institutional and human factors with the drivers related to them, as discussed by Nam&Pardo (2011) (see Figure 2.1).

It is the result of the efforts of many stakeholders, working together in different shape and form. Therefore, the implementation of the smart city follows very different paths that depend on the objectives, funding, and size of the city (Sanseverino et al., 2017). In the latest frame, smart cities are figured as the gathering of instruments in various scales that are connected through multiple networks. Batty et al. (2012) stated that they provide continuous data regarding the mobility of people and materials in terms of the flow of decisions about the physical and social form of the city.

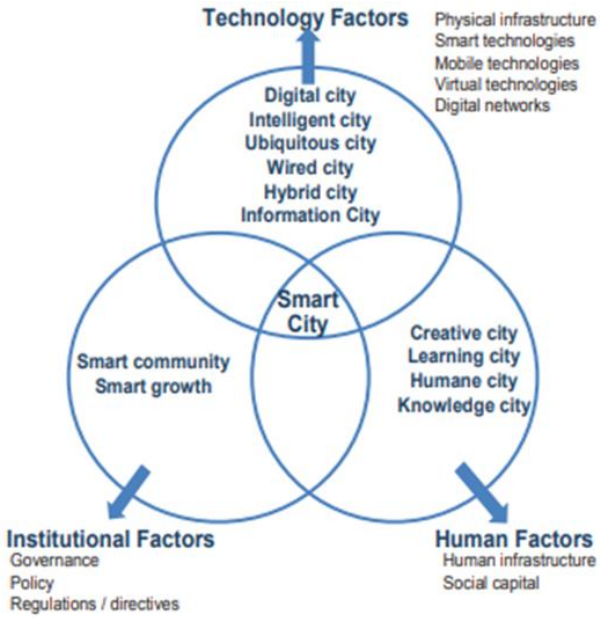

Figure 2.1. Core Components of Smart City Concept (Nam&Pardo, 2011, p.286)

There are several fields of activity in the literature which describe the smart city: health, education, transport, finance, energy, technical infrastructure retail, logistics, leisure, and industry. A project conducted by the Centre of Regional Science at the Vienna University of Technology identifies six main axes along which a ranking was made for seventy middle size cities in Europe (Albino et al., 2015). These axes represent the specific aspects of a city upon which smart initiatives and strategies impact to achieve the expected goals. They are; smart economy, smart mobility, smart environment, smart people, smart living, and smart governance.

Sanseverino (2017) describes them in a similar way with a slight difference, and that is the use of smart energy instead of smart environment. Hence the six dimensions by Sanseverino (2017) are: smart economy, smart governance, smart living, smart energy, smart people, and smart mobility.

These six dimensions -or axes- are connected with traditional theories of urban growth and development. In particular, the dimensions are based on theories of natural resources, quality of life, transport and ICT economics, urban competitiveness, human and social capital, and the participation of citizens (Albino et al., 2015). A smart city performs well in a foresighted way in these six dimensions, built on the 'smart' combination of self-decisive activities with independent and aware citizens. (Vienna UT, 2007)

The first dimension, smart economy, "is an aspect that could be linked to a spirit of innovation, entrepreneurialism, flexibility or labor market, integration in the international market and transformability" (Rezafar&Koramaz, 2014, p.65). It contains factors of economic competitiveness as innovation, productivity, and flexibility of the labor market, entrepreneurship, trademarks, as well as the integration in the national market. (Vienna UT, 2007)

One other dimension defined by Rezafar&Koramaz (2014, p.65) is about access and transport as they argue that smart mobility refers to a local and supra-local accessibility, ITC availability as well as modern and sustainable transport systems. Infrastructure, transport means, goods, and travelers are highly connected to achieve optimized door-to-door mobility (European Comission, 2017).

As the third dimension, "smart management is related to participation in decision-making processes, transparency of governance systems, availability of public services and quality of political strategies" (Rezafar&Koramaz, 2014 p.65). This dimension is also called smart Governance, which comprises the functioning of the administration. (Vienna UT, 2007)

Fourth dimensions, smart environment or smart energy, are about the attractiveness of natural conditions, which would require good air quality, minimum pollution and the sustainable resource management (Rezafar&Koramaz, 2014, p.65). Smart Environment is also emphasized by the report of Vienna UT (2007) as efforts towards environmental protection.

One other dimension, smart living, "involves the quality of life, availability of cultural and educational services, tourist attractions, social cohesion, healthy environment, personal safety, and housing" (Rezafar&Koramaz, 2014 p.65).

Finally, the last dimension is smart people. It includes both the level of qualification or education of the citizens, and the quality of their social interactions. The latter is related with such issues as integration, public life and the openness towards the "outer" world (Vienna UT, 2007, p.11).

The six dimensions described above in Figure 2.2 which was created by Boyd Cohen (2012) involve main goals that help stakeholders reach by implementing smart city initiatives. The way these goals are achieved is specific and changeable depending on technology, material, and political processes. "Every territory, every urban area, each human environment, especially if already existing, can be reinterpreted through different elements (history, tradition, language, and religious aspects, innovation, etc.) that will hand back more accurate, clearer and sharper boundaries" (Sanseverino&Sanseverino&Vaccaro, 2017, p.23).

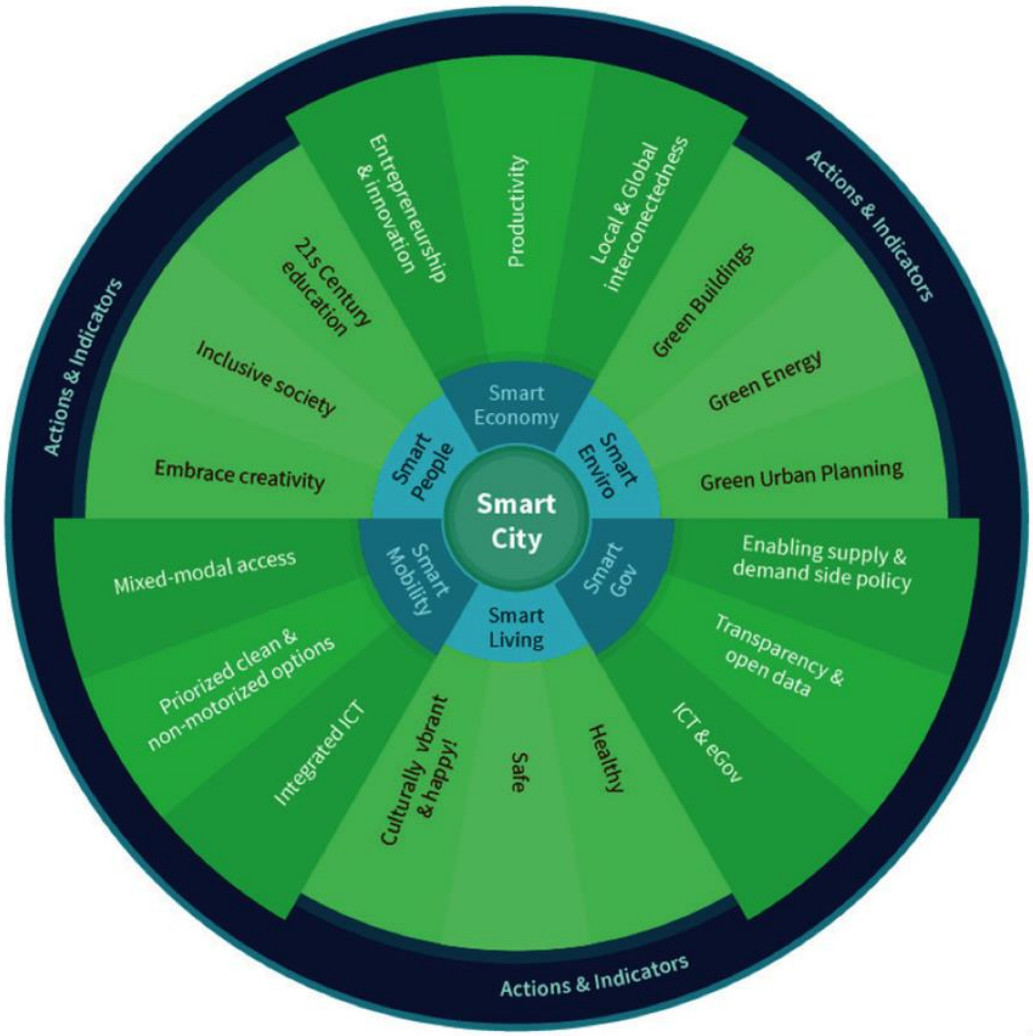

Figure 2.2. *Smart City Wheel (Cohen, 2012b)*

In the light of the survey conducted by McKinsey Global Institute (see Figure 2.3), it was seen that among all dimensions of smart city, smart mobility applications have the highest proportion between others in terms of smart city initiatives of world cities. As the keystone of the 'smart city' concept, smart mobility will be the main focus in this thesis.

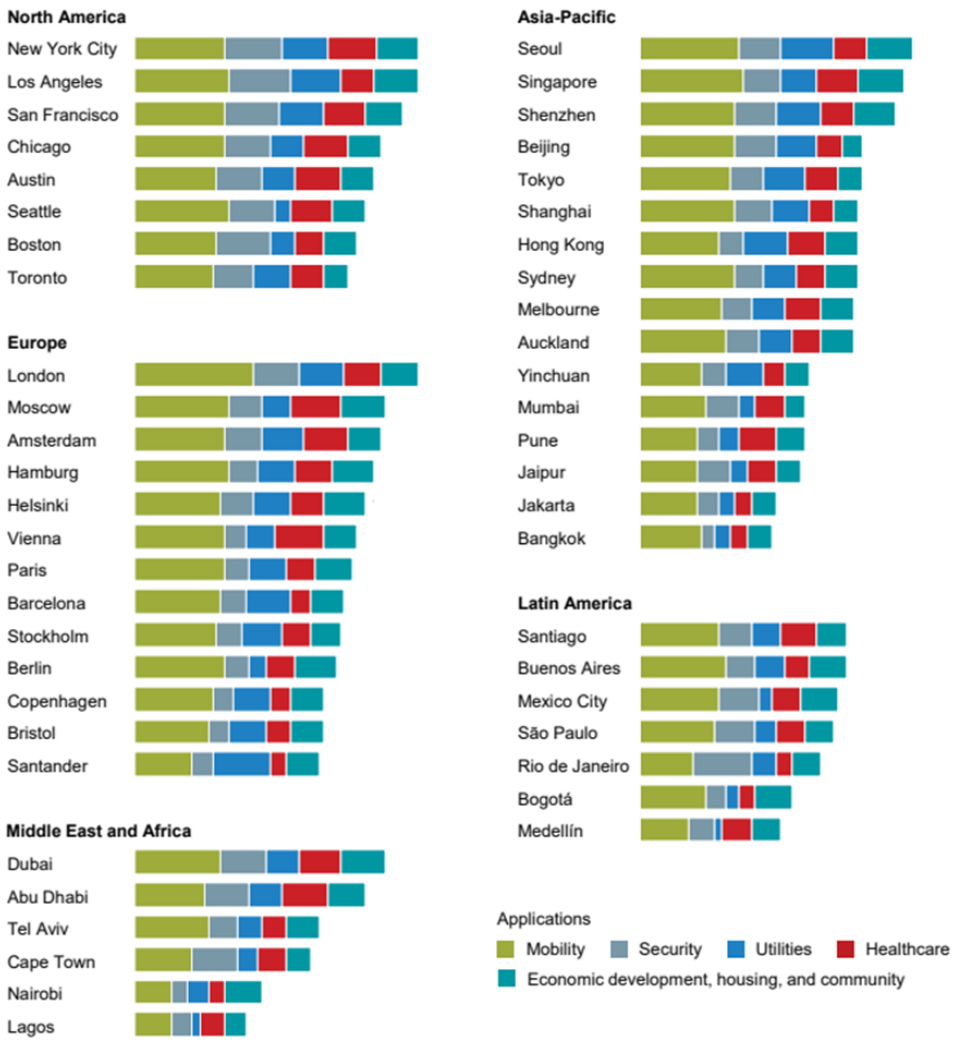

Figure 2.3. The proportions of smart city dimensions that deployed by world cities (McKinsey Global Institute, 2018)

2.4. Smart Mobility as a Component of Smart City

The interaction between accessibility, transport activities and economic growth gained importance in the second half of the 20th century. Although the general idea was that they are not achievable without the other, the negative externalities that have been caused by transport activities have posed severe restrictions on economic performance (Mingardo, 2008).

Consequently, since the migration to urban areas as well as city populations grow continuously, transportation and urban mobility become one of the essential challenges to obtain sustainable economic growth. Transport activities consume significant amounts of energy and create severe levels of emissions, in the form of CO2, one of the main greenhouse gases. Therefore, urban mobility has an important role in helping achieve sustainability goals and represents a crucial factor among other dimensions within the smart city framework.

Mobility term has several direct and indirect interactions with other components of a city, as well as providing a basis for many urban layers. To improve urban sustainability, new technologies must be integrated into citizens' habits since human and social capital plays a vital role in the smart mobility context. According to Papa, Gargiulo and Russo (2017), social dynamics influence how ICTs are applied to transport, which include Intelligent Transportation Systems (ITS), improvement of the management of public transport demand, improvement of safety, and reduction of pollution and congestion. Since mobility is one of the most important keystones of an urban area, it has significant impacts in terms of sustainability, environmental concerns and population's quality of life. Even in today's technology, information and communication era, urban mobility systems are essential. High level of internal and external accessibility is a critical necessity for urban areas since accessibility, and economic performance are still believed to be closely related to each other, both at the urban level and regional level (Mingardo, 2008).

According to Papa and Gargiulo (2017), smart mobility has two main definitions. The first one defines it as efficient and effective mobility, whether depending on ICT or not. On the other hand, the second definition focuses more on innovation, and takes new technologies as a base to obtain a sustainable transport system. Papa and Gargiulo (2017) argue that the latter description has undoubtedly gained much credit in the last years, both due to the technological improvements that become significant day-by-day as well as the growing investments and funding opportunities of international foundations which emphasizes the importance of ICT use.

Since the latter definition is accepted in this thesis, achieving a sustainable, comprehensive and efficient mobility system is considered as the overall challenge that is addressed in the Smart Mobility actions. “Implementing a multimodal public transport system, fostering alternatives to the car-based mobility and making public transport reachable and available to all citizens is the three main axes that will allow reducing congestion and pollution in cities and improving connectivity” (Monzon, 2015, p.4)

Besides the vast literature on smart city, economic institutions like Deloitte, or big technology companies like Microsoft and Siemens have been conducting several surveys and preparing reports about smart mobility strategies and actions in urban areas. Also, in their reports, smart mobility is mentioned as an essential tool to achieve a sustainable development and high quality of life. According to Siemens’ report, smart mobility term has three components which are shown in Figure 2.4, efficient resource transport in terms of environmental frame; higher productivity, in terms of economic frame, and higher quality of life, in terms of the societal frame.

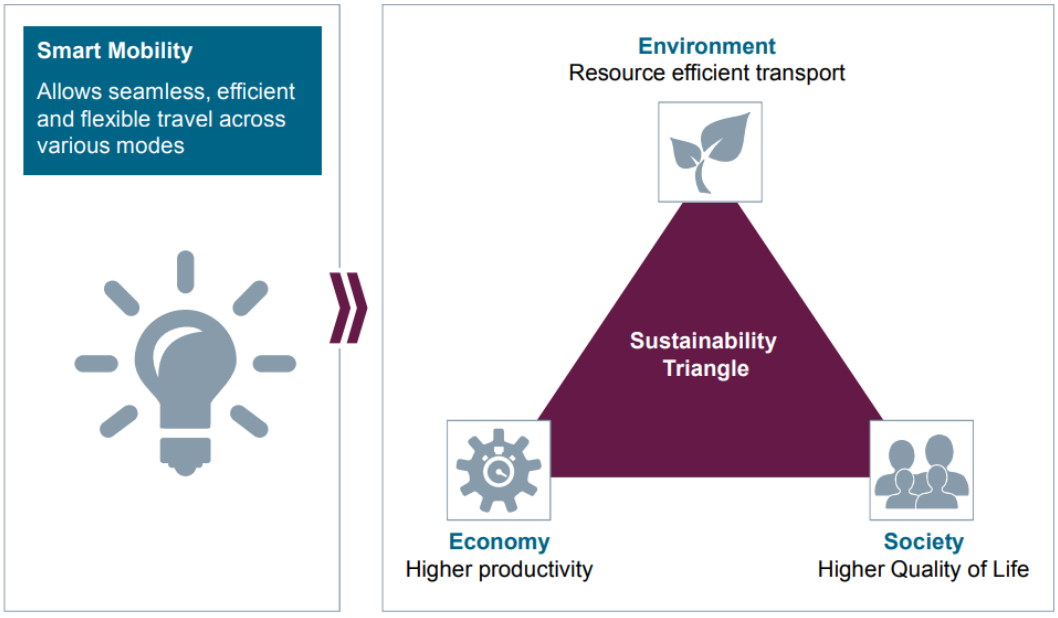

Figure 2.4. Three main components of smart mobility term (Siemens, 2015, p.4)

Using the benefits of smart mobility, there is an evolution from a single-modal transport system to multi-modal system, which shown in Figure 2.5. Similarly, in Deloitte's "Smart Cities, How Rapid Advances in Technology Are Reshaping Our Economy and Society" Report (2015), it is claimed that smart mobility solutions intend to reduce congestion by fostering faster, cheaper and greener transportation options. Some of the solutions are named as smart parking, smart traffic control, peer to peer ride services, personalized transport information or adaptive connected cars. In today's smart mobility agenda, suggested solutions either optimize the current transportation system or create whole new systems.

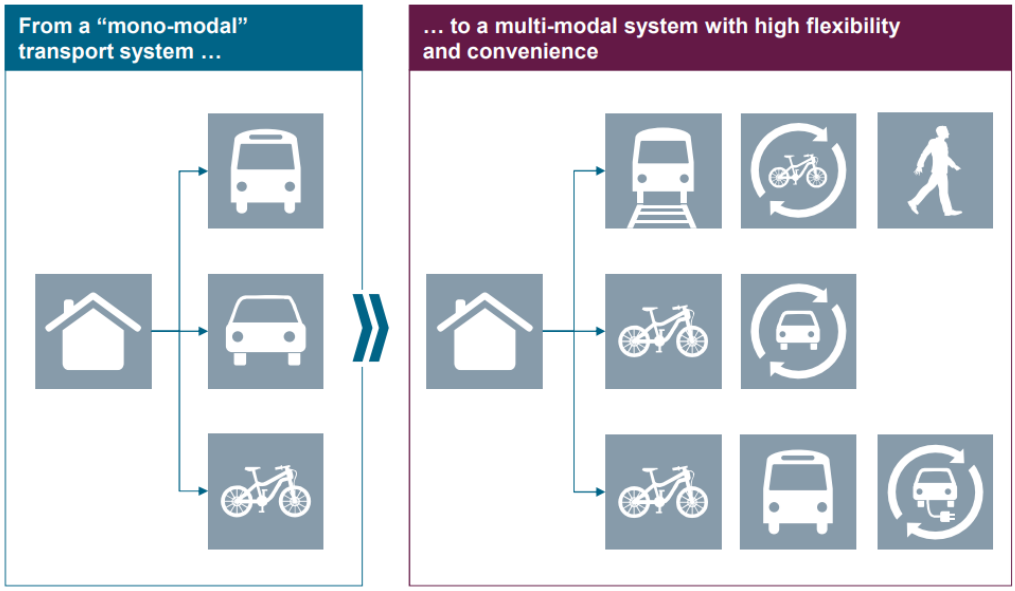

Figure 2.5. Multi-modal transport system in smart mobility (Siemens, 2015, p.10)

In the following chapter, these current approaches and tools in smart mobility is described in more detail.

2.5. Current Smart Mobility Approaches and Applications

Debates about the future of urban development have been increasingly influenced by discussions of smart cities. As a result of today's knowledge and technology era, anyone lives in a city desires to reach places -work, school or anywhere else- in the fastest, safest, most comfortable and affordable way possible.

Urban Transport from smart mobility's perspective is "where infrastructure, transport means, travelers and goods will be increasingly interconnected to achieve optimized door-to-door mobility, higher safety, improved impact on climate and the environment and lower operational costs" (European Comission, 2017, p.10).

For the challenge of how to get from A to B, there are many modes. Microsoft (2017) states that since motivating people to use multimodal transport system is the principal aim of the smart mobility, thinking about in what circumstances this journey actualizes and in what fare are the crucial questions.

The typical answers of world examples are passenger transportation apps "driven by live streaming of GPS and sensor data providing the status of trans, buses or subways, together with route planning intelligence, alerts, and personal account, pre-pay or contactless payments" (Microsoft, 2017, p.3). To achieve efficiency at system-level, new actions and strategies are needed that can be rapidly deployed. It is discussed in Microsoft's report (2017) that when managed wisely, sensing, transmission, integration, processing, and analysis of all data can reset our experience and inform our choices of travel and modes of transport. At the same time, governing authorities and operators understand better the performance of policies and services to optimize cost-effectiveness, efficiency and new business models to improve urban mobility. Through all these improvements, during the whole traveling process, passengers, drivers, operators, and field distributed staff that interacts with mass transit systems are connected to learn where and when to be (Microsoft, 2017).

It is claimed in McKinsey Global Institute's Report (2018) that three layers make a smart city work by the collaboration between these layers. First is the technology layer, which contains networks of connected devices, such as smartphones and other sensors as well as open data portals. As its working mechanism, sensors read variables such as traffic flow, air quality, and energy consumption, giving information to users. The second layer includes smart applications and capability of data analysis.

The process of the analysis and translation of data into alerts, insights, and actions incorporate technology providers and app developers to obtain the correct tools. The third is the public usage layer which can lead to better choices and changing behaviors by the adaption of citizens to all the above. In this sense, the report lists smart mobility applications which will be relevant for cities in near future: “real-time public transit information, digital public transit payment, autonomous vehicles, predictive maintenance of transportation infrastructure, intelligent traffic signals, congestion pricing, demand-based micro transit, smart parking, e-hailing (private and pooled), car sharing, bike sharing, integrated multimodal information, real-time road navigation, parcel load pooling and smart parcel lockers” (McKinsey Global Institute, 2018, p.3).

From the European Union's perspective, integrating solutions that address transport means and infrastructure into a user-friendly European transport system with smart connected mobility and logistics is the key target. Research and innovation on equipment and systems make them smarter in terms of obtaining more automated, cleaner and quieter transport by reducing the use of fossil fuels. Smart infrastructure solutions are also necessary to achieve advanced passenger services, traffic management, and information systems, efficient logistics, construction, and maintenance technologies. Under the smart mobility concept, ITS enables to achieve the vision of making mobility as a service real, by connecting all elements of the multimodal transport system -passengers, goods, vehicles, and ICT- in a proper regulatory framework. Multimodal transport across countries meet passenger’s mobility needs as well as allow a shift to more environmentally friendly modes of transport by making better use of the existing infrastructure. In this case, it is important to develop a transport information system throughout Europe that provides real-time data. Combining this information system with up-to-date information from each relevant transport mode source enables both intraregional and cross border trips.

As a part of this integrated system, the availability of open and high-quality transport data provides substantial improvements for the performance of transport networks by raising their efficiency, visibility, resilience and enabling easy access to online booking, payment and ticketing services (European Comission, 2017).

2.5.1. The Evolution of Smart Mobility Systems

Since it is the subject of many plans, strategies, and actions, Smart Mobility Systems, alias Intelligent Transport Systems (ITS), consist of several aims, which are increasing mobility, decreasing travel times, increasing traffic safety, optimum utilization of existing road capacities, providing energy efficiency and reducing environmental damage. The system is based on the multi-dimensional data exchange between user-vehicle-infrastructure-center, and the analysis and control (Tektaş&Korkmaz&Erdal, 2016).

An, Lee and Shin (2011) define it as a concept which integrates computers, information and other ICTs and applies them in transport field to create an integrated system of roads, vehicles and people. Through the development process of intelligent transportation systems, preliminary researches have started in the 1960s-70s which is considered as the first stage (Yardım&İlkyıldız, 2005). In the 1980s, the necessary conditions for the development of the system were created. The emergence of the memory unit in computers has reduced the cost of operating systems and new researches based on practical use have begun. The Road/Automobile Communication System (RACS) Project, which forms the basis of the vehicle routing system that is currently used in Japan, Programme for a European Traffic System with Highest Efficiency and Unprecedented Safety (PROMETHEUS), which was initiated by car manufacturers, Dedicated Road Infrastructure for Vehicle Safety in Europe (DRIVE), which was initiated by the European Union, and America's Intelligent Vehicle-Highway Systems (IVHS) projects emerged during the second stage. In today's last stage, the most important characteristic is the realization of the practical applications.

ITS is now being used not only to solve problems caused by car traffic, but also to solve other inter-modal problems. Moreover, ITS is recognized as a vital element in the hierarchy of the national and international information technologies through the world (Qureshi&Abdullah, 2013). In this last stage, two main discussions left its mark on both the literature and practice. First one is the idea that ITS has revolutionized overall transport area. Second one is the general expectation that ITS will be a pioneering model in the implementation of information technologies in general (Yardım&İlkyıldız, 2005).

In its latest generation that is used today, it has a massive capacity for reducing traffic congestion, risks, carbon emissions, accidents rates, air pollution as well as satisfying travelers for all modes by increasing safety and reliability, travel speeds and traffic flow. To use that capacity, ITS collaborates with different fields of the transportation system, such as transportation infrastructure, management, operations, policies and control methods (Qureshi&Abdullah, 2013).

As the most vital tool for the multi-modal transport system, ITS provides services and implementations not only for highway traffic but also for the air transport system, water transport system, and rail systems.

2.6. Smart Mobility Projects: World Examples

Besides scholars and institutions, several cities and their city authorities have also set out their perspectives on what smart city means to them and what the strategies are throughout the implementation process. Barcelona City Hall defines a smart city as "a high-tech intensive and advanced city that connects people, information and city elements using new technologies to create sustainable greener city, competitive and innovative commerce and an increased life quality a straightforward administration and a good maintenance system" (Bakıcı&Almirall&Wareham, 2012, p.139). Similarly, Amsterdam City Hall assumes that the smart city uses innovation and technology to change population behavior related to energy consumption to tackle climate goals (Lee&Hancock&Hu, 2013).

Amsterdam's smart city concept is seen as a common approach for reducing a city's carbon footprint design by developing a sustainable program. Although the frame and scope of smart mobility initiatives vary, they all aim at improving the population's quality of life by being smarter based on a durable technological infrastructure. These initiatives are delivered by a range of different open data platforms and ICT-based service that generally connect to smartphone apps or a web device. These services are offered to citizens through smart city apps by various public and private bodies which increase the social value of the city's public services, infrastructure, and private-sector attempts (Lee et al., 2013). Some cities serve as a model in terms of ITS projects, policies, and strategies.

In the 1980s, ICT started to be a major tool for shaping and consolidating the success of cities in many countries. Hollands (2008) states that in the USA, 'City of the Future' San Diego was one of the first examples of ICT investment, while in Canada, $60 million was allocated for the nationwide initiative 'Smart Communities'.

In the UK, claiming to be the first smart city, Southampton developed its multi-application smartcard, while in Asia, IT2000 plan was designed for Singapore to create an 'intelligent island,' with the help of ICT to transform the life in the island (Hollands, 2008). Apart from these, there are many other examples around the globe, such as India's Bangalore city as a Silicon Valley, or Australia's Brisbane as a sustainable smart urbanism.

Rather than demand-driven, smart city solutions have been evolved in a more supply-driven way through the world (Komninos, 2011). Various conceptual smart city models have appeared with some of them focusing on ICTs, and others on related technology with innovation and human capital. Thus, different smart city models are implemented in hundreds of world cities, as presented in the work by Ercoşkun (2016). In the following section, literature on the outcomes and lessons from world examples will be reviewed; and criticisms will be presented regarding smart city initiatives.

2.7. Inferences from World Examples and Criticisms of the Smart City Initiatives

As Paulin (2016) claims, the main approach of any smart city initiative needs to follow a stronger citizen-centric approach that engage citizens and stakeholders. Additionally, Anthopoulos (2016) emphasizes the capability of smart infrastructure and smart services to make smart city a 'liveable' one, in terms of satisfaction and quality of life of citizens. Also, open data and innovation platforms result in creating jobs for the digital economy. In his analysis of ten smart cities around the world, Anthopoulos (2016) observed several types of coalitions in which a city can be a project owner or a project manager; while stakeholders can either be engaged in same projects or they develop their own.

It is clear that ICT and creative industries are able to transform many urban areas in an economic, social and spatial way (Graham and Marvin, 2002; 1996; Florida, 2002). However, Hollands (2008) argues that although the use of the term 'smart' can create certain conjectures about this transformation, the problem is in which ways the term 'smart' is treated.

"It might be argued that the problematic mapping of the smart label onto a series of other seemingly progressive debates and concepts concerning the technological and creative city, creates not only definitional problems, it also hints at some of the more normative and ideological dimensions of the concept/label" (Hollands, 2008, p.304).

For many, the term 'smart city' represents the transformation process that takes advantage of technology and innovations. However, Yesner (2017) states that despite the growing awareness against the opportunities of being 'smart', most public and private agencies are struggling with realizing their ideas; mostly due to the difficulty of securing funding, determining the solutions and action, and scaling initiatives. Although the number of successful initiatives is increasing, the changing and innovating pace of cities are slow. Thus, it is still unclear how cities correspond to the complex and transformative changes.

Similarly, Albino et al. (2015) claim that together with the growing interest in smart cities, the concept of being smart generates confusion which represents an important obstacle to policy makers. These main obstacles are the ability to recognize a smart city, to measure the smartness performance and to determine appropriate policies to correspond to smart city's needs. Monzon (2015) criticize smart city projects to follow the same strategies without considering the challenges such as the starting conditions, available resources, and citizens' willingness. These challenges are important for population growth, economic development and quality of life to walk on the same path. "Cities are the places where inequalities are stronger and, if they are not properly managed, the negative effects can surpass the positive ones" (Monzon, 2015, p.17).

Although technology and innovation are the keystone of a smart city and ICT has a capacity to transform the urban life, technological innovation is a means to smart city, not an end. According to Papa et al. (2017), the use of ICT can help to implement more sustainable urban mobility; however, it is not sufficient by itself. The conscious participation of citizens is needed to achieve this goal. In similar way, Komninos (2008) defines ICT as a facilitator for creating a new urban environment based on innovation.

Holland (2008) criticizes cities for blindly believing ICT to automatically transform and improve cities, rather than considering the human capital side. Nam and Pardo (2011, p.286) state that "IT infrastructure and applications are prerequisites, but without real engagement and willingness to collaborate and cooperate between public institutions, private sector, voluntary organizations, schools and citizens there is no smart city."

These threats lead the ITS criticisms to a vital endpoint, the dangerous potential of ITS applications in creating a digital divide. Batty et al. (2012) explain the situation as a tendency of new information technologies to create polarization and divide among people.

As stated before, ITS applications' tendency to create digital divide is the main focus of this thesis. Floridi (2002, p. 3) claims that digital divide "disempowers, discriminates and generates dependency" and that it can cause "new forms of colonialism and apartheid that must be prevented, opposed and ultimately eradicated". Dijk and Hacker (2003, p.324) emphasize that "in the information and network society, relative differences in getting information and lines of communication become decisive for one's position in society, more than in every society in history before." Only providing technological sources and internet is not able to prevent it alone. Much deeper differences in both usage and skills are highly effective factors. The vital task of future society is argued to be minimizing structural inequalities in the ICT usage and skill, not just providing access to it. Similarly, Mutula (2010) notes that the failures of the ITS projects worldwide indicate that focusing on providing access is necessary, but not sufficient alone. The digital divide should be treated as complex phenomena, which is embedded in social, physical, human and digital relationships. Therefore, the focus is needed to be redirected to the effective integration of ITS into the society's life (Warschauer, 2003). Pitkin (2001) also states that designing the technology with the needs of society is essential for ICT-based services to be accepted and used.

Addressing different local challenges of societies, such as poor ICT infrastructure, limited skills or inadequate resources is crucial for bridging the digital divide. All created ITS projects and applications should include the society's need and characteristics in order to be used.

2.8. Smart Mobility Projects in Turkey

Smart city projects have been launched in many Turkish cities. The first initiative started inYalova city in the early 2000s, which is an ICT Valley Project. After the Great Marmara Earthquake, Yalova was also selected as pilot city by Turkey's company of communication and entertainment technologies, called Türk Telekom, for the provision of internet infrastructure that is resistant to natural disasters.

After Yalova; Ankara, Bursa, Kocaeli, and many other cities were considered to conduct ICT Valley Project. In this context, local governments started to put the concept of Urban Information Systems on to their agenda. Many municipalities, such as Fatih and Beyoğlu in Istanbul, started to create three-dimensional images of the streets with the help of Google Earth. Moreover, many municipalities initiated geographical database management systems (Akiner, 2016).

In year 2015, an important smart city project, AkıllıKenTT, was started by the Ministry of Transportation and Infrastructure and Türk Telekom, as reported in detain by Ercoşkun (2016). The main target was facilitating urban life with innovations conducted in smart transportation, smart environment, smart life, smart economy, smart society and smart management areas. The project was implemented in Karaman, Antalya, and Kars. Karaman was selected as the first smart city project, with the aim of creating a model for other cities in the country. In Karaman, all the smart initiatives of the project are managed by a single platform; Innova, which is a software developer and integrator company. The second AkilliKenTT project was decided to be implemented in Antalya, then in Kars. The project was the first initiative in ITS context, which has several extensive strategies (see Table 2.2).

As another important smart city initiative, Our City Project has been conducted by the Ministry of Environment and Urbanization since 2018. Pilot project also began in Gaziantep, Bolu, Konya and Kayseri.

Table 2.2. *AkıllıKenTT Transport Strategies (Ercoşkun, 2016)*

Transportation Strategies	Smart Stations for buses and trains	Designed to reduce waiting times and to optimize the public transport system.
	Smart Intersection System	Designed to reduce waiting time at junctions, to lower carbon emissions and fuel consumption, to give priority to emergency response vehicles.
	Intelligent Parking System	Optimized parking services by reducing time spent searching parking lots
	Traffic Management System (TEDES)	Identification of drivers breaking traffic laws and regulations, to improve traffic safety on roads.

In ITS context, the first ICT-based application was the Smart Card. In 1999, Smart Cards started to be used in public transportation and integrated to all transport modes. In the same year, open-road tolling system was introduced and later on, Express Pass System was implemented in the 2010s. In 2014, ITS Strategy Document (2014-2023), which includes the biggest research in ITS context, was conducted by the government, prepared by the Ministry of Transport and Infrastructure.

Some of the main projects emphasized in the document are smart traffic light systems, green wave system, digital traffic signs and solar powered bus stops with digital arrival time boards (Gonel&Akıncı, 2018). Nowadays, several technological items are used in smart city applications. As it is demonstrated in Figure 2.6, mobile applications have the highest usage ratio.

Most of the ITS applications including route planning, navigation, bike sharing, traffic safety, parking information, transportation data collection, vehicle fuel consumption and emissions, and travel information are provided mostly via mobile applications. Beside private enterprises, new mobile applications had been started to produce and use by many municipalities as well. The research in this thesis, therefore, focuses on ITS-based mobile applications. ITS applications of the three biggest cities of Turkey are described below, focusing on the experiences that are considered as successful initiatives.

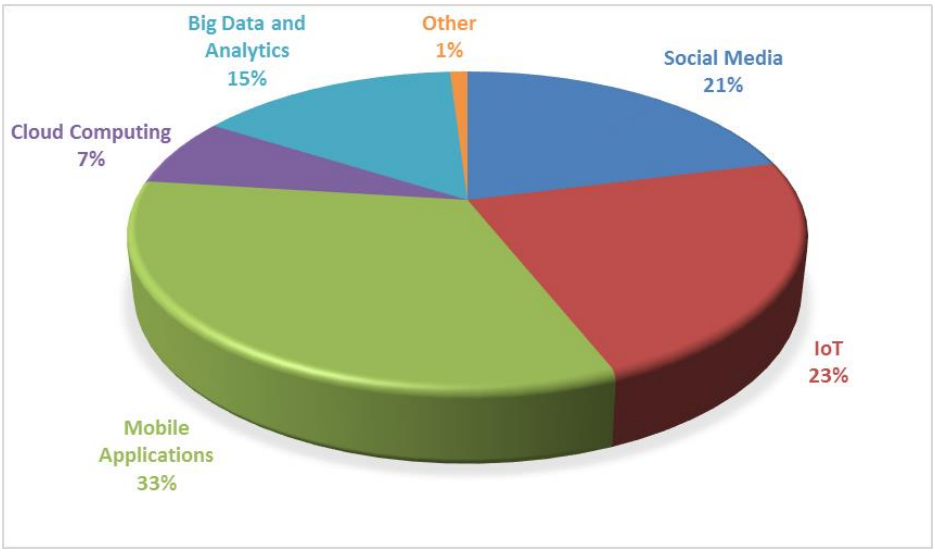

Figure 2.6. Distribution of Technological Items Used in Smart City Applications (Novusens, 2016)

2.8.1. Smart City İstanbul

As a common problem of Turkish cities, the rapid increase in population due to the mass migration to the city created crucial deficiencies in resources and services (Gunay&Dokmeci, 2012). As a result of this massive human and vehicle population, citizens of Istanbul have been facing various problems.

2.8.1.1. Smart Mobility Services and the Implementation Process

Governmental agencies have started to use information technologies effectively for controlling and monitoring the city's transport problems. In the field of ITS, smart signaling, smart stop, smart parking, smart signboard, vehicle tracking, charging box with USB outlets that are placed on buses, free internet service, traffic control center and electronic control system have been frequently use (Bulu&Önder&Aksakallı, 2014).

Istanbul Metropolitan Municipality started the Smart City Istanbul project (2016) with the Big Smart Istanbul slogan and launched many mobile applications such as IMM CepTrafik, IMM Guiding, Beyazmasa and iTaksi (see Figure 2.7).

Figure 2.7. Mobile Application Signs of İstanbul Metropolitan Municipality (Gürsoy, 2019)[1]

[1] İBB Cep Trafik", "İBB Yol Gösteren", "Beyaz Masa", "İBB Kurban", "İBB Simultane", "iTaksi", "İBB Radyo", "İstanbul'u Seyret", "İstanbul Eczanesi", "İstanbul Şehir Haritası", "Miniatürk", "İstanbul Bülteni", "İstanbul'un Metrosu", "Mobil İSKİ", "İSEM", "İBB İmar Sor", "İBB Şehir Tiyatroları", "İBB Karekod", "Mobiett", "Şehir Hatları", "İstanbulkart", "Sesli Kütüphane", "İBB Kültür", "Yürü & Keşfet", "Tech İstanbul", "Ramazan İstanbul".

According to the Turkish local governing system, Ministry of Transport and Infrastructure is responsible for maintenance of city highways and the bridges. Other inner-city transport lines are under the responsibility of the Metropolitan Municipality as well as many local and international projects are conducted by this institute (Bulu&Önder&Aksakallı, 2014).

2.8.2. Smart City İzmir

Being one of the oldest port cities along the Aegean Sea, İzmir has been driving smart city development since the beginning of the 2000s. With more than 4 million inhabitants, the city has an extensive transport network. The Metropolitan Municipality aims to expand the mass transportation system by integrating different transport modes and increasing the quality of travels.

2.8.2.1. Smart Mobility Services and the Implementation Process

Izmir has one of the most advanced ITS systems in the country. The city has a comprehensive Full Adaptive Traffic Management System, and an awarded project 'ITS İzmir' which includes traffic control, parking, pedestrian zones, information tables, and smart city platform. Another continuing project, funded by the World Bank, involves e-payment cards to be used in all transportation modes, including ferries, busses, train, and metros. (US Commercial Service Turkey, 2016) Taking the important steps towards the goal of İzmir as a city of bicycle, the interest of Smart Bike Sharing System (BİSİM) is increasing day by day with 1 million 622 thousand rented bikes since the Metropolitan Municipality put it into service in 2014.

Izmir Metropolitan Municipality has an extensive online website 'Smart Transport Guide' which consists of all public transport stops, public transport modes and trip details working together. Moreover, several mobile applications have also been provided by the Municipality (See Figure 2.8).

Figure 2.8. Mobile Application Signs of İzmir Metropolitan Municipality (Gürsoy, 2019)[2]

The Metropolitan Municipality has been conducting many projects, actions and mobile applications; some of which are financed by the government, while some others are financed by the World Bank, European Union or Cardiff Research Center.

2.8.3. Smart City Ankara

As being the capital, rapid increase in population caused deficiencies in resources and services. In this context, smart city concept was seen as a solution and several initiatives that were related to technology and innovation have started in the 2010s.

2.8.3.1. Smart Mobility Services and the Implementation Process

In Ankara, "people spend mean 71 minutes for their commuting with public transit in a day" (Moovit Statistics, 2019).

According to the Ministry of Environment and Urbanization (2019), the city has a holistic traffic management system varying from traffic data production to information screens, from central junction management system to traffic monitoring systems. Moreover, smart bus stops, on-line traffic density maps, and online tracking systems were also provided by the Metropolitan Municipality. The main pilot project which was launched by the Metropolitan Municipality and the Ministry of Environment and Urbanization, Smart City Ankara, is planned to be based on public-NGO-private sector investment and will conduct several ITS projects.

[2]"İzmir Büyükşehir Belediyesi", "ESHOT Mobil", "İZUM", "İzmir Doğal Yaşam Parkı", "Eşrefpaşa Hastanesi".

Ankara Metropolitan Municipality has many important services both online and mobile, such as EGO Cepte and ABB Trafik (see Figure 2.9), which involves route and traffic density information, smart bus stops and e-payment.

Figure 2.9. Mobile Application Signs of Ankara Metropolitan Municipality (Gürsoy, 2019)[3]

The projects and mobile applications are generally conducted by The Metropolitan Municipality, EGO General Directorate and Ankara Water and Sewerage Administration General Directorate. Digital payment system, mobile applications and information systems that are related with ITS initiative are put in service via internet and mobile applications.

2.8.4. Inferences from Turkish Examples of Smart City Initiatives

It is clear that Turkey is trying to build a strong infrastructure to be able to handle large amounts of data and catch up with the global move towards building smart cities. Public and private agencies are trying to improve and deploy ITS applications, with the effort to spread the smart strategies and initiatives across the country.

In current situation, Turkish cities have a lot to do about clean transport, non-motorized modes, and multi-modal transit since there is no specific ITS institution or action plan to determine the exact road to follow during the whole process. Ercoşkun (2016) claims that they also need to utilize technology to enhance citizen participation about what is going on in their cities.

[3]"ABB Mobil", "EGO Cepte", "ABB Trafik", "Kurban", "ABB Mezarlık Bilgi Sistemi", "ABB Hafriyat", "Ankara Kent Rehberi", "Ankara Asist", "Ankara AR", Mavi Masa", "ASKİ".

Novusens (2016) states that barriers against the spread of the smart initiatives are mainly lack of funding and qualified human resources.

It is seen that there are increasing numbers of research in Turkey on smart city and smart mobility, but the issue of digital divide appears to be an area not researched thoroughly yet. Hence this study focuses on smart mobility projects and applications in Turkish cities and their possible effects on creating inequalities in the society, i.e. a digital divide. Therefore, in the next chapter, a more in-depth review of the digital divide issue is presented, after which, the methodology of the research conducted in Turkey is described, followed by the research findings and conclusions.

CHAPTER 3

DIGITAL DIVIDE

Information and communication technologies are new; but technological inequalities among people are not. Since there is an ongoing rapid change in all fields of technology, it is difficult to envisage future tendencies and trends from the social, physical and economic characteristics of early adopters. This difficulty is explained by Tichenor, Donohue and Olien (1970, p.159) as follows: "as the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tends to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease."

The digital divide concept was first used by the U.S. National Telecommunications and Information Administration to refer to the gap between people who do and do not access to computers and internet in the 1990s. The digital divide between ICT 'haves' and 'have–nots' has been the topic of a vital discussion since then, and many initiatives and projects have been conducted to bridge this gap. Foster (2000, p.445) used the concept to refer to "the social implication of unequal access of some sectors of community to Information and Communication Technology and the acquisition of necessary skills". Partridge (2004, p.2) mentions that "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."

3.1. The Background of Digital Divide

The digital divide term first appeared in the literature in the mid-1990s. As a reflection of that time's superficial idea about Internet's connection to economic and social change, the approach to the term was based on making all people connected, no matter what the cost was (Warschauer, 2003). As a result of this approach, the term has been used to define inequality between people in their ability to access ICT. At the end of 1990s, more related research appeared in the context of developing and improving ICT as well as rising global political ambition for increasing capital on ICT in order to enable economic growth. Yu (2006) claims that the entrance of digital divide concept, particularly the political and economic implications of it, to academic discourse cought the attention of researchers. The term was connected to the concepts of development potentials and strategies, information infrastructure, economic growth, universal access and information network.

One of the most complex conceptualizations was proposed by Kim and Kim (2001). According to their claim, the digital divide is a multi-dimensional -including media accessibility, information mobilization and information consciousness- and multi-staged -including opportunity divide, utilization divide and reception divide-phenomena. Their claim is based on the idea that the digital environment consists of many non-digital elements which help people to define their position in today's digitalized information world. On the other hand, other than the attempts to define digital divide as multi-dimensional and multi-layered concept, Corrocher and Ordanini's (2002) and Sciadas's (2005) studies have been attempted to define the concept in a quantitative frame. They defined digital divide as the level of distribution of the synthetic digitalization indexes that varied in societies. When it came to the 2000s, ICT development process started to shift to the 21st century's idea of globalization and global competition. Consequently, its social impacts spread, which is particularly important for socially excluded part of the population.

Those parts of the population were unable to use the services supported by governments or participate the process that includes the development of ICT-based services (Mervyn&Simon&Allen, 2014). This social exclusion that can be named as 'digital exclusion' has been described by Castells (2002, p.3) as "...one of the most damaging forms of exclusion in our economy and in our culture", since it may also deepen the existing inequalities and social exclusion." Similarly, Mbarika et al.(2007), Van Dijk & Hacker (2003) and Maldonado&Pogrebnyakov&vanGorp (2006) also emphasized that this new ICT developments may reinforce existing exclusion in societies, because the ability to access and use these services is deeply linked with income and occupation as well as technical skill that is gained depending on a person's social and economic situation.

Digital divide that caused the inequalities between people refers to not just insufficient access to new technologies, but the ability and desire to use these technologies. "Digital inequality reflects not only disparities in the structure of access to and use of ICT; it also reflects the ways in which longstanding social inequities shape beliefs and expectations regarding ICT and its impacts on life chances" (Kvasny, 2006, p.1).

3.2. Why and How Digital Divide Emerged

"Information tends to flow toward the information haves. That is because they are more eager than information have-nots to acquire information and more competent to understand information" (Kim&Kim, 2001, p.81). Several crucial social inequalities have been existing in the digitalized world from the time the technology first came to people's lives. Since the 1990s, with the rising investments to ICT, ICT-based services have been causing types of digital divides. In general, the global divide, which appeared between countries and nations, and the social divide, which appeared within populations have been expanding parallel to ICT development. In many world cities, internet and continuing innovations has left behind many people with different disadvantages.

However, although today's information and innovation age created substantial inequalities in both access and usage, it is believed that if digital divide could be overcome, new technologies will provide multiple potentials for development (Norris, 2001). "The role of technology has therefore fueled a debate among optimists envisaging the positive role of the Internet for transforming poverty in developing societies, skeptics who believe that new technologies alone will make little difference one way or another, and pessimists who emphasize that digital technologies will further exacerbate the existing [global] divide" (Norris, 2001, p.9). Graham (2002) argues the main logic of ICT-based change as to underlie urban polarization, and the social, economic technological alienation of the powerful from the less powerful. Despite different ideas of optimists, skeptics and pessimists about whether ICT-based services create digital divide, it is clear that there will be social inequalities in access to technology, as in other dimensions of life. The digital divide is constant and abiding, which, in turn, reflects the inequalities that exist in a society. The main inequality factors causing the digital divide are both between countries and individuals:

"It seems likely that, in a world where wealth is unequally distributed, there will always be a digital divide ... the digital divide in ICTs reflects past and existing wealth divides. But, more fundamentally, the digital divide suggests how future divides in wealth may take shape, as ICTs are increasingly determining the ability of individuals, firms and nations to create future wealth." (ITU, 2007, p.32).

The focus of the digital divide is now shifting from inequalities in access and quantity to quality of the user experience and user capacity. Today, the complex relationship between cities and ICT are evolving within an unusual context which causes severe challenges to understanding cities differently from the traditional ways. Graham (2002) describes the uneven growth of the Internet and other ICT-mediated systems as a powerful process of dualization within and between human settlements, and states that ”urban societies become separated into the ‘on-line’ and the ‘off-line’ in complex tapestries of inclusion and exclusion which work simultaneously at multiple geographical scales" (Graham, 2002, p.37).

These new tendencies clearly started to affect the physical, social, economic and spatial layers of cities and the society living in it.

3.3. The Difficulties about Measuring the Digital Divide

As a dynamic concept, digital divide has several challenges when it comes to assess the impacts and set some measurements.

The first challenge is based on the rapid change of technology, and correspondingly ICT-based services. Patterns of both access to and use of the technology may change considerably in very short time. As a result, determining any measurement or assessing the impact of that technology as well as social adaptation is a vital challenge. Secondly, the studies and evidence researches are hard to generalize throughout the world, since many countries and societies have their own dynamics and conditions. Turkey has very limited studies in this context, which require a dependence on research findings for other countries, although these may not be valid for Turkey. Thirdly, since the digital divide is a multi-dimensional concept, the assessment of its impact and creating some criteria is a challenge which includes integration of numerous disciplines such as sociology, city planning, engineering, anthropology, psychology and computer studies (Norris, 2001).

3.4. The Dimensions of Digital Divide

The digital divide is a multi-layered phenomenon. Therefore, there is not a single cause of divide, but multiple sub-causes, which occurred within countries, between the young and the elderly, between a doctor and a worker or between men and women. Digital inequalities between individuals with different circumstances and backgrounds prevent people with socio-economic disadvantages from taking the advantage of ICT-based services. Research studies have shown that types of digital inequalities exist in different socio-economic, demographic and geographic dimensions (OECD, 2001). Hargitti&Hinnant (2008) noted that experience in using internet stimulates the complex and comprehensive usage of internet services for several purposes, and that these users are more likely to be educated and skilled.

These claims again prove the fact that being connected will not necessarily solve the problems of inequality. Kim and Kim (2001) claimed the dimensions of digital divide as sex, generation, class and region. Hsieh et al. (2008) reported that socio-economic status; which includes income and occupation, and level of education, has a direct impact on users and non-users of ICT services. Many studies to date have indicated the socio–economic perspective of the digital divide as a dominant factor where income, occupation and education are the primary causes influencing the diffusion of digital divide. Partridge (2004) argued that discovering the cultural, social and psychological drivers are important to understand the the digital divide that prevent people from embracing technology into their lives. According to several studies (Lenhart et al., 2003; Norris. 2001; Hargitti et al., 2008), the primary sub-causes affecting the digital divide are income, occupation, education, and less-effectively gender and age. These are elaborated in more detail in the following sections.

3.4.1. Income

Norris (2001) claimed that there was a significant relation between income level and the access to the technology. The income gap between users is proved, since people who have high-level income have more access and ability to use technology-based services than low-level income group. Income is one of the main factors which determine one’s ability to access to services as well as interpret and use them, both financially and intellectually. Several factors within each society may influence the income gap in technology access, such as government initiatives to make smart mobility services free, at least the most common and useful ones. Especially in smart mobility context, income is deeply related with two opposite result, high private car ownership and high potential to have and use the technology, which also depend on other criteria in person's life.

3.4.2. Occupation

Another important factor that determines the access to, and use of, the technology-based services is occupation.

Several professional jobs provide full access to the technological products and services, both hardware and software such as full access to internet, a laptop or a smart phone. Thus, a person's job significantly increases the ability to access any technology, learn, use and interpret them, although the worker normally may not afford them. In fact, most companies make workers learn to use the products and services such as providing collective or private learning seminars. Besides, many other professional jobs make workers use these products and services, especially smart mobility applications, so that they can do their job. An example can be a pharmaceutical representative, who needs to use traffic and map application during the work hours.

3.4.3. Education

Education was one of the main factors until very recently, however, its effect seems to decrease. In 2001, Norris stated that "schools and colleges provide an environment that is exceptionally rich in all forms of info-tech and indeed these have usually been among the first institutions wired to the Net in most countries" (p.81). However, these access potentials of education units have declined, since people have their internet on their pocket. Nevertheless, education still improves one's ability for analytical thinking and dealing with the information flow, or more generally, it eases one's 'after access' process including the understanding, using and interpreting (Norris, 2001).

3.4.4. Gender

The importance of gender dimension is not lost but has decreased over time. Bolt and Crawford (2000) argue that women's level of computer use is less than men, due to not continuing their education after some point as well as gender prejudice toward science and technology department. It is accepted that "the position of women as primary caregivers in the home and family may also play a role, since we have already observed the importance of work environments for Internet access" (Norris, 2001, p.83). However, in today's world, the number of independent and well-educated women is so much more than ever before. There was an overbalance by men, but now, technology is accessed by both men and women in similar levels.

3.4.5. Age

"The generational difference in adaptation to new technologies is perhaps the most significant for the future technological developments" (Norris, 2001, p.84). The generation gap caused by people's age gave a big social digital division in the beginning of the century. Although the gap between younger and older population has narrowed over the years, younger people have more tendency, and ability, than older ones in terms of using technological hardware and software. Especially for newly released applications and products, younger people have a huge capacity to catch them up so quickly, while older ones generally have some troubles for learning and using.

In addition to all these factors listed above, "the national-level country variables usually continued to be significant, even after controlling for social background" (Norris, 2001, p.86). Opportunities offered by each nation strongly affect the access to and use of the provided technology even if the personal-level differences such as occupation, income or education are brought up to the mark. For instance, a well-educated manager with high income living in Oslo is likely to have more ability to access the technology and related products than an equivalent colleague working in Athens (Norris, 2001).

3.5. Types of Digital Divide

Various studies have been conducted to analyze the types of digital divide. Jung, Qui and Kim (2001, p. 3) discussed the following question: "What is the Digital Divide? Does it mean mere ownership of Internet connections…or does the digital divide describe more fundamental inequalities in people's connection to communication technologies?"

In related literature, people's behaviors that use these services have been studied since the 1990s. The perspective of these studies was mainly the diffusion, adoption and domestication of technology. Davis, Bagozzi and Warshaw (1989) have explained the adoption dynamics of users via technology acceptance model.

On the other hand, Rogers (1995) have evaluated different kinds of people using these services in the frame of 'early adopters', 'early majority', 'laggards' and 'non-adopters' via his diffusion theory. In the 21st century, where innovations and ICT have been evolving day by day, new technologies that were used widely like smart phones are requiring a new model different than others to explain the diffusion of these new technologies and adoption decisions of people, since the culture, local norms, values and customs of a society have a considerable impact on that society's adoption of mobile services (Barnes and Huff, 2003). In this context, Jung et al. (2001) has suggested that current digital divide studies failed to consider the society's social, cultural and psychological barriers. The reason is that these barriers create differences in both the acceptance and adoption process of ICT-based services and digital divide created by these services.

Harper has suggested re-defining the digital divide "away from a simple lack of access and toward the social, cognitive, and communicative factors that truly divide groups" (2003, p.1). According to Van Dijk et al. (2003, p.326), "digital skills not only mean abilities to operate the hardware and software (instrumental skills) … they will mean the ability to search, select, process, and apply information (informational skills) from digital sources and to strategically use them to improve one's position in society (strategic skills)." As the price of accessing technology have fallen and people can afford the technology products easier than ever before, the socio-economic factors that creates digital divide became less persuasive in terms of explaining all motives for not-using ICT-based services. In this sense, Van Dijk and Hacker (2003) emphasized that the divide should re-conceptualize in the frame of both access to the services and use, and that both aspects should be dealt not as two aspect of a single dimension, but on-going processes with multidimensions.

One of the first studies based on the psychology of the digital divide, conducted by Eastin and LaRose (2000), explained the digital divide in social cognitive theory context. This study revealed that people tend to act upon their "perceived capabilities" and "the anticipated outcomes".

Jung et al. (2001) suggested that the factors that measures digital divide are inadequate in terms of considering the social context in which people correlate with technology. The authors suggest that although the access to the internet services is ensured, the real question should be what people do after being connected. They argued that "existing inequalities even after gaining access to the Internet can directly affect the capacity and the desire of people to utilize their connections for purposes of social mobility" (Jung et al., 2001, p. 8). As a crucial perspective, focusing on not just accessing technology but the ability to use that technology was further mentioned in the Kvasny's study (2002). The author emphasized the 'digital inequality' concept "to signify a shift and distinction in focus from access to use of information and technology" (2002, p. 16).

Different than defining and conceptualizing, there have also been several attempts for categorizing the digital divide. According to Kim et al. (2001), as a multidimensional and multi-staged concept, the digital divide consists of three dimensions of inequality; media accessibility, information mobilization and information consciousness. At the same time, it consists of opportunity divide, utilization divide, and reception divide stages. Firstly, the media accessibility dimension and opportunity divide stage are closely related with the economic conditions of users that enables access to information technologies. Secondly, the information mobilization dimension and the utilization divide stage are strongly related with social environment of users, where users can obtain and create added value by using the information. Thirdly, information consciousness dimension and reception divide stage are closely related with users' ability to internalize the information as well as intellectually and culturally add their own lives. Norris (2001) has defined three categories of the digital divide, which provide a strong base for further categorizations in the literature.

The global divide concerns the ICT divergence between developed and developing societies. The social divide refers to the access gap between information-rich and information-poor in societies. Lastly, the democratic divide refers to the difference between political users and non-users of digital resources to engage in public life.

In similar but not the same way, Harper (2003) categorizes digital divide phenomena as access digital divide, which refers to the divergence in access to new technologies, and social digital divide, which includes various barriers that prevent people from using these technologies. Since the latter one is more valid for current divide situation and the frame of this thesis, the access and social digital divide are described below in more detail.

3.5.1. The Access Digital Divide

According to Harper (2003), the access digital divide consists of the barriers to access mainly based on the cost factors. In several smart city initiatives, part of the living population is not able to access the necessary technology, due to the high levels of economic insufficiency. (Monzon, 2015) According to Norris (2001), the economic conditions that might affect the ability to access the technology mainly contain the cost and availability of technology. More specifically, several scholars (Bertot, 2003; Davison and Cotten, 2003; Hargittai, 2002; Van Dijk and Hacker, 2003) have strongly emphasized that access inequality need to be treated as a variety of differences including type of hardware and software, the amount of understandable and accessible content and mode of connection. Beside these two main factors, secondary condition for the level of access to technology-based products and services might be the investment in science and technology in a country. Expenditures made on R&D departments bring up several students, technicians, scientists, and engineers, as well as enabling exports of high-tech products, which eventually increase society's ability to access related technology. "One reason why use of mobile phones is so high in Scandinavia, for example, is because Nokkia and Ericsson, two leading telecommunications manufacturing companies, are located there" (Norris, 2001, p.57).

3.5.2. The Social Digital Divide

The social digital divide includes the barriers for motivation, knowledge, skill, content and social networks which come up with the differences depending on one's perception, relations and culture, which are proved to affect the users' perception and use of technology. More important than access digital divide, each barrier causes crucial problems because of the correlation between these barriers (Harper, 2003). Several scholars (Bertot, 2003; Davison and Cotten, 2003; Hargittai, 2002; Van Dijk and Hacker, 2003) have argued that different than access inequalities, usage imparities need to be a variety of different mental access, skills, aim of usage and literacy.

Harper (2003) describes social digital divide by referring to to the presence of vast numbers of individuals who possess access but choose to avoid information technology. Crump and Mclroy (2003) conducted a project based on the people living in Wellington, New Zealand, with the aim of understanding why some people choose not to use the technology, even if it was provided in an available environment with no cost. Similarly, Lenhart et al. (2003) also conducted a project researching economic and social inclusion of people living in Wellington, which has also proven that not all people who do not access the technology or use it due to some reasons necessarily want to be able to access or use it. Some people do not believe -or notice- their relationship with ICT and ICT-based services as a positive contribution to improve their quality of lives. In this context, Steyaert (2002) emphasized two critical bases for social digital divide: technology-illiteracy and information-illiteracy. Technology-illiteracy is based-on the fact that not everybody has the same effectiveness and efficiency while using a technology and related services. Due to the income, occupation, education, gender and age differences, some people have problems with new innovations, since they may not have necessary skills, such as through their financial abilities, education life or occupation type. Information-illiteracy, on the other hand, is based on the fact that people do not have the same level of the ability and attitude to search for and understand relevant information, translate it depending upon current personal situation, take the essential steps and action.

These different but related dimensions make digital divide a societal issue which has an extreme importance. Therefore, this study focuses on providing a better understanding of the digital divide issue, in the context of Turkey. As described in the previous chapter, there are increasing numbers of smart city applications, especially mobility-related applications in Turkish cities. However, while the issue of digital divide and the possible impact of smart mobility applications on creating a level of inequality in the society is discussed in the world, this topic appears as an area that is not analyzed in Turkey.

CHAPTER 4

METHODOLOGY

4.1. Context and Research Questions

This study questions whether providing access to new smart mobility services is enough to make people use these services and whether there are other dynamics which determine the one's access and use. To answer these questions, a case study was conducted as a research method since the topic of the study is a complex multi-dimensional issue which needs an in-depth appreciation.

Although the starting point of the digital divide concept was the ability to access a computer and internet, over the years it evolved to comprise a wider set of issues, because even though people may have easy access to computers and the internet, they still may not be able or willing to use smart applications, hence contributing to this divide. ICT have evolved and changed considerably since the beginning of the 21st century. Mobile phones have evolved to smart phones; computers are now available in various types; the internet is now accessible via laptops, smart phones, tablets, televisions, and many other devices. At this point, the essential question is whether those various devices and the high ability to access the internet will be enough to overcome the digital divide? Norris (2001) asked the following question 18 years ago and it still appears valid: "Will digital inequalities prove a temporary problem that will gradually fade over time, as Internet connectivity spreads and normalizes, or will this prove an enduring pattern generating a persistent division between info-haves and have-nots?" (Norris, 2001, p.11)

The research question can be formulated as follows:

Do the services based on information and communication technologies (ICT), and more specifically smart mobility systems and applications create new or existing inequalities between people that have emerged since the first appearance of the internet?

The vital issue that is emphasized in this thesis, therefore, is that since the digital divide concept has first appeared, many researches claimed that access to technology can prevent digital inequalities and helps overcome digital divide. Thus, most governmental initiatives about preventing digital divide is based on providing access to technology for everyone, since many scholar and officials believed that physical access is the key factor to overcome the divide. However, providing access to new smart mobility technologies, creating circumstances for its initial usage and expecting people to be connected are not enough for people's intention to use these ICT-based services. "Understanding post-implementation acceptance is essential as benefits from ICT occur through sustained use. ... Government initiatives to implement ICT will not alter the state of digital inequality unless there is continued use." (Hsieh, Rai & Keil, 2008, p.98). Many government and private officials expect that no matter what the social and economic condition of a person is, people respond to the same technology in a similar way. However, this assumption may not be valid. At this point, another vital problem that is emphasized in this thesis is whether the drivers for the intention to use smart mobility services are the same for all people despite their different circumstances, and whether these people react in same way when the access to these services is provided?

To answer these questions, a case study was conducted as a research method since the topic of the study is a complex multi-dimensional issue which needs an in-depth appreciation. The methodology of the research is described below.

4.2. Research Methodology

"The case study approach allows in-depth, multi-faceted explorations of complex issues in their real-life settings." (Crowe et al., 2011, p.1). As a research methodology, single case study approach was conducted covering mobile smart mobility applications particularly related with public transport, since mobile applications have the highest use among all smart-mobility services (see figure 6) which enables the research to investigate the criteria coming from the literature. The case study includes different modes of public transport in METU so that the study covers all dimensions of digital divide.

4.2.1. Case Selection

In the research, METU campus has been selected as the case. The campus has barred access due to its function and location. The main public transport system of Ankara; bus, metro and dolmush systems are valid for this bordered area. Consequently, the campus presents a variety of transport options, and it can be assumed that the large number of people living in or travelling to the campus can benefit from smart mobility applications, to reach and move from there. In addition, the campus population provides an opportunity to include people with different socio-economic and demographic characteristics: students, academics, administrative staff, as well as Teknokent staff. As dimensions of digital divide coming from the literature, the population in METU campus varies with respect to age, gender, occupation, income and education, since the campus consists of different parts for studying, working, resting, eating, shopping, and so on. Hence, it has been assumed that this diversity could help analyse people with different mobility patterns and different attitudes towards smart technologies. Furthermore, METU campus can present required results in terms of context, accessibility and availability of data. Case selection should include "accessibility (whether the data needed can be collected from the case individual or organization), resources (whether resources are available to support travel and other data collection and analysis costs), and time available" (Rowley, 2002, p.19).

4.2.2. Research Design

"A research design is the logic that links the data to be collected and the conclusions to be drawn to the initial questions of a study; it ensures coherence." (Rowley, 2002, p.18).

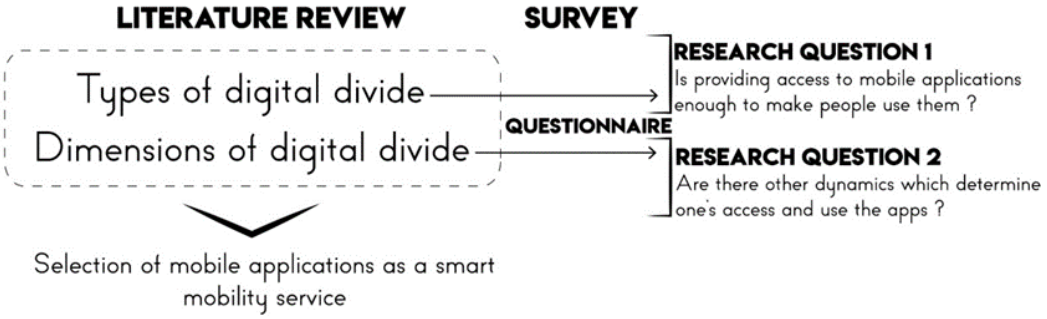

Figure 4.1. Overall design of the research

Figure 4.1 demonstrates the design of the research to answer the two research questions via the relation between the criteria coming from the literature and the research tool. This thesis study is designed as a research based on an important but not well-enquired topic, digital divide. Although digital divide is studied deeply in world literature, it is new and low-enquired topic which has very little research in the Turkish literature. Therefore, the design of the thesis is based on a deep literature review, specifying the criteria for a survey and evaluates them in Turkey context. As a survey method, questionnaire is used to answer the thesis question. The literature gave two different kinds of criteria for digital divide: the ones based on types of digital divide and the ones based on dimensions of digital divide. These two kinds provided different data which help to understand whether access to mobile applications is enough, whether there are any types of digital divide, and what kind of dynamics are there to explain a possible digital divide.

4.3. Brief History of Smart Mobility Applications of Ankara city

Ankara has three mobile applications about public transport: Ego Cepte, Moovit and ABB Trafik (See Figure 4.2).

Figure 4.2. The signs of Ego Cepte, ABB Trafik and Moovit Applications

The first application Ego Cepte has been provided by the Metropolitan Municipality, as a service of General Directorate of EGO, since 2012. The application is the first app that comes to mind when using public transport in Ankara. The system of the app is based on only bus system, both public, private public and private buses, as well as offerings several information such as specific bus schedule; its speed, location and occupancy rate, searching for specific bus stop based on its number, searching for certain address or location of a person at that time, and transactions on Ankara Kart.

The second application Moovit is an international application provided by a private company. Its Ankara part, which was released in 2018, called 'Moovit Toplu Taşıma', provides step by step directions while travelling to specific location chosen. It also views information about bus and train schedules, how far to walk to selected location after using public transport, arrival times of vehicles, how many stops are left and detailed routes on a map.

The third application ABB Trafik is also provided by Metropolitan Municipality, as a service of General Directorate of EGO, since 2014. Besides its main service which is showing the instant traffic density of selected road on map, the app offers much other information such as live cameras, road information, the bus lines located on selected road, route and address detection. Since the first one is based mainly on bus schedule information, the second one based on address description to a certain location and third one based on the instant traffic density, all three applications were studied in the research to cover all public transport modes and their users.

4.4. Research Tools

When it comes to the data collection part, research tools are necessary to be able to finalize the study. "Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes" (Kabir, 2016, p.202). For this study, survey questionnaire was selected as a research tool; thus, the crucial part of the study; user's perspective was involved.

4.4.1. Survey Questionnaire

Questionnaires are needed to collect data, especially from user perspective. To gather all the necessary views and information from user perspective, questionnaires are useful.

In this study, survey questionnaire based on the usage of three mobile public transport applications is conducted. The aim of using this tool is collecting data from the users about their ability to access and use these applications. The researcher designed the questionnaire to gather qualitative data based on two research questions. The survey questions were achieved from literature review. The questionnaire includes two main parts. First part consists of questions about personal information. Second part consists of questions for people who do not use that application to understand their reason for not using. The second part have same questions for three different applications. All parts of the survey are designed by the researcher to get answer for the research questions of the thesis.

4.4.2. Detailed Content of the Questionnaire

The first part of the questionnaire includes questions about the user’s personal information to obtain a detailed user profile. This part would give the researcher the dimensions of digital divide, achieved from Norris (2001), which is an answer for the second research question.

The questions in this part contain one choice question, about the user's income, education level, occupation, age and gender. (For the survey questionnaire, see Appendix A). Second part of the questionnaire consists of one choice question for the people who do use that application. The answer would help to understand the reason why that person does not use this application. The second part includes one question; for non-user people to select why they do not use. This part would give the researcher the types of digital divide; access digital divide and social digital divide, achieved from Harper (2003), which is an answer for the first research question. Options 'a', 'b', 'c', 'd', 'f', 'g' in second part intend to prove the access is not enough alone to make a person to be 'connected', which is called social digital divide. The option 'e', on the other hand, intends to learn the current validity of access digital divide.

4.4.3. The Overview of the Case Area

METU is located on the south-western part of Ankara (see figure 4.3). This is a dominant growth direction for the city, which is served by a major arterial, İnönü Boulevard, which is also known as Eskişehir Boulevard in Ankara.

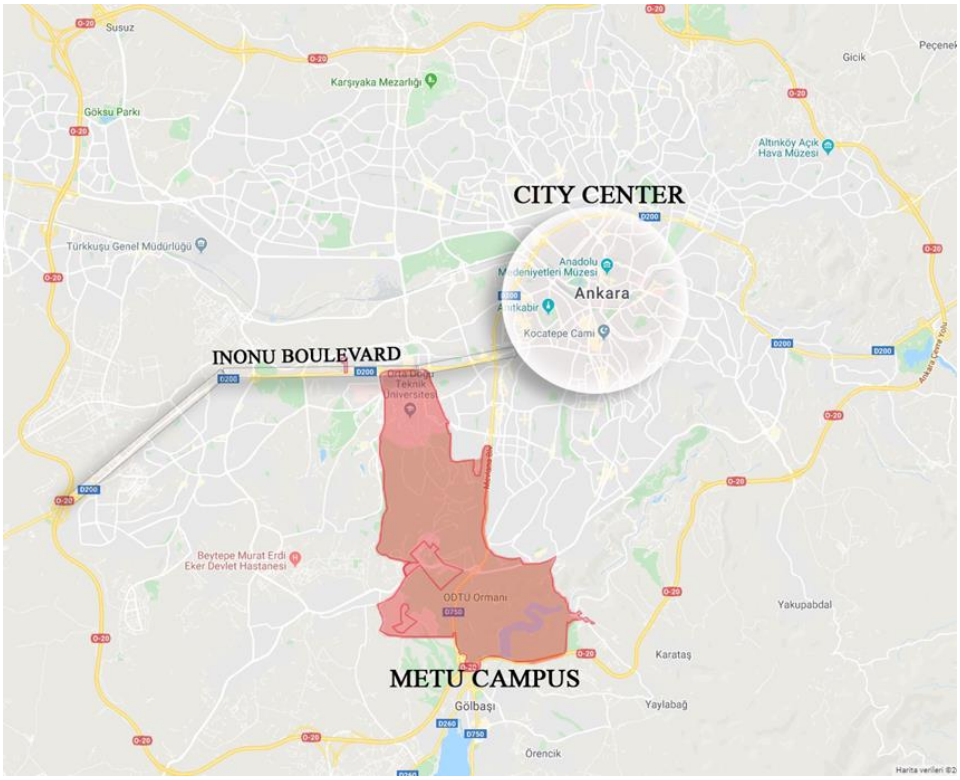

Figure 4.3. The Location of METU Campus in Ankara

The campus is situated on the southern side of this boulevard and gets direct access from this main arterial. This main entry is known as the A1 Gate of the campus. In addition, A4 gate provides access from the central city area, while A7 gate provides access from the western side, the rapidly growing areas of the city (see figure 4.4).

The university has 4500 hectares campus area, comprising all academic departments, administrative buildings, dormitories, sports and catering facilities, and an R&D site known as Teknokent. According to METU Institutional Development and Planning Office, the number of students is 27582, the number of acamedic staff is 2223, the number of administrative staff is 2632, and the number of Teknokent staff is 6700 (data is for the 2017-2018 Academic Year).

Most daily activities are held in the midpart of the campus area (see figure 4.4). The campus has five entry gates, and three of them are actively used for entrances.

The campus has a strong public transport accessibility, which comprise bus, metro and dolmuş systems. As public transport modes, the campus can be reached via different vehicles, some of which enter the campus (like dolmuş and some buses) while some modes do not enter the campus but provide access to gates (figure 4.4). For the passengers who aim to reach west and north-west side of the city such as Ümitköy or Etimesgut, there are several buses, dolmuş lines and a metro line which has stops at the A1 gate of the campus. For the passengers who aim to reach city center or central districts, there are dolmuş, bus lines that enter the campus and a metro line which has a stop at A1 gate. Similarly, there are dolmuş and bus lines that use A4 gate, which enables access to central city via Çetin Emeç Boulevard and Ayrancı. According to Altintasi and Tuydes-Yaman (2012), public transport users form 41%, private car users form 39%, dolmuş users form 13% and those who walk form 7% of daily passengers of METU campus.

Figure 4.4. The Public Transport Lines to METU Campus

4.4.4. Application Process of the Questionnaire

The questionnaires were applied in the Middle East Technical University in the beginning of August at weekdays, between 11 am and 4 pm. As a case study, METU campus contains a huge number of people living in or attending the areas within the campus; and therefore, it could be assumed that they can benefit from smart mobility applications, to reach and move from there. As transport modes, the campus has different transport vehicles which enter the campus. Since the campus has a barred access due to its function and location, and a car entrance restriction, there is a huge number of public transport users in the campus. As dimensions of digital divide coming from the literature, these users vary depending on age, gender, occupation, income and education, since the campus consists of different parts for studying, working, resting, eating, shopping, and so on.

To obtain the most reliable results, the questionnaire was made in these different parts of the campus, which are commonly used by various people (see figure 4.5). These parts consist of Teknokent, Library, Rectorship and Çarşı area. Teknokent area mainly consists of white-collar workers who work at various private firms located in that area, and some students and waiters. Library area mainly includes variety of students from different socio-aconomic dimensions, and some administrative workers and academics. Rectorship area mainly contains administrative and technical staff, and some academics. And finally, Çarşı area, which is the most diverse one, consists of students, craftsmen, waiters, academics, and some medical, technical and administrative stuff. By applying the questionnaire in these much-used parts of the campus, the researcher had an opportunity to make the questionnaire with people who have different income, education level and occupation, from different age and gender.

The researcher filled the survey questionnaires by directly asking the questions to the participants. In situations when the participant does not familiar with the application or any feature, the researcher explained it.

First, the aim and the context of the study were introduced to the potential participants, and they were asked their willingness to participate in this three-minute questionnaire. Additionally, the researcher informed the participants about their identity to be confidential, as well as participants' option to stop answering anytime.

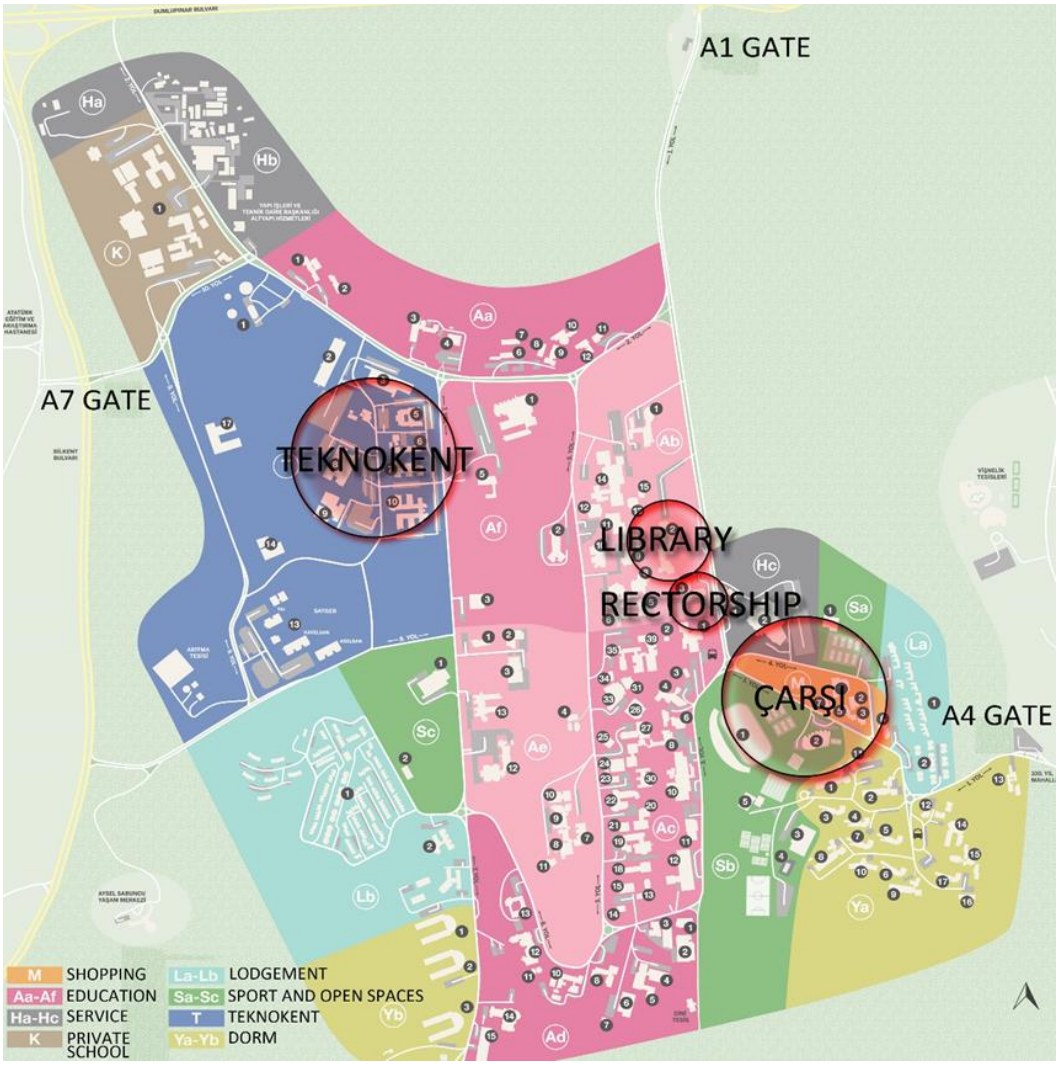

Figure 4.5. The four main parts of METU campus

4.4.5. Analysis of the Questionnaire

After collecting data via the survey questionnaire, descriptive analysis is used to involve the perspective of participants. In the scope of descriptive analysis, crosstabs and frequencies of data were used. By using this analysis, the general user profiles, that is income, education level, occupation, age and gender, and their reasons for not using these applications and their percentage were understood. In this way, the qualitative data gathered from the participants were converted to quantitative data, which enables the researcher to find the answer of two research questions: the effect of digital divide dimensions; income, education level, occupation, age and gender on digital divide types; access and social digital divide and the inter-relations between these types.

CHAPTER 5

RESULTS AND COMMENTARIES

The aim of this chapter is to evaluate the findings of survey questionnaire, which has been based on the two research questions of the study. The flow of this chapter mentions respectively the general profile of participants (e.g. age, gender, income, occupation, education level), and rate of using the applications separately. Then, with the aim of data provision to the first research question, collected data based on types of digital divide is presented. Afterwards, with the aim of data provision to the first research question, collected data based on dimensions of digital divide is provided. Finally, the data conducted from all two parts are analyzed together to assess the relation between dimensions and types of digital divide. Finally, at the end of the chapter, the researcher provides an overall evaluation based on all the findings mentioned throughout the chapter.

5.1. General Profile of Participants

Survey questionnaire has been conducted with 145 participants in different parts of the METU campus. The number of participants is 43 people in Teknokent area, 30 people in Library area, 22 people in Rectorship area, and 50 people in Çarşı area.

The age, gender, education, income and occupation distribution of participants are listed below. Figure 5.1 shows the age distribution that covers whole adult age groups from 18-24 to 55 and older. The most frequent age interval is 25-34 with almost 45%. The least frequent age interval is 55+, with 6%.

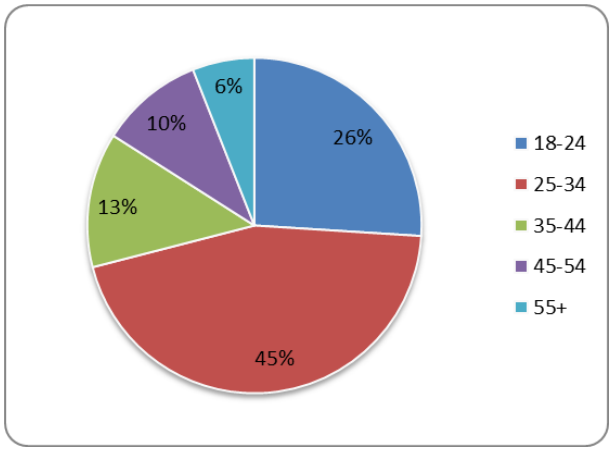

Figure 5.1. Age Distribution of Participants

Figure 5.2 shows the gender distribution, which is considered acceptable for capturing gender differences in the theme to be analyzed. 43% of respondents are female, and 57% male.

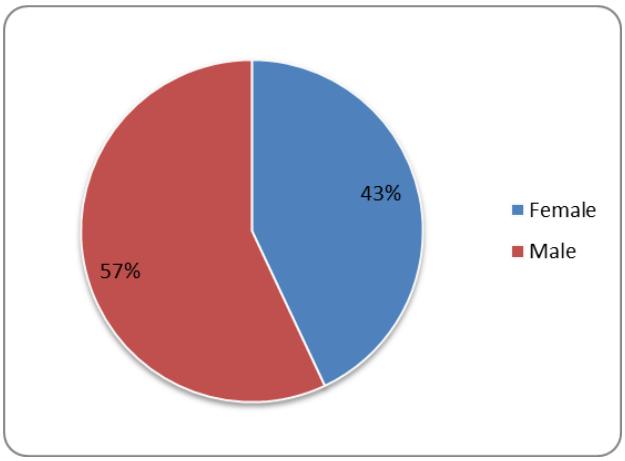

Figure 5.2. Gender Distribution of Participants

Figure 5.3 shows the education levels that cover whole levels from primary to graduate school. They were categorized depending on graduation level; therefore, students are counted as secondary school level education. The most frequent levels are undergraduate and secondary school which is almost 40%.

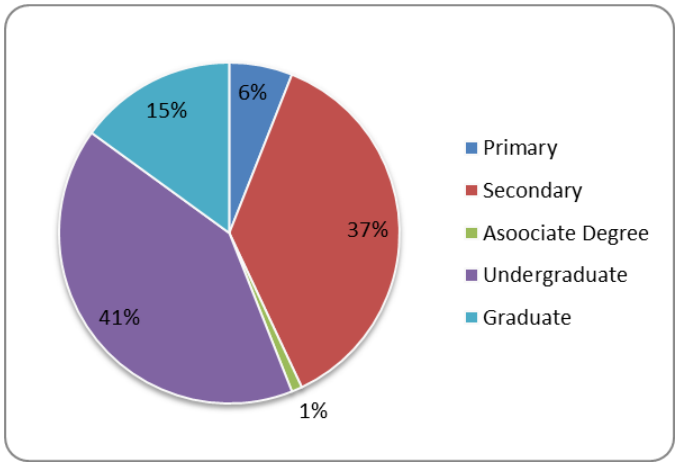

Figure 5.3. Education Level of Participants

Figure 5.4 shows the income levels, which consist of three levels: 0-1999 TL, 2000-3999 TL, and 4000 TL and more. The frequencies of all three levels are close, with 2000-3999 and 4000+ are almost equal with 35% and 40%.

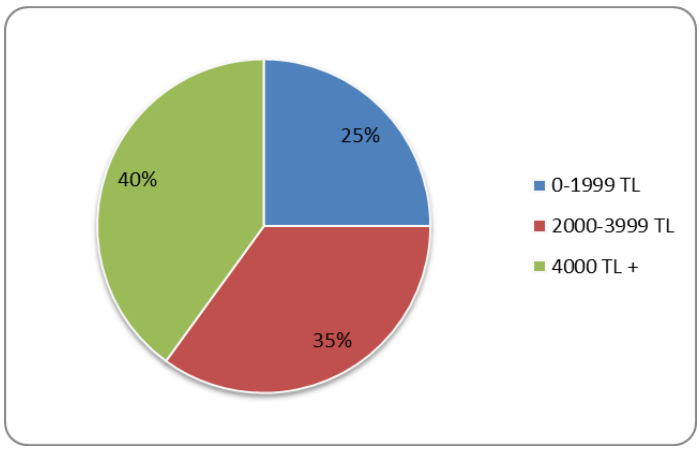

Figure 5.4. Income Level of Participants

Figure 5.5 shows the occupation distributions, which include academics, administrative staff, technical staff, craftsmen, medical staff, waitstaff, teknokent staff and students. The most frequent ones are student with 32% and Teknokent staff with 26% as well as the lowest is medical staff with 1%. This shows that more than half of the respondents correspond to students and Teknokent staff, who may be more literate

in digital technologies; however, the shares of other staff may also help reveal their inclinations regarding digital technologies and smart applications.

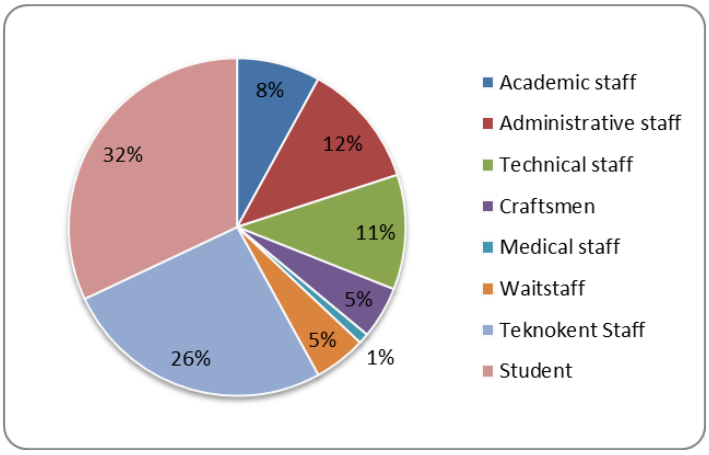

Figure 5.5. Occupations of Participants

Figure 5.6 show the car-owning rate of participants. The owners are 39% of participants who state themselves as low users of public transport.

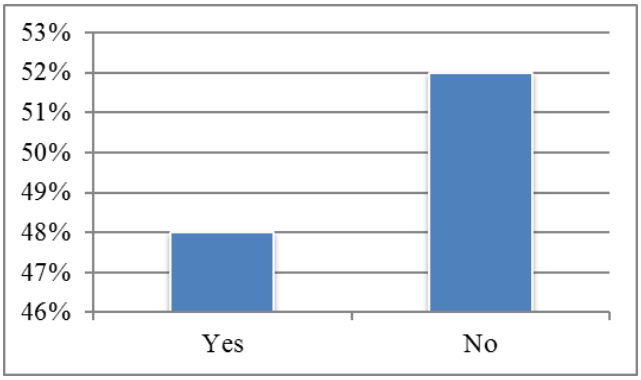

Figure 5.6. The car-owning rate of participants

Figure 5.7, 5.8 and 5.9 demonstrate the usage frequencies of three case applications, Ego Cepte, Moovit and ABB Trafik. The most frequent one is Ego Cepte application, with 48% usage level (Figure 5.7). Other two applications have close levels of usage; Moovit with 15% usage frequency (Figure 5.8) and ABB Trafik with 12% usage level (Figure 5.9).

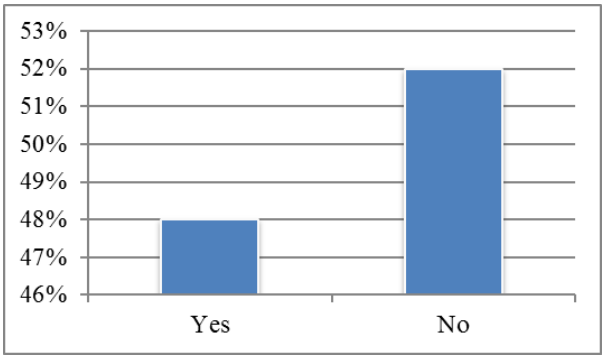

Figure 5.7. The usage frequency of Ego Cepte application

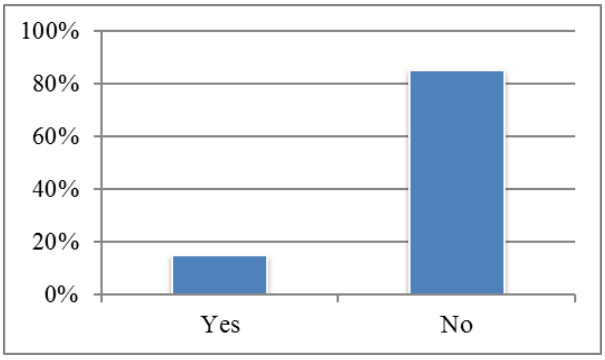

Figure 5.8. The usage frequency of Moovit application

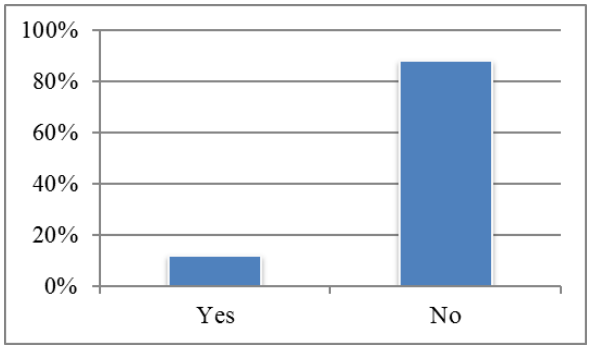

Figure 5.9. The usage frequency of ABB Trafik application

5.2. Types of Digital Divide

This part of the survey consists of the same questions for all three applications, which was designed to discover the types digital divide. Access divide corresponds to 'e' option and social divide is covered under ‘a', 'b', 'c', 'd', 'f' and 'g’ options.

Table 5.1 shows the reasons of not using Ego Cepte application and these reasons include 7 different options. The most frequent answer is 'knowing the app but not needing it' (c) with 19%. Other popular answers are 'knowing the app but not meeting respondent's need' (d) with 10% and 'not knowing and not needing the app' (a) with 8%. The least frequent is 'knowing the app but insufficient phone' answer with 2%, which is the option for measuring the access digital divide.

Table 5.1. *The reasons for not using Ego Cepte application*

	Frequency	Percent
Not knowing and not needing the app (a)	12	8%
Not knowing but if he/she knows he/she may use (b)	4	3%
Knowing the app but not needing it (c)	28	19%
Knowing the app but not meeting respondent's need (d)	14	10%
Knowing the app but insufficient phone (e)	3	2%
Knowing the app but not knowing how to use it and if the respondent knows, he/she will use it (f)	6	4%
Knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it (g)	2	1%
Total	69	

Table 5.2 shows the reasons of not using Moovit application, and it covers 7 different options mentioned above. The most frequent answer is 'not knowing and not needing the app' (a) with 43%. This was 19% for the first mobile application Ego Cepte, and hence it is seen that this rate is much high for the Moovit application. Other popular answers are 'not knowing but if he/she knows he/she may use' (b) with 23% and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (g) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (f) options with 5,5%.

The least frequent ones are 'knowing the app but insufficient phone' and 'knowing the app but not meeting respondent's need' (d) answers with 2,1% both.

Table 5.2. *Reasons of not using Moovit application*

	Frequency	Percent
Not knowing and not needing the app (a)	62	43%
Not knowing but if he/she knows he/she may use (b)	34	23%
Knowing the app but not needing it (c)	5	3%
Knowing the app but not meeting respondent's need (d)	3	2%
Knowing the app but insufficient phone (e)	3	2%
Knowing the app but not knowing how to use it and if the respondent knows, he/she will use it (f)	8	6%
Knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it (g)	8	6%
Total	123	

Table 5.3 shows the reasons of not using ABB Trafik application, and it includes 7 different options mentioned above. The most frequent answer is 'not knowing and not needing the app' (a) with 42%, a rate similar for the Moovit application, and again much higher than this answer for the Ego Cepte application. Other popular answers are 'not knowing but if he/she knows he/she may use' (b) with 25% and ‘knowing the app but not needing it' (c) with 12%. The least frequent ones are 'knowing the app but insufficient phone' and 'knowing the app but not meeting respondent's need' (d) answers with 2,1% both.

Table 5.3. *The reasons for not using ABB Trafik application*

	Frequency	Percent
Not knowing and not needing the app (a)	61	42%
Not knowing but if he/she knows he/she may use (b)	36	25%
Knowing the app but not needing it (c)	19	13%
Knowing the app but not meeting respondent's need (d)	3	2%
Knowing the app but insufficient phone (e)	3	2%
Knowing the app but not knowing how to use it and if the respondent knows, he/she will use it (f)	6	4%
Knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it (g)	3	2%
Total	127	

5.3. Dimensions of Digital Divide

This part of the study consists of the analysis of answers with regards to personal information of participants, such as income, education level, occupation, age and gender. The rate of usage of this application is analyzed by taking this personal information into consideration.

5.3.1. Ego Cepte Application

Table 5.4 shows the number of Ego Cepte users and non-users based on participants' income level. The income level which has the highest usage (answer 'yes') is 0-1999 level with 25 users over 36 (70% of those from that income level). 2000-3999 level has the second highest usage with 31 users over 51 (60% of those from that income level) which followed by the lowest usage that is 4000 and more level with 20 users over 58 (34%). The participants' usage of the Ego Cepte Application was observed to have a correlation with income levels. 41% of those who stated that they use the app are from the 2000-3999 TL income level; 33% are from the lowest segment while 26% are from the highest (4000 TL and above).

The reason why 2000-3999 income level has the highest usage may be due to the fact that most of the app users belong to middle-income group whose income is high in terms of being familiar with technology; but low in terms of having a private car. Also, it should be noted that the income groups' familiarity with the applications may not be related to their digital literacy but may be related with their familiarity with public transport. In other words, higher income groups are probably the car-owner group who is using public transport less frequently, and hence not using Ego Cepte.

Table 5.4. *The usage of Ego Cepte application based on income level*

		No	Yes	Total	Percent (yes)
Income (TL)	0-1999	11	25	36	70%
	2000-3999	20	31	51	60%
	4000+	38	20	58	34%
Total		69	76	145	

Table 5.5 shows the number of Ego Cepte users and non-users based on participants' education level. Students were counted as secondary school level because the categorization of the education level is based on the graduated school. The education level which has the highest usage (answer 'yes') is secondary school level with 32 users over 54 (60%). Undergraduate level has the second highest usage with 33 users over 60 (55%). The lowest level of usage belongs to graduate level with 6 users over 21 (30%). To explain in a different way, 42% of those who said that they use the Ego Cepte app are secondary school graduates (which possibly corresponds to the current university students) and 43% are university graduates.

Table 5.5. *The usage of Ego Cepte application based on education level*

		No	Yes	Total	Percent (yes)
Education	Primary	4	4	8	50%
	Secondary	22	32	54	60%
	Associate Degree	1	1	2	50%
	Undergraduate	27	33	60	43%
	Graduate	15	6	21	30%
Total		69	76	145	

Table 5.6 shows the number of Ego Cepte users and non-users based on participants' occupation. The occupation which has the highest usage (answer 'yes') is students with 31 users over 46 (70%). The usage levels of other occupations are technical staff with 10 users over 16 (62%), administrative staff with 11 users over 18 (60%), medical staff with 1 user over 1 (50%), Teknokent staff with 17 users over 37 (45%), and waitstaff with 2 users over 7 (28%). Craftsmen have no using participant over 7.

The above finding can also be explained as follows: 41% of those who stated that they use Ego Cepte are students. This is followed by Teknokent staff: 22% of those who stated that they use Ego Cepte are Teknokent staff. Then 14% of those who stated that they used the app are Administrative staff, and 13% technical staff.

Table 5.6. *The usage of Ego Cepte application based on occupation*

		No	Yes	Total	Percent (yes)
Occupation	Academics	8	4	12	33%
	Administrative	7	11	18	60%
	Technical	6	10	16	62%
	Craftsmen	7	0	7	-
	Medical	1	1	2	50%
	Waitstaff	5	2	7	28%
	Teknokent Staff	20	17	37	45%
	Student	15	31	46	70%
Total		69	76	145	

Table 5.7 shows the number of Ego Cepte users and non-users based on participants' age distribution. The age interval which has the highest usage (answer 'yes') is 18-24 interval with 25 users over 38 (65% of that age group), which is followed by 25-34 interval with 34 users over 65 (52% of that age group) and 35-44 interval with 9 users over 19 (47% of that age group). Other intervals have close results, 45-54 interval with 5 users over 14 (35%) and the lowest, 55 and older interval with 3 users over 9 (33%). The findings show that majority of the respondents that are younger than 35 use the app, whereas for the 35 and above majority do not use.

Table 5.7. *The usage of Ego Cepte application based on age distribution*

		No	Yes	Total	Percent (yes)
Age	18-24	13	25	38	65%
	25-34	31	34	65	52%
	35-44	10	9	19	47%
	45-54	9	5	14	35%
	55+	6	3	9	33%
Total		69	76	145	

5.3.2. Moovit Application

Table 5.8 shows the number of Moovit users and non-users based on participants' income level. The income level which has the highest usage (answer 'yes') is 0-1999 level with 7 users over 36 (19% of this income group). 2000-3999 level has the second highest usage with 8 users over 51 (16% of this income group) which followed by the lowest usage that is 4000 and more level with 7 users over 58 (12% of this income group). It is seen that income factor has unclear impact on the usage rate of Moovit application.

Table 5.8. *The usage of Moovit application based on income level*

		No	Yes	Total	Percent (yes)
Income (TL)	0-1999	29	7	36	19%
	2000-3999	43	8	51	16%
	4000+	51	7	58	12%
Total		123	22	145	

Table 5.9 shows the number of Moovit users and non-users based on participants' education level. Students were counted as secondary school level because the categorization of the education level is based on the graduated school. The education levels which have the highest usage (answer 'yes') are associate degree level with 1 user over 2 (50%) and graduate level with 4 users over 21 (19%).

Other levels have similar results, undergraduate level with 10 users over 60 (16%), primary school level with 1 user over 8 (12%) and the lowest, secondary school level with 6 users over 54 (11%). The effect of education level on the usage of the application seems unclear, since the high usage rate of secondary school (students) and undergraduate level may or may not be specific for Moovit application. These education levels are the ones who use all applications most; thus, these rates may be the results of general situation.

Table 5.9. *The usage of Moovit application based on education level*

		No	Yes	Total	Percent (yes)
Education	Primary	7	1	8	12%
	Secondary	48	6	54	11%
	Associate Degree	1	1	2	50%
	Undergraduate	50	10	60	16%
	Graduate	17	4	21	19%
Total		123	22	145	

Table 5.10 shows the number of Moovit users and non-users based on participants' occupation. The occupation which has the highest usage (answer 'yes') is Teknokent staff with 7 users over 37 (19% of those in this occupation group). Other levels have similar results, administrative staff with 7 users over 46 (16% of those in this occupation group), academics with 2 users over 12 (16% of the academics), student with 7 users over 46 (15% of the students), craftsmen with 1 user over 7 (14%), and technical staff with 2 users over 16 (13%). Waitstaff and medical staff have no using participant over 7 and 2. The reason for high using rates of Teknokent staff and students may be their tendency to use new technologies as qualified users.

Table 5.10. *The usage of Moovit application based on occupation*

		No	Yes	Total	Percent (yes)
Occupation	Academics	10	2	12	16%
	Administrative	15	3	18	16%
	Technical	14	2	16	13%
	Craftsmen	6	1	7	14%
	Medical	2	0	2	-
	Waitstaff	7	0	7	-
	Teknokent Staff	30	7	37	19%
	Student	39	7	46	15%
Total		123	22	145	

Table 5.11 shows the number of Moovit users and non-users based on participants' age distribution. The age interval which has the highest usage (answer 'yes') is 18-24 interval with 8 users over 38 (21% of this age group), which followed by 25-34 interval with 10 users over 65 (15% of this age group) and 35-44 interval with 3 users over 19 (15% of this age group). 45-54 interval has low usage with 1 user over 14 (7% of this age group). 55 and older interval age group does not use the app according to this sample.

Table 5.11. *The usage of Moovit application based on age distribution*

		No	Yes	Total	Percent (yes)
Age	18-24	30	8	38	21%
	25-34	55	10	65	15%
	35-44	16	3	19	15%
	45-54	13	1	14	7%
	55+	9	0	9	-
Total		123	22	145	

Table 5.12 shows the number of Moovit users and non-users based on participants' gender distribution. Female participants have higher usage with 11 users over 62 (17% of females) and male participants have 11 'yes' answers over 83 (13% of males). The usage rates among gender seems similar, the reason for percentage of women is high is due to the higher male participant number.

Table 5.12. *The usage of Moovit application based on gender distribution*

		No	Yes	Total	Percent (yes)
Gender	Female	51	11	62	17%
	Male	72	11	83	13%
Total		123	22	145	

5.3.3. ABB Trafik Application

Table 5.13 shows the number of ABB Trafik users and non-users based on participants' income level. The income levels which have the highest usage (answer 'yes') is 0-1999 level with 5 users over 36 (13% of this income group) and 4000 and more level with 8 users over 58 (13%). The lowest usage belongs to 2000-3999 level with 5 users over 51 (9%). It is seen that income factor has unclear impact on the usage rate of ABB Trafik application.

Table 5.13. *The usage of ABB Trafik application based on income level*

		No	Yes	Total	Percent (yes)
Income (TL)	0-1999	31	5	36	13%
	2000-3999	46	5	51	9%
	4000+	50	8	58	13%
Total		127	18	145	

Table 5.14 shows the number of ABB Trafik users and non-users based on participants' education level. Students were counted as secondary school level because the categorization of the education level is based on the graduated school. The education level which has the highest usages (answer 'yes') are associate degree level with 1 user over 2 (50%), and undergraduate level with 8 users over 60 (13%). Other levels have similar results, primary school level with 1 user over 8 (12%), secondary school level with 6 users over 54 (11%), and the lowest, graduate level with 2 users over 21 (9%). The effect of education level on the usage of the application seems unclear, since the high usage rate of secondary school (students) and undergraduate level may or may not be specific for ABB Trafik. These education levels are the ones who use all applications most; thus, these rates may be the results of general situation.

Table 5.14. *The usage of ABB Trafik application based on education level*

		No	Yes	Total	Percent (yes)
Education	Primary	7	1	8	12%
	Secondary	48	6	54	11%
	Associate Degree	1	1	2	50%
	Undergraduate	52	8	60	13%
	Graduate	19	2	21	9%
Total		127	18	145	

Table 5.15 shows the number of ABB Trafik users and non-users based on participants' occupation. The occupation which has the highest usage (answer 'yes') is craftsmen with 2 users over 7 (28%). Other occupations have similar level of usage; Teknokent staff with 6 users over 37 (16%), waitstaff with 1 user over 7 (14%), technical staff with 2 users over 16 (12%), administrative staff with 2 users over 18 (11%), student with 5 users over 46 (10%), and technical staff with 2 users over 16 (13%). Academics and medical staff have no using participant over 12 and 2.

Table 5.15. *The usage of ABB Trafik application based on occupation*

		No	Yes	Total	Percent (yes)
Occupation	Academics	12	0	12	-
	Administrative	16	2	18	11%
	Technical	14	2	16	12%
	Craftsmen	5	2	7	28%
	Medical	2	0	2	-
	Waitstaff	6	1	7	14%
	Teknokent Staff	31	6	37	16%
	Student	41	5	46	10%
Total		127	18	145	

Table 5.16 shows the number of ABB Trafik users and non-users based on participants' age distribution. The all age interval have similar results, the highest usage (answer 'yes') that belongs to 45-54 interval with 2 users over 14 (14% of this age group), which followed by 18-24 interval with 5 users over 38 (13% of this age group), 25-34 interval with 8 users over 57 (12% of this age group), 55 and older interval with 1 user over 9 (11% of this age group), and 35-44 interval with 2 users over 19 (10% of this age group).

As it is observed in all applications, the most using occupations are Teknokent staff and students. The reason for high using rates of these occupations may be their tendency to use new technologies as qualified users.

Table 5.16. *The usage of ABB Trafik application based on age distribution*

		No	Yes	Total	Percent (yes)
Age	18-24	33	5	38	13%
	25-34	57	8	65	12%
	35-44	17	2	19	10%
	45-54	12	2	14	14%
	55+	8	1	9	11%
Total		127	18	145	

Table 5.17 shows the number of ABB Trafik users and non-users based on participants' gender distribution. Female participants have lower usage with 5 users over 62 (8% of females) and male participants have 13 'yes' answers over 83 (15% of males).

Table 5.17. *The usage of ABB Trafik application based on gender distribution*

		No	Yes	Total	Percent (yes)
Gender	Female	57	5	62	8%
	Male	70	13	83	15%
Total		127	18	145	

It is observed that the number of Moovit and ABB Trafik users are far less than Ego Cepte users. Thus, there seems unclear correlation between income level, age, gender and Moovit and ABB Trafik applications as it is in Ego Cepte application.

Occupation and education, on the other hand, observed to have higher effect on usage rates. Occupation is a determinant especially for ABB Trafik application, since the user participants stated that they familiar with this app due to their usage of this app during their working hours. Differently, education is more significant determinant for all three applications, since the younger population is more curious and qualified to use any technology than older ones.

5.4. Relation Between Dimensions and Types

This part of the results consists of answers including the reasons why participants do not use that application and the comparison of these answers with the dimensions of digital divide, which is participants' income, education level, occupation, age and gender. The specified categories in each dimension are measured in itself.

5.4.1. Ego Cepte Application

Table 5.18 shows the reasons of not using Ego Cepte application depending on income levels of participants. The most common answers are respectively 'knowing the app but not needing it' (c) with 30 answers over 69 (43%), 'knowing the app but not meeting respondent's need' (d) with 14 answers over 69 (20%), and 'not knowing and not needing the app' (a) with 12 answers over 69 (17%). Other answers are below 5%. Between income levels, the most common answer of 0-1999 level is 'knowing the app but not needing it' (c) which was answered 8 times by 11 participants (72%). Other given answers are 'knowing the app but not meeting respondent's need' (d) which was answered 2 times by 11 participants (18%) and 'not knowing and not needing the app' (a) which was answered 1 time by 11 participants (9%).

The answers of 2000-3999 level have similar percentages; 'not knowing and not needing the app' (a) which was answered 6 times by 20 participants (30%), 'knowing the app but not meeting respondent's need' (d) which was answered 5 times by 20 participants (25%), 'knowing the app but not needing it' (c) which was answered 4 times by 20 participants (20%), 'knowing the app but insufficient phone' (e) which was answered 3 times by 20 participants (15%), and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 2 times by 20 participants (10%).

The most common answer of 4000 and more level have is 'knowing the app but not needing it' (c) which was answered 18 times by 38 participants (47%), 'knowing the app but not meeting respondent's need' (d) which was answered 7 times by 38 participants (18%), 'not knowing and not needing the app' (a) which was answered 5 times by 38 participants (13%), 'not knowing but if he/she knows he/she may use' (b) which was answered 4 times by 38 participants (11%). The least answers are 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 2 times by 38 participants (5%).

Table 5.18. *The reasons of not using Ego Cepte depending on income levels*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Income (TL)	Using	a	b	c	d	e	f	g	Not Using	Total
0-1999	25 (69%)	1 (9%)	0	8 (72%)	2 (18%)	0	0	0	11 (31%)	36
2000-3999	31 (60%)	6 (30%)	0	4 (20%)	5 (25%)	3 (15%)	2 (10%)	0	20 (40%)	51
4000+	20 (34%)	5 (13%)	4 (11%)	18 (47%)	7 (18%)	0	2 (5%)	2 (5%)	38 (66%)	58
Total	76	12	4	30	14	3	4	2	69	145

Table 5.19 shows the reasons of not using Ego Cepte application depending on education levels of participants. The most common answers are respectively 'knowing the app but not needing it' (c) with 30 answers over 69 (43%), 'knowing the app but not meeting respondent's need' (d) with 14 answers over 69 (20%), and 'not knowing and not needing the app' (a) with 12 answers over 69 (17%). Other answers are below 5%.

Between education levels, the most common answer of primary school level graduates is 'not knowing and not needing the app' (a) which was answered 2 times by 4 participants (50%). Other given answers are 'knowing the app but not needing it' (c) and 'knowing the app but not meeting respondent's need' (d) which was answered 1 time by 4 participants (25%).

The answers of secondary school level includes 'knowing the app but not needing it' (c) which was answered 7 times by 22 participants (32%), 'knowing the app but not meeting respondent's need' (d) which was answered 6 times by 22 participants (27%), 'not knowing and not needing the app' (a) which was answered 4 times by 22 participants (18%), 'knowing the app but insufficient phone' (e) which was answered 3 times by 22 participants (14%). The least answer is 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 2 times by 22 participants (9%).

The answer of associate degree level participant who does not use Ego Cepte is 'knowing the app but not meeting respondent's need' (d).

The most common answer of undergraduate level is 'knowing the app but not needing it' (c) which was answered 16 times by 27 participants (59%). The other answers have similar percentages; 'not knowing and not needing the app' (a) which was answered 4 times by 27 participants (15%), 'knowing the app but not meeting respondent's need' (d) which was answered 3 times by 27 participants (11%), 'not knowing but if he/she knows he/she may use' (b) which was answered 2 times by 27 participants (7%).

The least answers are 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 27 participants (4%).

The most common answer of graduate level is 'knowing the app but not needing it' (c) which was answered 6 times by 15 participants (40%). Other answers have similar percentages; 'knowing the app but not meeting respondent's need' (d) which was answered 3 times by 15 participants (20%), 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which was answered 2 times by 15 participants (13%). The least answers are 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 15 participants (6%).

It is observed the highest rate belongs to same reason for all education levels: knowing the app but not needing it'. Since all participants were claimed themselves as public transport users, the possible cause of this result may be the usage of dolmush or metro as a mode for public transport. Ego Cepte contains only bus system.

Table 5.19. *The reasons of not using Ego Cepte depending on education levels*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Education level	Using	a	b	c	D	e	f	g	Not Using	Total
Primary	4 (50%)	2 (25%)	0	1 (13%)	1 (13%)	0	0	0	4 (50%)	8
Secondary	32 (60%)	4 (7%)	0	7 (13%)	6 (11%)	3 (6%)	2 (4%)	0	22 (40%)	54
Associate Degree	1 (50%)	0	0	0	1 (50%)	0	0	0	1 (50%)	2
Undergrad.	33 (55%)	4 (7%)	2 (3%)	16 (27%)	3 (5%)	0	1 (2%)	1 (2%)	27 (45%)	60
Graduate	6 (29%)	2 (10%)	2 (10%)	6 (29%)	3 (14%)	0	1 (5%)	1 (5%)	15 (70%)	21
Total	76	12	4	30	14	3	4	2	69	145

Table 5.20 shows the reasons of not using Ego Cepte application depending on occupations of participants. The most common answers are respectively 'knowing the app but not needing it' (c) with 30 answers over 69 (43%), 'knowing the app but not meeting respondent's need' (d) with 14 answers over 69 (20%), and 'not knowing and not needing the app' (a) with 12 answers over 69 (17%). Other answers are below 5%. Between occupations, the most common answer of academics is 'not knowing and not needing the app' (a) which was answered 3 times by 8 participants (37%). Other given answers are 'knowing the app but not needing it' (c) and 'knowing the app but not meeting respondent's need' (d) which was answered 2 time by 8 participants (25%), and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time over 8 participants (12%)

The most common answer of administrative staff is 'knowing the app but not needing it' (c) which was answered 4 times by 7 participants (57%). Other answer 'not knowing but if he/she knows he/she may use' (b) was answered 2 times by 7 participants (29%), and the least answer is 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time by 7 participants (14%).

The most common answer of technical staff is 'knowing the app but not needing it' (c) which was answered 2 times by 6 participants (33%). Other given answers have same percentages; 'not knowing and not needing the app' (a), 'knowing the app but not meeting respondent's need' (d), 'knowing the app but insufficient phone' (e), and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 1 time by 6 participants (17%). The most common answer of craftsmen is 'not knowing and not needing the app' (a) which was answered 3 times by 7 participants (43%). Other given answers are; 'knowing the app but not meeting respondent's need' (d) which was answered 2 times by 7 participants (29%), and the least answered ones; 'knowing the app but not needing it' (c) and 'knowing the app but insufficient phone' (e) which were both answered 1 time by 7 participants (14%).

The answer of medical staff participant who does not use Ego Cepte is 'not knowing but if he/she knows he/she may use' (b).

The most common answers of waitstaff are 'not knowing and not needing the app' (a) and 'knowing the app but not needing it' (c) which were both answered 2 times by 5 participants (40%). The least answer is 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 1 time by 5 participants (20%).

The most common answer of Teknokent staff is 'knowing the app but not needing it' (c) which was answered 13 times by 20 participants (65%). Other answers have similar percentages; 'knowing the app but not meeting respondent's need' (d) which was answered 3 times by 20 participants (15%), 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 2 times by 20 participants (10%). The least answers are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which were both answered 1 time by 20 participants (5%).

The most common answers of students are 'knowing the app but not needing it' (c) and 'knowing the app but not meeting respondent's need' (d) which were both answered 6 times by 15 participants (40%). Other answers have similar percentages; 'not knowing and not needing the app' (a) which was answered 2 times by 15 participants (13%), and the least; 'knowing the app but insufficient phone' (e) which was answered 1 time by 15 participants (6%).

Table 5.20. *The reasons of not using Ego Cepte depending on occupations*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Occupation	Using	a	b	c	D	e	f	g	Not Using	Total
Academics	4 (33%)	3 (25%)	0	2 (17%)	2 (17%)	0	0	1 (8%)	8 (67%)	12
Adm.	11 (61%)	0	2 (11%)	4 (22%)	0	0	0	1 (6%)	7 (39%)	18
Technical	10 (63%)	1 (6%)	0	2 (13%)	1 (6%)	1 (6%)	1 (6%)	0	6 (38%)	16
Craftsmen	0	3 (43%)	0	1 (14%)	2 (29%)	1 (14%)	0	0	7 (100%)	7
Medical	1 (50%)	0	1 (50%)	0	0	0	0	0	1 (50%)	2
Waitstaff	2 (29%)	2 (29%)	0	2 (29%)	0	0	1 (14%)	0	5 (71%)	7
Teknokent Staff	17 (46%)	1 (3%)	1 (3%)	13 (35%)	3 (8%)	0	2 (5%)	0	20 (54%)	37
Student	31 (67%)	2 (4%)	0	6 (13%)	6 (13%)	1 (2%)	0	0	15 (33%)	46
Total	76	12	4	30	14	3	4	2	69	145

Table 5.21 shows the reasons of not using Ego Cepte application depending on age distribution of participants. The most common answers are respectively 'knowing the app but not needing it' (c) with 30 answers over 69 (43%), 'knowing the app but not meeting respondent's need' (d) with 14 answers over 69 (20%), and 'not knowing and not needing the app' (a) with 12 answers over 69 (17%). Other answers are below 5%.

The most common answers of 18-24 interval are 'knowing the app but not needing it' (c) and 'not knowing and not needing the app' (a) which were both answered 5 times by 13 participants (38%). Other answers have similar percentages; 'knowing the app but not meeting respondent's need' (d) which was answered 2 times by 13 participants (15%), and the least; 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 1 time by 13 participants (7%).

The most common answer of 25-34 interval is 'knowing the app but not needing it' (c) which was answered 15 times by 31 participants (48%). Second high percentage belongs to 'knowing the app but not meeting respondent's need' (d) which was answered 10 times by 31 participants (32%). Other answers have similar percentages; 'not knowing and not needing the app' (a) which was answered 3 times by 31 participants (10%), 'not knowing but if he/she knows he/she may use' (b) which was answered 2 times by 31 participants (6%), and the least; 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time by 31 participants (3%).

The most common answer of 35-44 interval is 'knowing the app but not needing it' (c) which was answered 4 times by 10 participants (40%). Other answers have same percentages; 'not knowing but if he/she knows he/she may use' (b) and 'knowing the app but not meeting respondent's need' (d) which were both answered 2 times by 10 participants (20%). The least answers are 'knowing the app but insufficient phone' (e) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 1 time by 10 participants (10%).

The most common answer of 45-54 interval is 'knowing the app but not needing it' (c) which was answered 4 times by 9 participants (44%). Other common answer is 'not knowing and not needing the app' (a) which was answered 3 times by 9 participants (33%). The least answers are 'knowing the app but insufficient phone' (e) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 1 time by 9 participants (11%). The most common answer of 55 and older interval is 'knowing the app but not needing it' (c) which was answered 2 times by 6 participants (33%). Others were answered same, 'not knowing and not needing the app' (a), 'knowing the app but insufficient phone' (e), 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f), and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 6 participants (17%).

Table 5.21. *The reasons of not using Ego Cepte depending on age distribution*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Age	Using	a	b	c	d	e	f	g	Not Using	Total
18-24	25 (66%)	5 (13%)	0	5 (13%)	2 (5%)	0	1 (3%)	0	13 (34%)	38
25-34	34 (52%)	3 (5%)	2 (3%)	15 (23%)	10 (15%)	0	0	1 (2%)	31 (48%)	65
35-44	9 (47%)	0	2 (11%)	4 (21%)	2 (11%)	1 (5%)	1 (5%)	0	10 (53%)	19
45-54	5 (36%)	3 (21%)	0	4 (29%)	0	1 (7%)	1 (7%)	0	9 (64%)	14
55+	3 (33%)	1 (11%)	0	2 (22%)	0	1 (11%)	1 (11%)	1 (11%)	6 (67%)	9
Total	76	12	4	30	14	3	4	2	69	145

Table 5.22 shows the reasons of not using Ego Cepte application depending on gender distribution of participants. The most common answers are respectively 'knowing the app but not needing it' (c) with 30 answers over 69 (43%), 'knowing the app but not meeting respondent's need' (d) with 14 answers over 69 (20%), and 'not knowing and not needing the app' (a) with 12 answers over 69 (17%). Other answers are below 5%.

The most common answer of female participants is 'knowing the app but not needing it' (c) which was answered 11 times by 24 participants (46%). The second common answer is 'knowing the app but not meeting respondent's need' (d) which was answered 4 times by 24 participants (17%). Other answers have same percentages; 'not knowing and not needing the app' (a), 'not knowing but if he/she knows he/she may use' (b), 'knowing the app but insufficient phone' (e) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 2 times by 24 participants (8%). The least answer is 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time by 24 participants (4%).

The most common answer of male participants is 'knowing the app but not needing it' (c) which was answered 19 times by 45 participants (42%). The second common answers are 'not knowing and not needing the app' (a) and 'knowing the app but not meeting respondent's need' (d) which were both answered 10 times by 45 participants (22%). Other answers have same percentages; 'not knowing but if he/she knows he/she may use' (b) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 2 times by 45 participants (4%). The least answers are 'knowing the app but insufficient phone' (e) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 45 participants (2%).

Table 5.22. *The reasons of not using Ego Cepte depending on gender*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Gender	Using	a	b	c	d	e	f	g	Not Using	Total
Female	38 (61%)	2 (3%)	2 (3%)	11 (18%)	4 (6%)	2 (3%)	2 (3%)	1 (2%)	24 (39%)	62
Male	38 (46%)	10 (12%)	2 (2%)	19 (23%)	10 (12%)	1 (1%)	2 (2%)	1 (1%)	45 (54%)	83
Total	76	12	4	30	14	3	4	2	69	145

It is seen that for all dimensions, the most common answers are 'knowing the app but not needing it' (c), 'knowing the app but not meeting respondent's need' (d) and 'not knowing and not needing the app' (a), with different percentages in each dimension. These different reasons reveal the social digital divide, which focused on various causes that prevent people from using the applications.

5.4.2. Moovit Application

Table 5.23 shows the reasons of not using Moovit application depending on income levels of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 62 answers over 123 (50%), and 'not knowing but if he/she knows he/she may use' (b) with 38 answers over 123 (31%). Other answers are below 7%.

Between income levels, the most common answer of 0-1999 level is 'not knowing but if he/she knows he/she may use' (b) which was answered 14 times by 29 participants (48%). The second common answer is 'not knowing and not needing the app' (a) which was answered 12 time by 29 participants (41%). Other given answers are 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 2 times by 29 participants (6%) and the least; 'knowing the app but not needing it' (c) which was answered 1 time by 29 participants (3%).

The most common answer of 2000-3999 level is 'not knowing and not needing the app' (a) which was answered 21 times by 43 participants (49%). The second common answer is ‘not knowing but if he/she knows he/she may use' (b) which was answered 12 times by 43 participants (28%). Other given answers are 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 4 times by 43 participants (9%), 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 2 times by 43 participants (5%), and the least ones; 'knowing the app but not meeting respondent's need' (d) and 'knowing the app but insufficient phone' (e), which were both answered 1 time by 43 participants (2%).

The most common answer of 4000 and more level have is 'not knowing and not needing the app' (a) which was answered 29 times by 51 participants (57%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 12 time by 51 participants (24%). Other given answers are 'knowing the

app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 6 times by 51 participants (12%), and the least ones; 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 2 times by 51 participants (4%).

Table 5.23. *The reasons of not using Moovit depending on income level*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Income	Using	a	B	c	d	e	f	g	Not Using	Total
0-1999	7 (19%)	12 (33%)	14 (39%)	1 (3%)	0	0	2 (6%)	0	29 (81%)	36
2000-3999	8 (16%)	21 (41%)	12 (24%)	2 (4%)	1 (2%)	1 (2%)	4 (8%)	2 (4%)	43 (84)	51
4000+	7 (12%)	29 (50%)	10 (21%)	2 (3%)	0	0	2 (3%)	6 (10%)	51 (88%)	58
Total	22	62	38	5	1	1	8	8	123	145

Table 5.24 shows the reasons of not using Moovit application depending on education levels of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 62 answers over 123 (50%), and 'not knowing but if he/she knows he/she may use' (b) with 38 answers over 123 (31%). Other answers are below 7%. Between education levels, the most common answer of primary school level is 'not knowing and not needing the app' (a) which was answered 4 times by 7 participants (57%). Other given answers are 'not knowing but if he/she knows he/she may use' (b) which was answered 2 time by 7 participants (29%), and the least; 'knowing the app but insufficient phone' (e) which was answered 1 time by 7 participants (14%).

The most common answer of secondary school level is 'not knowing and not needing the app' (a) which was answered 23 times by 48 participants (48%).

The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 17 times by 48 participants (35%). Other answers includes 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 4 times by 48 participants (8%), and the least answers; 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 2 times by 48 participants (4%). The answer of associate degree level participant who does not use Moovit is 'not knowing but if he/she knows he/she may use' (b).

The most common answer of undergraduate level is 'not knowing and not needing the app' (a) which was answered 26 times by 50 participants (52%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 13 times by 50 participants (26%). Other answers have similar percentages; 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 4 times by 50 participants (8%), 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 3 times by 50 participants (46%), and the least answer; 'knowing the app but not meeting respondent's need' (d) which was answered 1 time by 50 participants (2%).

The most common answer of graduate level is 'not knowing and not needing the app' (a) which was answered 9 times by 17 participants (53%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 5 times by 17 participants (29%). The least answer is 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered only 1 time by 17 participants (6%).

Table 5.24. *The reasons of not using Moovit depending on education level*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Education level	Using	a	b	c	d	e	f	g	Not Using	Total
Primary	1 (13%)	4 (50%)	2 (25%)	0	0	1 (13%)	0	0	7 (88%)	8
Secondary	6 (11%)	23 (43%)	17 (31%)	2 (4%)	0	0	4 (7%)	2 (4%)	48 (89%)	54
Associate Degree	1 (50%)	0	1 (50%)	0	0	0	0	0	1 (50%)	2
Undergrad.	10 (17%)	26 (43%)	13 (22%)	3 (5%)	1 (2%)	0	4 (7%)	3 (5%)	50 (83%)	60
Graduate	4 (19%)	9 (43%)	5 (24%)	0	0	0	0	3 (14%)	17 (81%)	21
Total	22	62	38	5	1	1	8	8	123	145

Table 5.25 shows the reasons of not using Moovit application depending on occupations of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 62 answers over 123 (50%), and 'not knowing but if he/she knows he/she may use' (b) with 38 answers over 123 (31%). Other answers are below 7%.

Between occupations, the most common answer of academics is 'not knowing and not needing the app' (a) which was answered 7 times by 10 participants (70%). Other given answers are 'not knowing but if he/she knows he/she may use' (b) which was answered 2 time by 10 participants (20%), and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time over 10 participants (10%)

The most common answers of administrative staff are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which were both answered 7 times by 15 participants (47%). The least answer is 'knowing the app but insufficient phone' (e) which was answered 1 time by 15 participants (17%).

The most common answers of technical staff are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which were both answered 6 times by 14 participants (43%). The least answer is 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 2 times by 14 participants (14%).

The most common answer of craftsmen is 'not knowing and not needing the app' (a) which was answered 4 times by 6 participants (67%). The least answered ones are 'not knowing but if he/she knows he/she may use' (b) and 'knowing the app but not meeting respondent's need' (d) which were both answered 1 time by 6 participants (17%).

The two answers of medical staff participants who does not use Moovit are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b).

The most common answer of waitstaff is 'not knowing and not needing the app' (a) which was answered 3 times by 7 participants (43%). Other answers have similar percentages; 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 2 times by 7 participants (29%), and the least answers; 'not knowing but if he/she knows he/she may use' (b) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 1 time by 7 participants (14%).

The most common answer of Teknokent staff is 'not knowing and not needing the app' (a) which was answered 14 times by 30 participants (47%). Other answers have same percentages; 'not knowing but if he/she knows he/she may use' (b) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 5 times by 30 participants (17%), and the least answers; 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 3 times by 30 participants (10%).

The most common answer of students is 'not knowing and not needing the app' (a) which was answered 20 times by 39 participants (74%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 15 times by 39 participants (38%). The least answers are 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 2 times by 39 participants (5%).

Table 5.25. *The reasons of not using Moovit depending on occupation*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Occupation	Using	a	b	c	d	e	f	g	Not Using	Total
Academics	2 (17%)	7 (58%)	2 (17%)	0	0	0	0	1 (8%)	10 (83%)	12
Adm.	3 (17%)	7 (39%)	7 (39%)	0	0	1 (6%)	0	0	15 (83%)	18
Technical	2 (13%)	6 (38%)	6 (38%)	0	0	0	2 (13%)	0	14 (88%)	16
Craftsmen	1 (14%)	4 (57%)	1 (14%)	0	1 (14%)	0	0	0	6 (86%)	7
Medical	0	1 (50%)	1 (50%)	0	0	0	0	0	2 (100%)	2
Waitstaff	0	3 (43%)	1 (14%)	0	0	0	1 (14%)	2 (29%)	7 (100%)	7
Teknokent Staff	7 (19%)	14 (38%)	5 (14%)	3 (8%)	0	0	3 (8%)	5 (14%)	30 (81%)	37
Student	7 (15%)	20 (43%)	15 (33%)	2 (4%)	0	0	2 (4%)	0	39 (85%)	46
Total	22	62	38	5	1	1	8	8	123	145

Table 5.26 shows the reasons of not using Moovit application depending on age distribution of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 62 answers over 123 (50%), and 'not knowing but if he/she knows he/she may use' (b) with 38 answers over 123 (31%). Other answers are below 7%. The most common answer of 18-24 interval is 'not knowing and not needing the app' (a) which was answered 14 times by 30 participants (47%).

The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 11 times by 30 participants (37%). Other answers have similar percentages; 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 3 times by 30 participants (33%), and the least; 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 2 time by 30 participants (7%).

The most common answer of 25-34 interval is 'not knowing and not needing the app' (a) which was answered 28 times by 55 participants (51%). Second high percentage belongs to 'not knowing but if he/she knows he/she may use' (b) which was answered 15 times by 55 participants (28%). Other answers have similar percentages; 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 4 times by 55 participants (7%), and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 3 time by 55 participants (5%). The least answer is 'knowing the app but not meeting respondent's need' (d) which was answered 1 time by 55 participants (2%).

The most common answers of 35-44 interval are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which were both answered 7 times by 16 participants (43%). The least answer is 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 2 times by 16 participants (13%).

The most common answer of 45-54 interval is 'not knowing and not needing the app' (a) which was answered 8 times by 13 participants (62%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 4 times by 13 participants (31%). The least answer is 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time by 13 participants (8%).

The most common answer of 55 and older interval is 'not knowing and not needing the app' (a) which was answered 5 times by 9 participants (56%). Others were answered same; 'not knowing but if he/she knows he/she may use' (b), 'knowing the app but not needing it' (c), 'knowing the app but insufficient phone' (e), and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 1 time by 9 participants (11%).

Table 5.26. *The reasons of not using Moovit depending on age distribution*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Age	Using	a	b	c	d	e	f	g	Not Using	Total
18-24	8 (21%)	14 (37%)	11 (29%)	0	0	0	3 (8%)	2 (5%)	30 (79%)	38
25-34	10 (15%)	28 (43%)	15 (23%)	4 (6%)	1 (2%)	0	4 (6%)	3 (5%)	55 (85%)	65
35-44	3 (16%)	7 (37%)	7 (7%)	0	0	0	0	2 (11%)	16 (84%)	19
45-54	1 (7%)	8 (57%)	4 (29%)	0	0	0	0	1 (7%)	13 (93%)	14
55+	0	5 (56%)	1 (11%)	1 (11%)	0	1 (11%)	1 (11%)	0	9 (100%)	9
Total	22	62	38	5	1	1	8	8	123	145

Table 5.27 shows the reasons of not using Moovit application depending on gender distribution of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 62 answers over 123 (50%), and 'not knowing but if he/she knows he/she may use' (b) with 38 answers over 123 (31%). Other answers are below 7%. The most common answers of female participants are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which were both answered 21 times by 51 participants (41%). The second common answer is 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 5 times by 51 participants (10%).

The least answers are 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 2 times by 51 participants (4%).

The most common answer of male participants is 'not knowing and not needing the app' (a) which was answered 41 times by 72 participants (57%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 17 times by 72 participants (24%). Other answers have similar percentages; 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 6 times by 72 participants (8%), 'knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 3 times by 72 participant (4%). The least answers are 'knowing the app but not meeting respondent's need' (d) and 'knowing the app but insufficient phone' (e) which were both answered 1 time by 72 participants (1%).

Table 5.27. *The reasons of not using Moovit depending on gender*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Gender	Using	a	b	c	d	e	f	g	Not Using	Total
Female	11 (18%)	21 (34%)	21 (34%)	2 (3%)	0	0	5 (8%)	2 (3%)	51 (82%)	62
Male	11 (13%)	41 (49%)	17 (20%)	3 (4%)	1 (1%)	1 (1%)	3 (4%)	6 (7%)	72 (87%)	83
Total	22	62	38	5	1	1	8	8	123	145

It is seen that for all dimensions, the most common answers are 'not knowing but if he/she knows he/she may use' (b) and 'not knowing and not needing the app' (a), with different percentages in each dimension. These different reasons reveal the social digital divide, which focused on various causes that prevent people from using the applications.

5.4.3. ABB Trafik Application

Table 5.28 shows the reasons of not using ABB Trafik application depending on income levels of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 61 answers over 127 (48%), 'not knowing but if he/she knows he/she may use' (b) with 36 answers over 127 (28%), and 'knowing the app but not needing it' (c) with 17 answers over 127 (13%). Other answers are below 5%.

Between income levels, the most common answer of 0-1999 level is 'not knowing and not needing the app' (a) which was answered 18 times by 31 participants (58%). %). The second common answer is ‘not knowing but if he/she knows he/she may use' (b) which was answered 9 times by 31 participants (29%). Other given answers are 'knowing the app but not needing it' (c) which was answered 3 times by 31 participants (10%) and the least; 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 1 time by 31 participants (3%).

The most common answer of 2000-3999 level is 'not knowing and not needing the app' (a) which was answered 18 times by 46 participants (39%). The second common answer is ‘not knowing but if he/she knows he/she may use' (b) which was answered 14 times by 39 participants (36%). Other given answers are 'knowing the app but not needing it' (c) which was answered 7 times by 46 participants (15%), 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 3 times by 46 participants (7%), 'knowing the app but not meeting respondent's need' (d) which was answered 2 times by 46 participants (4%), and the least ones; 'knowing the app but insufficient phone' (e) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 46 participants (2%).

The most common answer of 4000 and more level have is 'not knowing and not needing the app' (a) which was answered 25 times by 50 participants (50%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 13 time by 50 participants (26%). Other given answers are 'knowing the app but not needing it' (c) which was answered 7 times by 50 participants (14%), 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 2 times by 50 participants (4%), and the least one; 'knowing the app but not meeting respondent's need' (d) which was answered 1 time by 50 participants (2%).

Table 5.28. *The reasons of not using ABB Trafik depending on income level*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Income	Using	a	B	c	d	e	f	g	Not Using	Total
0-1999	5 (14%)	18 (50%)	9 (25%)	3 (8%)	0	0	1 (3%)	0	31 (86%)	36
2000-3999	5 (10%)	18 (35%)	14 (27%)	7 (14%)	2 (4%)	1 (2%)	3 (6%)	1 (2%)	46 (90%)	51
4000+	8 (14%)	25 (43%)	13 (22%)	7 (12%)	1 (2%)	0	2 (3%)	2 (3%)	50 (86%)	58
Total	18	61	36	17	3	1	6	3	137	145

Table 5.29 shows the reasons of not using ABB Trafik application depending on education levels of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 61 answers over 127 (48%), 'not knowing but if he/she knows he/she may use' (b) with 36 answers over 127 (28%), and 'knowing the app but not needing it' (c) with 17 answers over 127 (13%). Other answers are below 5%. Between education levels, the most common answer of primary school level is 'not knowing but if he/she knows he/she may use' (b) which was answered 3 times by 7 participants (43%).

Other given answers are 'not knowing and not needing the app' (a) which was answered 2 time by 7 participants (29%), and the least ones; 'knowing the app but not needing it' (c) and 'knowing the app but insufficient phone' (e) which were both answered 1 time by 7 participants (14%).

The most common answer of secondary school level is 'not knowing and not needing the app' (a) which was answered 26 times by 48 participants (54%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 11 times by 48 participants (23%). Other answers includes 'knowing the app but not needing it' (c) which was answered 5 times by 48 participants (10%),and the least answers 'knowing the app but not meeting respondent's need' (d), 'knowing the app but not knowing how to use it and even if the respondent knows, 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f), and he/she will not use it' (g) which were both answered 2 times by 48 participants (4%).

The answer of associate degree level participant who does not use ABB Trafik is 'not knowing but if he/she knows he/she may use' (b). The most common answer of undergraduate level is 'not knowing and not needing the app' (a) which was answered 22 times by 52 participants (42%). The other common answers are 'not knowing but if he/she knows he/she may use' (b) which was answered 16 times by 52 participants (31%), and 'knowing the app but not needing it' (c) which was answered 9 times by 52 participants (17%). Other answers are 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 4 times by 52 participants (8%), and the least answer; 'knowing the app but not meeting respondent's need' (d) which was answered 1 time by 52 participants (2%). The most common answer of graduate level is 'not knowing and not needing the app' (a) which was answered 11 times by 19 participants (58%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 5 times by 19 participants (26%).

Other answers are 'knowing the app but not needing it' (c) which was answered 2 times by 19 participants (11%), and the least; 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 times by 19 participants (5%).

Table 5.29. *The reasons of not using ABB Trafik depending on education level*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Education level	Using	a	b	c	d	e	f	g	Not Using	Total
Primary	1 (13%)	2 (25%)	3 (38%)	1 (13%)	0	1 (13%)	0	0	7 (88%)	8
Secondary	6 (11%)	26 (48%)	11 (20%)	5 (9%)	2 (4%)	0	2 (4%)	2 (4%)	48 (89%)	54
Associate Degree	1 (50%)	0	1 (50%)	0	0	0	0	0	1 (50%)	2
Undergrad.	8 (13%)	22 (37%)	16 (27%)	9 (15%)	1 (2%)	0	4 (7%)	0	52 (87%)	60
Graduate	2 (10%)	11 (52%)	5 (24%)	2 (10%)	0	0	0	1 (5%)	19 (90%)	21
Total	18	61	36	17	3	1	6	3	137	145

Table 5.30 shows the reasons of not using ABB Trafik application depending on occupations of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 61 answers over 127 (48%), 'not knowing but if he/she knows he/she may use' (b) with 36 answers over 127 (28%), and 'knowing the app but not needing it' (c) with 17 answers over 127 (13%). Other answers are below 5%. Between occupations, the most common answer of academics is 'not knowing and not needing the app' (a) which was answered 7 times by 12 participants (58%).

Other common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 4 time by 12 participants (33%). The least answer is 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time over 12 participants (8%). The most common answer of administrative staff is 'not knowing but if he/she knows he/she may use' (b) which was answered 9 times by 16 participants (57%).

Other common answers are 'knowing the app but not needing it' (c) which was answered 4 times by 16 participants (25%) and 'not knowing and not needing the app' (a) which was answered 2 times by 16 participants (13%). The least answer is 'knowing the app but insufficient phone' (e) which was answered 1 time by 16 participants (6%). The most common answers of technical staff are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which were both answered 6 times by 14 participants (43%). The least answers are ‘knowing the app but not needing it' (c) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time by 14 participants (7%).

The most common answer of craftsmen is 'not knowing and not needing the app' (a) which was answered 3 times by 5 participants (60%). The least answered ones are 'not knowing but if he/she knows he/she may use' (b) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 5 participants (20%). The two answers of medical staff participants who does not use ABB Trafik are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b). The most common answer of waitstaff is 'not knowing and not needing the app' (a) which was answered 3 times by 6 participants (50%). Other answers have same percentages; 'not knowing but if he/she knows he/she may use' (b), 'knowing the app but not needing it' (c), and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 1 time by 6 participants (17%).

The most common answer of Teknokent staff is 'not knowing and not needing the app' (a) which was answered 14 times by 31 participants (45%). Other answers have similar percentages; 'knowing the app but not needing it' (c) which was answered 7 times by 31 participants (23%), 'not knowing but if he/she knows he/she may use' (b) which was answered 5 times by 31 participants (16%), and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 4 times by 31 participants (13%).

The least answer is 'knowing the app but not meeting respondent's need' (d) which was answered 1 time by 31 participants (3%). The most common answer of students is 'not knowing and not needing the app' (a) which was answered 25 times by 41 participants (61%). The other common answers are 'not knowing but if he/she knows he/she may use' (b) which was answered 9 times by 41 participants (22%), and 'knowing the app but not needing it' (c) which was answered 4 times by 41 participants (10%). Another answers are 'knowing the app but not meeting respondent's need' (d) which was answered 2 times by 41 participants (5%), and the least one; 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 1 time by 41 participants (2%).

Table 5.30. *The reasons for not using ABB Trafik depending on occupation*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Occupation	Using	a	b	c	d	e	f	g	Not Using	Total
Academics	0	7 (58%)	4 (33%)	0	0	0	0	1 (8%)	12 (100%)	12
Adm.	2 (11%)	2 (11%)	9 (50%)	4 (22%)	0	1 (6%)	0	0	16 (89%)	18
Technical	2 (13%)	6 (38%)	6 (38%)	1 (6%)	0	0	0	1 (6%)	14 (88%)	16
Craftsmen	2 (29%)	3 (43%)	1 (14%)	0	0	0	0	1 (14%)	5 (71%)	7
Medical	0	1 (50%)	1 (50%)	0	0	0	0	0	2 (100%)	2
Waitstaff	1 (14%)	3 (43%)	1 (14%)	1 (14%)	0	0	1 (14%)	0	6 (86%)	7
Teknokent Staff	6 (16%)	14 (38%)	5 (14%)	7 (19%)	1 (3%)	0	4 (11%)	0	29 (78%)	37
Student	5 (11%)	25 (54%)	9 (20%)	4 (9%)	2 (4%)	0	1 (2%)	0	41 (90%)	46
Total	18	61	36	17	3	1	6	3	137	145

Table 5.31 shows the reasons of not using ABB Trafik application depending on age distribution of participants.

The most common answers are respectively 'not knowing and not needing the app' (a) with 61 answers over 127 (48%), 'not knowing but if he/she knows he/she may use' (b) with 36 answers over 127 (28%), and 'knowing the app but not needing it' (c) with 17 answers over 127 (13%). Other answers are below 5%.

The most common answer of 18-24 interval is 'not knowing and not needing the app' (a) which was answered 16 times by 33 participants (48%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 9 times by 33 participants (27%). Other answers are knowing the app but not needing it' (c) which was answered 5 times by 33 participants (15%), 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 2 times by 33 participants (6%), and the least; 'knowing the app but not meeting respondent's need' (d) which was answered 1 time by 33 participants (3%).

The most common answer of 25-34 interval is 'not knowing and not needing the app' (a) which was answered 33 times by 57 participants (58%). Second high percentage belongs to 'not knowing but if he/she knows he/she may use' (b) which was answered 14 times by 57 participants (25%). Other answers are 'knowing the app but not needing it' (c) which was answered 6 time by 57 participants (11%), and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 2 times by 57 participants (4%). The least answers are 'knowing the app but not meeting respondent's need' (d) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 57 participants (2%).

The most common answer of 35-44 interval is 'knowing but if he/she knows he/she may use' (b) which were both answered 7 times by 17 participants (41%).

The other answers have similar percentages; 'not knowing and not needing the app' (a) which was answered 5 time by 17 participants (29%), and 'knowing the app but not needing it' (c) which was answered 4 time by 17 participants (24%).

The least answer is 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 1 time by 17 participants (6%). The most common answers of 45-54 interval are 'not knowing and not needing the app' (a) and 'not knowing but if he/she knows he/she may use' (b) which were both answered 4 times by 12 participants (33%). The second common answer is 'knowing the app but not needing it' (c) which was answered 2 times by 12 participants (17%). The least answers are 'knowing the app but not meeting respondent's need' (d) and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 12 participants (8%).

The most common answer of 55 and older interval is 'not knowing and not needing the app' (a) which was answered 3 times by 8 participants (38%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 2 times by 8 participants (25%). Others were answered same; 'knowing the app but insufficient phone' (e), 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f), and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which were both answered 1 time by 8 participants (13%).

Table 5.31. *The reasons of not using ABB Trafik depending on age distribution*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Age	Using	a	b	c	d	e	f	g	Not Using	Total
18-24	5 (14%)	16 (42%)	9 (24%)	5 (13%)	1 (3%)	0	2 (5%)	0	33 (87%)	38
25-34	8 (12%)	33 (51%)	14 (22%)	6 (9%)	1 (2%)	0	2 (3%)	1 (2%)	57 (88%)	65
35-44	2 (11%)	5 (26%)	7 (37%)	4 (21%)	0	0	1 (5%)	0	17 (89%)	19
45-54	2 (12%)	4 (29%)	4 (29%)	2 (12%)	1 (7%)	0	0	1 (7%)	12 (86%)	14
55+	1 (11%)	3 (33%)	2 (22%)	0	0	1 (11%)	1 (11%)	1 (11%)	8 (89%)	9
Total	18	61	36	17	3	1	6	3	137	145

Table 5.32 shows the reasons of not using ABB Trafik application depending on gender of participants. The most common answers are respectively 'not knowing and not needing the app' (a) with 61 answers over 127 (48%), 'not knowing but if he/she knows he/she may use' (b) with 36 answers over 127 (28%), and 'knowing the app but not needing it' (c) with 17 answers over 127 (13%). Other answers are below 5%.

The most common answer of female participants is 'not knowing and not needing the app' (a) which was answered 28 times by 57 participants (49%). The second common answer is 'not knowing but if he/she knows he/she may use' (b) which was answered 19 times by 57 participants (33%). The other answers have similar percentages; 'knowing the app but not needing it' (c) which was answered 5 times by 57 participants (9%), 'knowing the app but not meeting respondent's need' (d) and 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which were both answered 2 times by 57 participants (4%), The least answer is 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 1 time by 57 participants (2%). The most common answer of male participants is 'not knowing and not needing the app' (a) which was answered 33 times by 70 participants (47%).

The other common answers are 'not knowing but if he/she knows he/she may use' (b) which was answered 17 times by 70 participants (24%) and 'knowing the app but not needing it' (c) which was answered 12 times by 70 participants (17%) Other answers have similar percentages; 'knowing the app but not knowing how to use it and if the respondent knows, he/she will use it' (f) which was answered 4 times by 70 participant (6%), and 'knowing the app but not knowing how to use it and even if the respondent knows, he/she will not use it' (g) which was answered 2 times by 70 participant (3%). The least answers are 'knowing the app but not meeting respondent's need' (d) and 'knowing the app but insufficient phone' (e) which were both answered 1 time by 70 participants (1%).

Table 5.32. *The reasons of not using ABB Trafik depending on gender*

	# of people	QUESTIONNAIRE OPTIONS (# of people)							# of people	# of people
Gender	Using	a	b	c	D	e	f	g	Not Using	Total
Female	5 (8%)	28 (45%)	19 (31%)	5 (8%)	2 (3%)	0	2 (3%)	1 (2%)	57 (92%)	62
Male	13 (16%)	33 (40%)	17 (20%)	12 (14%)	1 (1%)	1 (1%)	4 (5%)	2 (2%)	70 (88%)	83
Total	18	61	36	17	3	1	6	3	137	145

It is seen that for all dimensions, the most common answers are 'not knowing but if he/she knows he/she may use' (b) and 'not knowing and not needing the app' (a), with different percentages in each dimension. These different reasons reveal the social digital divide, which focused on various causes that prevent people from using the applications.

5.5. Overall Evaluation

Data collected from the participants shows that Ego Cepte, Moovit and ABB Trafik applications have different usage rates; respectively 47,6%, 15,2% and 12,4%. (Figure 5.10).

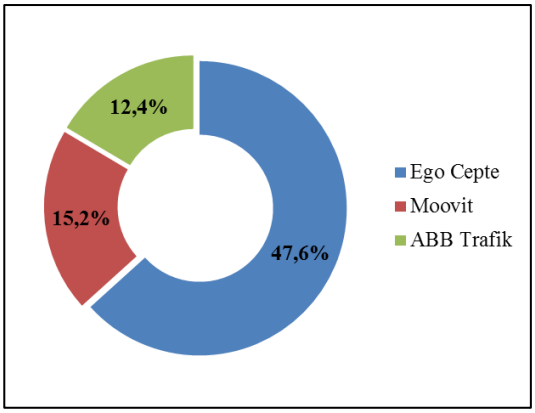

Figure 5.10. Usage rates of applications

During the survey questionnaire, most participants mentioned that the applications are used depending on different circumstances.

As it is mentioned above, all three applications have different features and aims about transport, which results in differences in the usage of each app. Ego Cepte is a daily app which may be used in daily life, by a daily public transport user. ABB Trafik is also a daily app, but it is observed that few people know the features of the app, the users of ABB Trafik are mostly people who are travelling in daytime due to their occupation (see table 5.30). Similarly, although most participants are only familiar with the feature of how to go to a specific location by bus, metro and walking, Moovit has many other features which make it also a daily app.

During the survey, most non-user participants asked what is Moovit and ABB Trafik, which proves most participants are not familiar with these apps, and their features. According the questionnaire, those who do not use Ego Cepte are 52,4%, those who do not use the Moovit app are 84,8% and those who do not use the ABB Trafik app are 87,6%. It is inferred from the results that non-users have different reasons for not using the apps, which may eventually be related with access and social digital divide. The most apparent reasons for Ego Cepte are 'knowing the app but not needing it' with 20,7%, 'knowing the app but not meeting respondent's need' with 9,7% and 'not knowing and not needing the app' with 8,3%. (see Figure 5.11)

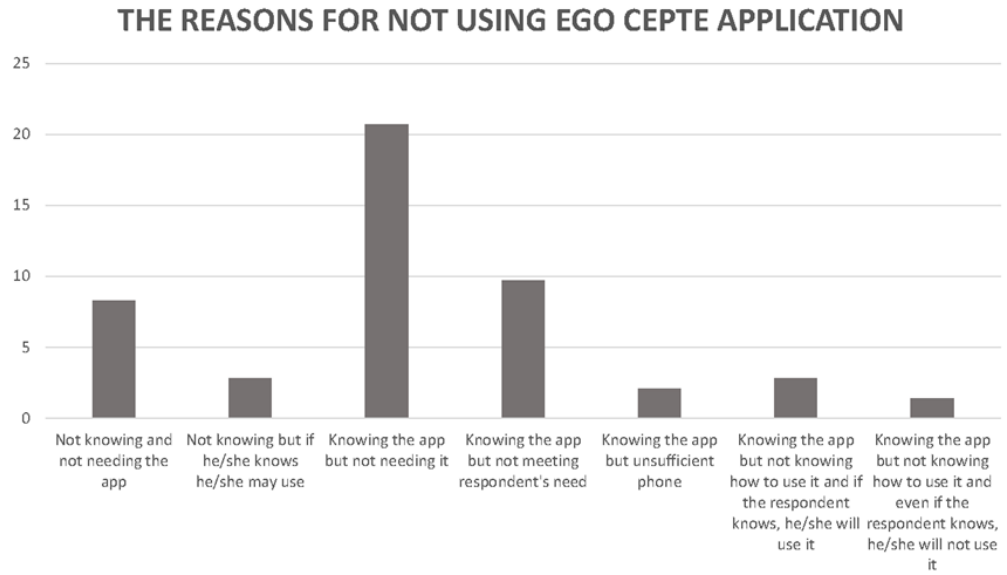

Figure 5.11. The reasons of not using Ego Cepte app

On the other hand, the most apparent reasons for Moovit are 'not knowing and not needing the app' with 42,8% and 'not knowing but if he/she knows he/she may use' with 8,3%. (see Figure 5.12)

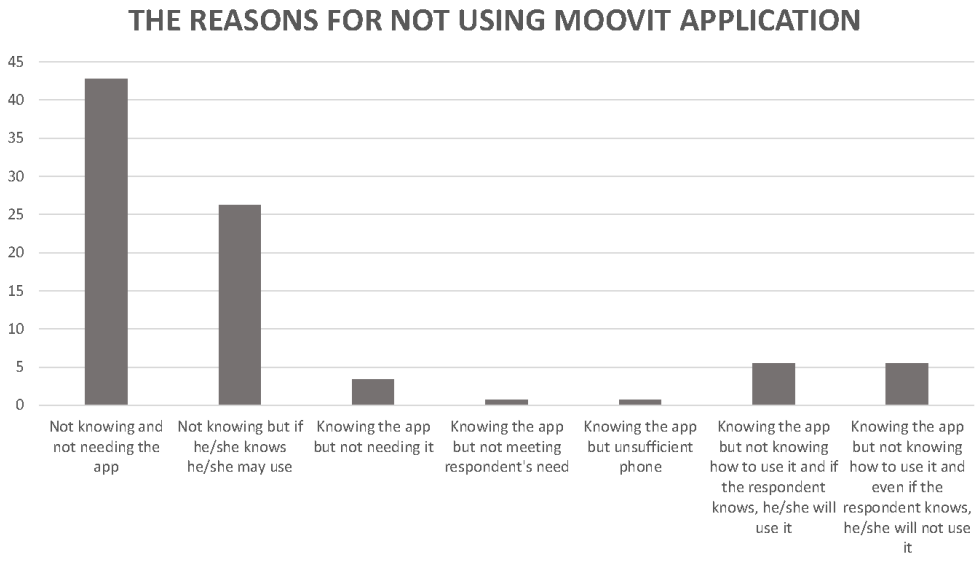

Figure 5.12. The reasons of not using Moovit app

Similarly, the most apparent reasons for ABB Trafik are 'not knowing and not needing the app' with 42,1%, 'not knowing but if he/she knows he/she may use' with 24,8% and 'knowing the app but not needing it' with 11,7%. (see Figure 5.13)

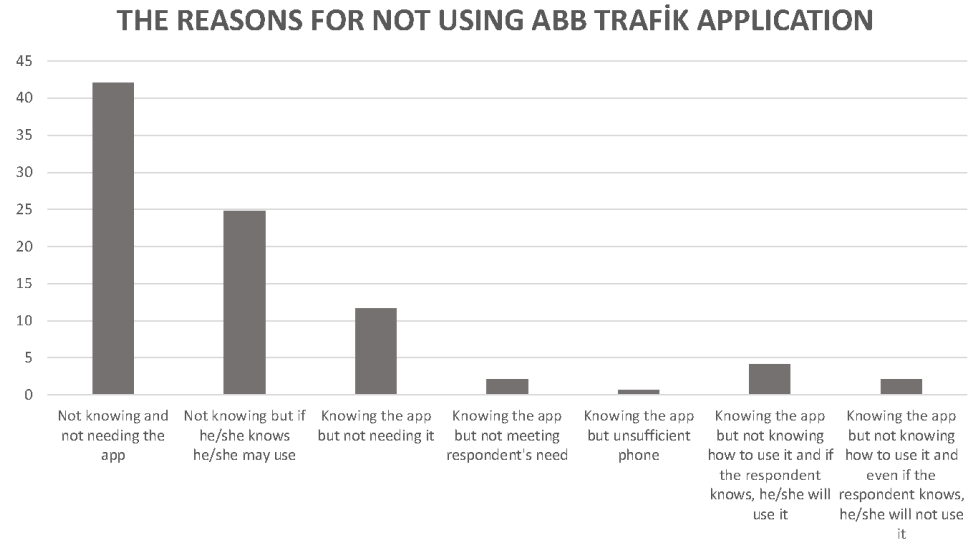

Figure 5.13. The reasons of not using ABB Trafik app

The unexpected result according to the survey above is that more participants were familiar with ABB Trafik than Moovit app. They have similar usage rate; however, the results show that part of the 'knowing ABB Trafik' participants have a thought that they do not need the app.

When it comes to the personal information of users which affects the usage of mobile applications, all five factors have their own dynamics which affecting the one's usage. The expected result was the low impact of participant's gender for their usage rates. It is not a dominant dimension as it mentioned by Norris in 2001. Different than Ego Cepte application, there seems unclear correlation between income level, age, gender and Moovit and ABB Trafik applications. Occupation and education, on the other hand, seem to have higher effect on usage rates. Education is more significant determinant for all three applications, since the younger population is more curious and qualified to use any technology than older ones.

It is expected that for Ego Cepte application, the most using occupations are Teknokent staff and students. Other occupations have also high usage rates in their own conditions.

Beside these, there are one expected and one unexpected result. The expected one is the fact that as the income arises the rate of usage falls (4000 and more income has the lowest usage of all applications). This fact needed to be approached differently for three applications. For Ego Cepte results, the fall may be explained by the fact that the more the income is, the more private car ownership. Thus, even if those people who have high income and private car state themselves as public transport user, their usage frequency is far less than other who do not have private car. On the other hand, the reason mentioned above may or may not be true for Moovit and ABB Trafik, since the number of users of these applications is insufficient to make such an inference. The unexpected one is occupation effect as a determinant especially for ABB Trafik application, since the user participants stated that they are familiar with this app due to their usage of this app during their working hours.

It is seen that for all dimensions, there are different reasons which reveals the social digital divide, focused on various causes that prevent people from using the applications. The results of this part of the research reveal that the reasons of non-use are based on: the lack of information about the application which make a person unqualified to use that application, the judgement of not needing the applications and the idea of not meeting the needs of a public transport user.

CHAPTER 6

CONCLUSION

This study focuses on smart mobility projects and applications in Turkish cities and their possible effects on creating digital divide. Although the starting point of the digital divide concept was the ability to access a computer and internet, over the years it evolved to comprise a wider set of issues. Mobile phones evolved to smart phones; computers are now available in various types; the internet is now accessible via laptops, smart phones, tablets, televisions, and many other devices. However, even though people may have easy access to computers and the internet, they still may not be able or willing to use smart applications, hence contributing to digital divide.

Recently, several technological items are used in smart city applications in Turkey. More importantly, most of the ITS applications including route planning, navigation, bike sharing, traffic safety, parking information, transportation data collection, vehicle fuel consumption and emissions, and travel information are provided mostly via mobile applications through smart phones. Beside private enterprises, new mobile applications had been started to produce and use by many municipalities as well. Thus, there are increasing numbers of researches in Turkey on smart city and smart mobility. However, the literature review showed that the issue of digital divide appears to be an area not researched thoroughly yet.

In this thesis, the digital divide concept was evaluated from two different perspectives; Harper's (2003) digital divide types; access and social digital divide, and Norris's (2001) digital divide dimensions; income, education, occupation, age and gender. In the light of these perspectives, this study has consisted of two parts; a literature review of smart city, smart mobility and digital divide, based on a comprehensive theoretical research, and a case study to discuss the findings coming from the literature.

The literature review showed that although the starting point of the term digital divide came from two different dimensions, access and social digital divide, the validity of 'access digital divide' has changed. Today, digital divide refers to not just insufficient access to new technologies, but the ability and desire to use these technologies, which is 'social digital divide'. To investigate the claim coming from the literature review, the thesis has questioned the validity of access and social digital divide, and the dimensions of digital divide in today's smart mobility system context. In the case study part, the study has focused on two main questions: whether providing access to new smart mobility services (such as mobile applications) is enough to make people use these services, and whether there are other dynamics that determine one's access and use. For this discussion, the data was collected through survey questionnaire conducted in METU campus, since the campus presents a variety of transport options, and includes a large number of people living in or travelling to the campus that benefit from smart mobility applications. In addition, the campus population provides an opportunity to include people with different socio-economic and demographic characteristics. The research focused on three mobile public transport applications, their usage rates, and the reasons of non-use both in general and according to five dimensions; income, education level, occupation, age and gender. The following part of this chapter includes the interpretation of the research results in the light of the theoretical frame coming from the literature.

6.1. Discussion of the Findings

In the research which is conducted with 145 participants, the data about the use and non-use of mobile public transport applications of Ankara was evaluated. In the light of first research questions, the types of digital divide suggested by Harper (2003); access and social digital divide were discussed. In comparison with the access digital divide concept, which focuses on lack of access as an only cause of digital divide, the results have proven that providing access is not enough alone to make a person use that application.

Among 145 participants, only 3 of them stated that they are not able to use these mobile applications due to their mobile phone to be insufficient for those applications. Others indicated different reasons, which reveal more important and complex type of divide: the social digital divide, which focused on various causes that prevent people from using the applications. The social digital divide includes barriers about motivation, knowledge, skill, content and social networks which come up with the differences depending on the one's perception, relations and culture, which are proved to affect the users' perception and use of a technology. With the aim of learning these barriers, the second part of the research presented participants possible causes for not using. The results of this part reveal that the reasons of non-use are based on three main factors: (1) the lack of information about the application which makes a person unqualified to use that application, (2) the judgement of not needing the applications and (3) the idea of not meeting the needs of a public transport user. These results have proven that in today's unprecedented technology-based world, the social divide is existing unhesitatingly, rather than access digital divide. In the light of second research question, personal characteristics of people such as income, education level, occupation, age and gender, which are called dimensions of digital divide by Norris (2001), are discussed in terms of whether they create digital divide. The results of the research prove these five criteria as being dimensions of digital divide. Income, education level, occupation, age and gender are both cause divide among people at different scales. According to the results, gender has lost its importance since Norris's statement (2001). After analyzing the types and dimensions separately, they were also evaluated together in the study. It is deduced that all these dimensions work as a barrier for people for social digital divide to be happened. Apparently, this research finds the answer of Norris's question of "Will digital inequalities prove a temporary problem that will gradually fade over time, as Internet connectivity spreads and normalizes, or will this prove an enduring pattern generating a persistent division between info-haves and have-nots?" (2001, p.11): this division is existing.

6.2. Limitations and Recommendations for Future Research

The study has some limitations both in theory and practice processes. During the literature review, the issue of digital divide being an area that is not researched thoroughly yet, which caused difficulties about the understanding the current situation in Turkey and the certain point of views. Another limitation is the people's reaction to the questionnaire. Some people have prejudices about participating a questionnaire, even if it does not include sensitive discomfortable questions. At this point, it was helpful to conduct the questionnaire in METU campus, since most people were more familiar with this type of surveys. Another important limitation is the scope of mobile applications of Ankara. Although all valid apps were studies, the scope of these apps observed to be insufficient in some points; for example, the fact that there is not any application including rail system of public transport; metro and Ankaray. Thus, it may make some participants to choose the 'knowing the app but not meeting respondent's need' option, since they use metro or Ankaray in their daily life. In addition to these passengers, there are huge numbers of dolmush users in Ankara, which may make them choose the option 'knowing the app but not meeting respondent's' or 'knowing the app but not needing it'. For further studies, it is suggested that those passengers can be evaluated differently, not from the mobile applications perspective, if new mobile apps which is integrated dolmush, metro or Ankaray system are not released. Another suggestion is as it mentioned previously, the frame of the digital divide concept has changed specifically in the past 10 years. Some facts still seem real; however, the concept of digital divide could be deepened as well as more dimensions and types could be added both in literature and practice.

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APPENDICES

A. Survey

TEMEL BİLGİLER

Yaşınız

Cinsiyet

Eğitim durumunuz

Ortalama gelir durumu (0-2000/2000-4000/4000+)

Meslek (Akademik/idari/Teknik/Esnaf/Dükkân Çalışanı /Spor hocası/Teknokent Çalışanı/Öğrenci)

Öğrenci ise bölümü

Kişisel aracınız var mı

Toplu taşıma kullanıyor musunuz

MOBİL UYGULAMALAR

Ego Cepte

Ego Cepte uygulamasını kullanıyor musunuz?

Evet/Hayır

Aşağıda Ego Cepte uygulamasının tarafınızca kullanılmamasının muhtemel nedenleri verilmiştir.

Uygun bulduğunuz seçeneği işaretleyebilirsiniz.

a) Bu uygulamadan haberdar değilim, ihtiyacım olduğunu düşünmüyorum

b) Bu uygulamadan haberdar değildim, haberdar olsaydım kullanırdım.

c) Bu uygulamayı biliyorum, fakat işime yaramadığı için kullanmıyorum (örneğin sürekli metro/dolmuş kullandığım için)

d) Bu uygulamayı biliyorum, fakat uygulama ihtiyaçlarımı karşılamadığı için kullanmıyorum

e) Bu uygulamayı biliyorum, fakat telefonum yetersiz olduğu için yükleyemiyorum.

f) Bu uygulamayı biliyorum, fakat Ego Cepte uygulamasını nasıl kullanacağımı bilmiyorum, öğrenirsem kullanırım.

g) Bu uygulamayı biliyorum, fakat Ego Cepte uygulamasını nasıl kullanacağımı bilmiyorum, bilsem de kullanmayı tercih etmezdim.

Moovit

Moovit uygulamasını kullanıyor musunuz?

Evet/Hayır

Aşağıda Moovit uygulamasının tarafınızca kullanılmamasının muhtemel nedenleri verilmiştir. Uygun bulduğunuz seçeneği işaretleyebilirsiniz.

a) Bu uygulamadan haberdar değilim, ihtiyacım olduğunu düşünmüyorum.

b) Bu uygulamadan haberdar değildim, haberdar olsaydım kullanırdım.

c) Bu uygulamayı biliyorum, fakat işime yaramadığı için kullanmıyorum (örneğin sürekli dolmuş kullandığım için).

d) Bu uygulamayı biliyorum, fakat uygulama ihtiyaçlarımı karşılamadığı için kullanmıyorum.

e) Bu uygulamayı biliyorum, fakat telefonum yetersiz olduğu için yükleyemiyorum.

f) Bu uygulamayı biliyorum, fakat Moovit uygulamasını nasıl kullanacağımı bilmiyorum, öğrenirsem kullanırım.

g) Bu uygulamayı biliyorum, fakat Moovit uygulamasını nasıl kullanacağımı

bilmiyorum, bilsem de kullanmayı tercih etmezdim.

ABB Trafik

ABB Trafik uygulamasını kullanıyor musunuz?

Evet/Hayır

Aşağıda ABB Trafik uygulamasının tarafınızca kullanılmamasının muhtemel nedenleri verilmiştir.

Uygun bulduğunuz seçeneği işaretleyebilirsiniz.

a) Bu uygulamadan haberdar değilim, ihtiyacım olduğunu düşünmüyorum.

b) Bu uygulamadan haberdar değildim, haberdar olsaydım kullanırdım.

c) Bu uygulamayı biliyorum, fakat işime yaramadığı için kullanmıyorum (örneğin sürekli dolmuş kullandığım için).

d) Bu uygulamayı biliyorum, fakat uygulama ihtiyaçlarımı karşılamadığı için kullanmıyorum.

e) Bu uygulamayı biliyorum, fakat telefonum yetersiz olduğu için yükleyemiyorum.

f) Bu uygulamayı biliyorum, fakat ABB Trafik uygulamasını nasıl kullanacağımı bilmiyorum, öğrenirsem kullanırım.

g) Bu uygulamayı biliyorum, fakat ABB Trafik uygulamasını nasıl kullanacağımı bilmiyorum, bilsem de kullanmayı tercih etmezdim.

Yukarı bahsedilenlerden başka kullandığınız bir mobil uygulama var mı? Varsa nedir?