CRITICAL EVALUATION OF SMART MOBILITY POLICIES OF KONYA METROPOLITAN MUNICIPALITY

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ABSTRACT

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As population in urban areas increases and problems arise as a consequence, many cities turn to smart city transformation. Some scholars argue that smart cities can provide strong solutions to urban problems. Smart city discourse mainly touches upon six major concepts which cities are required to apply to become a smart city: Smart economy, smart people, smart governance, smart environment, smart living and finally smart mobility based on ICT. The most common issues based upon increasing population is transportation problems which has been seen in Turkish cities as well. As a response to these, smart mobility applications are becoming more and more widespread in Turkish urban areas. The purpose of this study is to provide a critical evaluation of transformation of Konya Metropolitan Area through smart mobility tools. Konya Metropolitan Area is becoming heavily car dependent and majority of the smart mobility applications target vehicles. Additionally, some recent policies and actions of the metropolitan municipality focus on public transportation. This study aims to evaluate smart mobility actions and policies in Konya Metropolitan area and to understand how smart mobility has become a main

focal point of transportation policies in the city. The research benefits from interviews with Municipal officials as well as official documents such as plans, projects and their associated reports. Finally, the study concludes with some policy recommendations to push smart mobility agenda forward in Konya Metropolitan Area.

Keywords: Smart City, Smart Mobility, Konya Metropolitan Area, Intelligent Transportation Systems

ÖZ

KONYA BÜYÜKŞEHİR BELEDİYESİ'NİN AKILLI ULAŞIM POLİTİKALARININ ELEŞTİREL BİR DEĞERLENDİRMESİ

Nalçakar, Zeyneb Zuhal
Yüksek Lisans, Kentsel Politika Planlaması ve Yerel Yönetimler Bölümü
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Kentsel alanlarda hızla artan nüfus ve bu artışa bağlı olarak ortaya çıkan problemler, pek çok kenti akıllı şehir dönüşümüne yöneltmiştir. Bazı akademisyenler, akıllı şehir dönüşümünün kentsel alanlarda yaşanan sorunlara cevap olabileceğini tartışmakta ve esas olarak altı ana başlıkta akıllı şehir olabilmek için gereken unsurları özetlemektedir: Akıllı ekonomi, akıllı insanlar, akıllı yönetişim, akıllı çevre, akıllı yaşam ve son olarak akıllı hareketlilik. Türkiye kentlerinde de hızlı nüfus artışına bağlı olarak ortaya çıkan problemlerin en başında, ulaşım alanında yaşanan sorunlar gelmektedir. Buna karşılık bir çözüm olarak ele alınan akıllı hareketliliğe yönelik çalışmalar, Türkiye kentlerinde daha geniş çapta gözlemlenmeye başlamıştır. Bu çalışmanın amacı, Konya metropoliten alanında gözlemlenen akıllı ulaşım eylem ve politikalarının hazırlanma ve uygulanma süreçlerine dair eleştirel bir değerlendirme yapmaktır. Konya kentsel alanı zamanla özel araç kullanımına daha bağlı bir ulaşım sistemine yönelmiş olup, akıllı ulaşım politikalarının büyük kısmı araç sürücülerini hedeflemektedir. Öte yandan, yakın

zamanda Konya Büyükşehir Belediyesi, toplu taşımaya yönelik çalışmalar da yürütmeye başlamıştır. Bu çalışma Konya kentindeki akıllı ulaşım eylem ve politikalarının eleştirel bir değerlendirmesini yapmayı ve akıllı ulaşım politikalarının Konya'da nasıl gündeme geldiğini anlamayı hedeflemektedir. Çalışma, Büyükşehir Belediyesi yetkilileri ile yapılan söyleşilere ve plan ve proje raporları gibi resmi bilgi ve belgelere dayanmaktadır. Son olarak, çalışma Konya metropoliten alanında akıllı ulaşım çalışmalarını daha da geliştirmek amaçlı bazı politika önerileri yapmaktadır.

Anahtar Kelimeler: Akıllı Kent, Akıllı Hareketlilik, Konya Metropoliten Alanı, Akıllı Ulaşım Sistemleri

To My Mother, Ayfer Nalçakar

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CHAPTER I

INTRODUCTION

I.I. Background to The Research Problem

Urban areas, more specifically cities, are considered to be the cooking pot of innovation and change in society and technology (Sharifi, 2019). The evolvement into the formation of the city has been influenced by common benefits which is still similar today. For instance, socio-economic development caused by urbanization is commonly associated with industrialization which can be defined as the pinnacle of modern urban areas (Chan & Shimou, 1999). Cities are a major attention center with their proximity to opportunities and benefits which invited more and more people from rural areas to cities. Moreover, some metropolitan cities attract people from other cities and are becoming more and more populated. This trend is expected to continue in this fashion. According to the estimations of United Nations, by the year of 2050, the number of people in urban areas will be as high as 6.5 billion (Streitz, 2015) which will roughly mean that 66% of the world's population will be residing in cities (Hashem, et al., 2016).

It is without doubt that such high numbers of population will bring forth a variety of problems alongside it; such as waste management, inevitable traffic congestion and transportation issues, unfair division of resources, increasing concerns regarding health of citizens, limited infrastructure and housing, environmental concerns such as pollution and energy waste (Chourabi, et al., 2012). The United Nations emphasize that 75% of World's resources are being consumed in and 80% of the total greenhouse gas emissions are caused by urban areas which does not only have an effect on city level but also has regional and global results (OECD, 2012).

Many discussions have been made to identify a response to problems caused by rapid urbanization and increasing population. One of the responses developed to tackle the problems defined above, which in truth, represents a fraction of the entire range of issues of modern cities, is the discourse of "Smart Cities". Since 1990s, this approach has been gaining popularity in the literature. The reason this discussion is increasing in popularity stems back to the role of the cities in modern societies. Cities are considered as the main scene of social and economic development and as a result, they impact the environment quite heavily (Mori & Christodoulou, 2012). This, quite obviously, lead the government officials and policy makers to consider methods to manage the new challenges. Many approaches focusing on improvement of cities as a whole, have become focused on new technologies, specifically Information and Communication Technologies (ICT) to tackle the problems and to build what we call a "Smart City" (Albino, Berardi, & Dangelico, 2015).

There is no strict definition for describing what actually a Smart City is and it is quite impossible to come up with a definition that defines every aspect of the discourse in a perfect manner (O'Grady & O'Hare, 2012). Several definitions have come up in scientific literature, focusing on different elements of a Smart City. For example, Barrionuevo et al. defines smart city as a city which is capable of implementing technology to its full capacity in urban areas in an "intelligent and coordinated manner" to create integrated and sustainable cities, which mainly considers the efficiency and sustainability aspects of smart cities (Carrionuevo, Berrone, & Ricart, 2012). As stated before, technology is at the core of Smart Cities and this approach also comes across in literature. Cretu claims that Smart Cities are stemmed from two main approaches. The first approach is in relation with governance and economy which are based on new paradigms. The second approach refers to technology as saying that Smart Cities are created through the network of sensors, data which is collected in real-time, smart devices and integration of ICT into every aspect of daily life (Cretu, 2012). As some definitions focus on the technology side of being smart, some other scholars argued about the social and

human aspect of smartness. For example, according to Kourtit and Nijkamp, Smart Cities are influenced by strategies that have high knowledge and creativity and aim to improve socio-economic, environmental and competitional power of a city. The authors continue to elaborate by saying that Smart Cities should be formed through a well-balanced combination of skilled labor force to improve human capital, centers where high technology communication skills are promoted to improve infrastructural capital, the ability to form new networks to improve social capital, and lastly, businesses where high risk is tolerable and creativity is advised, to improve entrepreneurial capital (Kourtit & Nijkamp, 2012).

Many Smart City studies also further analyze the concept by defining dimensions of a Smart City. The dimensions can be understood as the must-have skills and abilities of Smart Cities. Dirks and Keeling, in their study, heavily emphasize the need for a well-measured and organically defined mix of city's various systems such as health care, housing, physical infrastructure, transportation, energy, education, food, water, and public safety (Dirks & Keeling, 2009).

A similar but much more detailed classification of dimensions have been made by Giffinger who has defined six major dimensions for Smart Cities which are further elaborated into certain indicators or elements. These dimensions are named as Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living and Smart Governance (Giffinger, 2007).

Similar to Giffinger's method, Cohen has also developed a classification model which he has named as "Smart City Wheel" (Cohen, What Exactly is a Smart City?, 2012). His dimensions are named Smart Mobility, Smart People, Smart Economy, Smart Governance, Smart Living and Smart Environment. These dimensions, later on, has been divided into three main indicators.

Throughout this study, the main focus will be on Smart Mobility aspect of the Smart Cities. This era, in which cities are rapidly and dramatically growing both in physical and demographical ways, one of the concerns is about generating and

monitoring mobility in cities. Mobility context developed to decrease the current growth-based conflicts of cities. In general perspective, mobility has two major focuses about these conflicts, one is about the impacts on people and the other one is on the planet.

Urban mobility has an increasingly important role in urban growth. The implementation of an efficient public transport system can solve some parts of congestion problems, but smart mobility wants to take it one step further. Some solutions are based on looking for innovative and sustainable ways to provide mobility to people in cities, such as the development of public transport fuels that respect environment, supported by advanced technology and proactive behavior of citizens. Smart mobility, based on these focuses within the usage of more innovative and sustainable solutions supported by advanced technology. Like smart mobility, many smart city initiatives, aim to use the technology to improve mobility, by maximizing its efficiency while minimizing its impact. Therefore, smart mobility aims public accessibility to the real-time information in order to save time and improve the trip, save money and reduce CO_2 emissions as well as connect and guide transport to improve services and provide information to citizens.

Smart mobility in a more general sense, is about making transport more connected, more efficient, and more flexible. It is the backbone for growth in cities. It involves many areas of usage from public transportation and car or bike-sharing services to private cars and commercial vehicles. It can provide alternative, dynamic routes and paths and more efficient and optimized transportation systems. Taken as a whole, smart mobility helps people and goods move more effectively and more efficiently, so everyone has a better day-to-day experience. Developing such a system, brings the attention to high technology-based elements for generating more mobile, healthier and more efficient transport circulation in cities.

In order to enable the city operators and to introduce smart solutions which is capable of helping citizens in their daily activities, a set of heterogeneous and integrated tools are needed. These solutions have to be capable to support different

scenarios in a smart and integrated way, to provide a mechanism to sense the context of the city, to drive the data in a singular or aggregated way, to provide the data scientists with set of tools for data analysis and a programming environment to computer scientists. A smart city platform should be able to inform both city users (citizens, students, commuters, workers, etc.) and city operators, to collect their feedback about city infrastructures and services, to provide an integrated info-portal for ad-hoc and personal visual applications (city dashboards) and finally to provide to the platform's admins a way to monitor the functionalities of the solution (Badii, Bellini, Difino, & Nesi, 2018).

From this point of view, generating and monitoring new advanced technologies becomes a necessity. The development of key enabling technologies, such as Internet of Things (IoT) and Internet of Everything (IoE), is driving even more rapid growth of sustainable ecosystems. The switch to the IoT/IoE paradigm is going to dramatically change the way the citizens and city operators interact with their nearby infrastructure: how they move, how they get energy, how they make decisions, and how the city entities are managed and controlled (Badii, Bellini, Difino, & Nesi, 2018). The Internet of Things (IoT) is a base for collaboration, offering a convenient way to bring together actors in the private and public sectors, so new business models can emerge. Most of these IoT-driven initiatives focus on the emphasis of delivering transport services that are simple to use and provide easy access to valuable, real-time information. The widespread adoption of smartphones and other mobile devices plays into this as well, since many people now carry or wear devices that support interactions with IoT-driven services, which basically allow them to become sensors.

In general understanding, developing more efficient and more effective environment in the context of smart mobility, requires many inputs. One of them, without any doubt, is conducting and monitoring the whole system within the participation of state. Like any other attempt on replacing an existing system – in this case, smart mobility implementations- without changing economic structure

requires important input and participation from state. Therefore, our understanding of the rationale for governance intervention in and management of the transition to smart mobility as being able to harness the opportunities put forward by this particular socio-technical transition to maximize the benefits to individuals that mobility provides, to manage the distribution of these improved mobility opportunities according to democratically agreed objectives on equalities and social justice, and to do this within the framework of international agreements about reducing the impact of mobility on the environment (Docherty, Marsden, & Anable, 2018).

Therefore, in smart mobility context, we can address two major aspects on implementation and monitoring. First aspect mostly focuses of IoT and IoT based actions to create more user-friendly and easily accessible applications in cities. Second aspect is based on inspecting and monitoring which draws an attention to policy makers/state and their approach to fictionalization of this system.

In Turkey, starting in 2000s, following the increasing popularity and the number of policy plans such as development plans and their targets, Annual Programs, and Vision 2023, for transformation towards a Smart City, a trend has begun (Bilici & Babahanoğlu, 2018). Smart City applications have begun to be considered intensely in cities such as Ankara, Bursa, Eskişehir, İstanbul and so on, with specific focus given towards e-government applications (Alkan, 2015), (Kaygısız & Aydın, 2017).

Clearly, the main distribution source of urban services, including the services which include Smart City elements, is the local governments. Local governments have a variety of responsibilities defined in Municipal Law No:5393 as mainly; "Infrastructure services such as urbanization, water and water treatment services, transportation; geographical and urban information systems; environment and environmental health; sanitation services and solid waste; municipal police, fire department, emergency services, rescue and ambulance; urban traffic; funeral and cemetery services; afforestation, parks and green spaces; housing; culture and art, tourism and promotions, youth and sports high education student dormitories; social

services and assistance, wedding, vocational courses; improvement of economy and trade" (5393 Sayılı Belediye Kanunu, 2005). The provision of services by municipalities, as it can be seen, is a responsibility, given by the law. This further means that Smart City initiatives, can mainly be distributed through the practices of municipalities.

Konya Metropolitan Municipality is one of the municipalities in Turkey which has focused on Smart City initiatives. Specific focus has been given on Smart Mobility incentives and applications. Konya Metropolitan Municipality is an active user of Information and Communication Technologies. According to Konya Metropolitan Municipality official website, some of the smart city initiatives of Konya Metropolitan Municipality can be considered as Smart Public Transportation System (ATUS), contact-free public transportation fee collection system (Elkart), Dynamic Junction System, Smart Bicycle System, Smart Waste Collection System, mobile applications and City Information System (Konya Metropolitan Municipality, 2019). Konya Metropolitan Municipality has partnered itself with TÜBİTAK (The Scientific and Technological Research Council of Turkey) to provide a wide fiber-optic network in Konya Metropolitan Area to be used for electronic communication and signed a protocol about the partnership, which was intended to be the bedding of smart mobility and communication infrastructure which later on, was implemented by Konya Metropolitan Municipality (Bilici & Babahanoğlu, 2018). This shows that Konya Metropolitan Municipality's Smart City transformation is heavily focused on Smart Mobility.

One of the most commonly used smart mobility implementation of Konya Metropolitan Municipality can be considered as ATUS. Through ATUS, commuters can gain access to many features and information regarding public transportation with municipal bus and tramway such as, bus location, bus lines, bus stop information (complete and based on bus lines), bus line routes, bus and tramway tariffs, bus arrival information, closest bus stop information as well as Elkart application, Elkart balance control and balance addition. Furthermore, the

system provides assistance with lost and found, taxi tariff, details about public transportation fleet, rules and regulations regarding public transportation, informatic videos, transportation fees, air, rail and road transportation information, transportation to provinces and lastly, ATUS Help Center (ATUS, 2019). Furthermore, similar information is accessible through QR codes on bus stops, mobile applications and 5669 SMS System (Bilici & Babahanoğlu, 2018).

Additionally, along the mobile applications and ATUS, Konya Metropolitan Municipality has been working towards physical Smart Mobility implementations as well. For instance, Konya Metropolitan Municipality is heavily invested in Dynamic Junction Management, Bluetooth Based Traffic Analysis Systems, Electronic Enforcement Systems and so on.

Dynamic Junction Systems refer to junctions that are powered with various sensors such as loop detectors or cameras, which enable counting of vehicles approaching to the junction. These sensors gather vehicle count data, and according to the analysis done by the system automatically, green light duration for each junction approach is arranged according to the analysis (ISSD, 2019). Furthermore, Konya Metropolitan Municipality has installed junctions with Signal Coordination (Green Wave) application. Green wave allows that the vehicles travelling at a designated speed in a corridor, always meet green light at intersections. Konya Metropolitan Municipality has further improved the transportation analysis through installation of Bluetooth based Traffic Analysis systems, which connect to Bluetooth enabled devices such as smartphones, wireless headphones or built-in Bluetooth modules in vehicles. When connected, Bluetooth device can capture the unique MAC ID of the devices and once the same MAC ID is captured by another Bluetooth device, given the distance between these two devices, average travel time can be calculated. This information is then published on Variable Message Signs (VMS) to notify drivers about long travel times, due to possible congestions and allow them to choose a different route. Dynamic junctions, green wave applications and travel time

estimation contributes to lowering the waiting times at junctions, hence lowering fuel consumption and CO_2 emission (ISSD, 2019).

Konya Metropolitan Municipality has supported Smart Traffic Management systems with Enforcement Systems as well. Konya Metropolitan Municipality has installed camera based average corridor speed enforcement systems. These cameras register the number plate of passing vehicles. These captured images from multiple cameras placed along the corridor are matched through a software and similar to the Bluetooth devices, given that the distance between camera installation points are known, average travel time, hence, travel speed can be calculated and drivers who are violating the rules can be issued with a ticket (ISSD, 2019).

I.II. Methodology of This Research

The data collection methods used in this research mainly consists of two elements. A field survey of questionnaires has been performed in Konya Metropolitan Area for two days with the participation of a total of 67 locals. Additionally, a total of 8 public officers who work at Konya Metropolitan Municipality have participated in a face-to-face in-depth interview which were semi structured where questions were directed to the participants and within the natural context of the interviews, when necessary additional questions were asked and further clarifications were demanded.

Questionnaire template has not been shared with the participants. Instead interviewer has directed the questions to the participants and noted down each answer on separate files. The questionnaires were performed on 22-23th of November, 2019. It was considered important that questionnaires have been performed on different locations within the Konya Metropolitan Area. For that reason, areas such as Selçuk University campus, Ankara Road, İstanbul Road, Organized Industrial Zone, areas around Mevlana Museum, Bedesten District and

City Center. 29 of the participants were female while 38 of the participants were male.

The interview questions consist of Yes-No questions, questions with ranking based on likert scale method and open-ended questions. Open-ended questions were aimed to detect deeper insights regarding transportation issues in Konya Metropolitan Area. For that reason, open-ended questions were categorized in a total of 7 groups. All answers to the open-ended questions have been listed in a separate file and based on the general tendencies of the answers, a grouping has been performed. All groups were further numbered and answers were assigned the related number. These groups are then named as "Infrastructure Issues", "Service-Related Issues", "Parking Issues", "Traffic Flow Issues", "Pedestrian Mobility Issues", Governance Issues" and "No Issues".

Infrastructure issues includes answers regarding to problems about physical implementations, design problems and accessibility problems. Service-related issues consists of scarcity of services, limitations regarding the public transportation services and modes, low number of available public transportation lines, pricing of public transportation, issues regarding service hours and frequency. Parking related issues includes parking at a non-parking spot especially on pedestrian roads or parking that limits pedestrian accessibility. Traffic flow issues include congestion due to usage of private cars, red light durations and close placement of red lights. Pedestrian mobility issues include answers in relation to limitation on pedestrian access especially on pedestrian underpasses and pedestrian overpasses. Governance issues cover the answers about limited inspection by the Municipality about traffic rule enforcement and general inspection on public transportation and limited incentives given by the Municipality to increase the usage of public transportation. Finally, last group includes participants who claimed that there were no transportation related issues in Konya Metropolitan Area.

For analyzing survey data, IBM SPSS software has been chosen as a tool. Collected data (both qualitative and quantitative based on close and open-ended survey

questions) raw survey data was entered on the interface of the software. After the data entry process, "Descriptive Statistics" tool used for calculating frequencies. Frequencies for each answer of each question was categorized. Then, for generating a holistic understanding for related questions, the "Crosstab" tool was used as one of the subcommands of Descriptive Statistics tool which allowed cross control of some of the answers that can provide deeper understanding.

Interviews were performed on different dates with 8 public officers of Konya Metropolitan Municipality and they have been recorded with the permission of the interviewee. Later on, all recordings were decoded and have been used as supportive arguments throughout this study. The role of the interviewees within the Municipality is given on the table below.

Table 1: Interviewee Details

Interviewee ID	**Date of the Interview**	**Location of the Interview**	**Role of the Interviewee**
Interviewee A	19th of April 2019	Konya Metropolitan Municipality Building	Member of Division of Traffic Signalization
Interviewee B	19th of April 2019	Konya Metropolitan Municipality Building	Member of Division of Traffic Signalization
Interviewee C	19th of April 2019	Konya Metropolitan Municipality Building	Member of Division of Traffic Signalization
Interviewee D	26th of May 2019	Konya Metropolitan Municipality Building	Member of Department of Information Technologies
Interviewee E	26th of May 2019	Konya Metropolitan Municipality Building	Member of Department of Information Technologies
Interviewee F	26th of May 2019	Konya Metropolitan Municipality Building	Head of Department of Transportation Planning and Traffic
Interviewee G	26th of May 2019	Konya Metropolitan Municipality Building	Member of Department of Transportation Planning and Traffic
Interviewee H	12th of July 2019	Konya Metropolitan Municipality Building	Konya Metropolitan Municipality Mayor

Due to a strict time limitation and unwillingness of potential participants, questionnaires have remained a low number compared to the population of the city. However, with the support of interviews with municipal administrators, and the review of certain documents such as Konya Transportation Master Plan, Konya Metropolitan Municipality Traffic Culture Report, a published paper of one of the interviewees as well as access to information obtained by Konya Metropolitan

Municipality Traffic Control Center, problems originating from limitations of the questionnaires have been eliminated.

I.III. The Aim and the Scope of the Research and Research Questions

In the context briefly discussed above, the aim and scope of this research is to identify the implications of implementations of Smart Mobility tools in Konya Metropolitan Area. Konya Metropolitan Municipality has completed multiple installations of Smart Mobility elements, powered by ICT in the urban area. The research has shown a limited pool of evaluation studies done for Konya Metropolitan Area with a specific focus on Smart Mobility. This study aims to contribute to the existing literature by providing insights from Konya Metropolitan Municipality regarding Smart Mobility investments.

Konya can be considered as one of the leading cities in Turkey, where Smart Mobility installations are becoming more and more common. Furthermore, Konya follows a progressive approach towards smart mobility implementations and develops This is the main reason behind selection of Konya Metropolitan Municipality for further analysis.

This research aims to understand the process of implementation of Smart Mobility elements, performed by Konya Metropolitan Municipality. As mentioned earlier, Konya Metropolitan Municipality implements smart mobility tools swiftly throughout the city but limited research activity on how these implementations are performed, what kind of effects they have on general public, which problems are countered with smart mobility and if the implementation process can be seen as a success, requires a deeper investigation of Konya Metropolitan Municipality and its actions towards becoming a mobility focused, smart city.

The research will first begin with an introduction on Chapter I, followed by a detailed literature review given in Chapter II. Literature review will heavily focus

on Smart City discourse and how it became a hot topic. Additionally, two main approaches to smart cities will be given in detail. Following that, Smart Mobility which is one of the dimensions of Smart Cities will be discussed. Chapter III will move on to the evaluation of Turkey's Smart Mobility initiatives. This chapter will initially provide a brief discussion on the global history of the development of Intelligent Transportation Systems by dividing the development into three major eras while also mentioning some of the important products and services developed in each era. Then, Intelligent Transportation Systems (ITS) in Turkey will be briefly evaluated and historical development of ITS implementations in the country will be summarized. This chapter will be finalized with summaries of major policy documents developed by various institutions and ministries in Turkey with a specific focus on National Intelligent Transportation Systems Strategies and Action Plan (ITS-SAP). Chapter IV will move on to evaluation of transportation network and ITS in Konya. After a general overview on transportation in Konya with the addition of key statistics of the city and smart mobility implementations. Each of the smart mobility implementations in the city will be discussed in this chapter. Later on, brief discussion on estimations in Konya Transportation Master Plan will be given. Chapter V will discuss the findings of the questionnaires, performed as a survey for this research and finally Chapter VI will conclude the research with some suggestions and discussions.

CHAPTER II

LITERATURE REVIEW

II.I. Emergence of Smart City Discourse

Since the first examples of cities, these areas are considered to be an attention center for mass production and consumption (Camboim, Zawislak, & Pufal, 2019). This allows many opportunities to rise in urban areas, attracting more and more people. Majority of the problems such as pollution, congestion and unemployment in urban areas can be traced back to increasing population. According to United Nations, the share of urban population is on the rise with 54% and approximately 4 billion people are now residing in metropolitan areas while around 1.7 billion of these live in cities which have 1 million population minimum (United Nations, 2016). Many disciplines are involved in the process of overcoming problems observed in urban areas and many responses have been developed to tackle urban issues which put quite a strong pressure on the resources and infrastructure of cities (Breetzke & Flowerday, 2016). The problems are expected to increase over time without proper prevention actions which may become a major challenge especially in the fields of energy, mobility, wastewater treatment and waste management as a whole (Buuse & Kolk, 2019).

One of the main responses to urban problems is considered as the "Smart City" which is gaining popularity all over the world due to emergence of IoT technologies such as sensors, RFID, smart phones and smart wearables (Evans, 2011) and is

expected by the UK based engineering consulting company Arup, to reach a global market capacity of 400 billion pounds by 2020 (Lu, Chen, & Yu, 2019). Smart City can basically be defined as an alternative approach which counters the challenges in urban areas through utilization of Information and Communication Technology (ICT) through means of accessibility and integrated infrastructure (Ismagilova, Hughes, Dwivedi, & Raman, 2019). According to Komninos and Mora, the cities that are equipped with ICT-based sensors and means to share the digital knowledge are the cities which function more efficiently and have stronger impacts on urban management models (Komninos & Mora, 2018). Some of the most visible transformations towards smartness can be observed in the fields of transportation and energy. Smart approaches require minimum human intervention while providing maximum output through cities being able to run themselves and in return, it is expected that quality of life is improved for all. The transformation is required to be done in relation to city's characteristics and existing infrastructure to avoid problem. As a result, it is expected of government officials to perform such a transformation based on the city's own needs and issues to make sure a smooth transformation with minimum side effects (Elvan, 2017).

II.II. Smart Cities

As 21st Century proved to be an innovation period, knowledge based digital advances have been observed and the digital applications have spread by creative industries (Florida, 2014). Many definitions for being a "smart" city have been developed over time through different perspectives which primarily mentioned the role of technology. For instance, one definition mentions the utilization of technological advancements in the fields of vehicular technology, mobile phones and networks and big data (Peng, Nunes, & Zheng, 2017). Similarly, Guo et al. defines a smart city as the owner of such vision which integrates various ICT elements to manage the assets of the city (Guo, Ma, Li, Zhang, & Zhang, 2017).

Even though majority of the definitions tend to highlight the role of technology, it is safe to claim that technology as a single element cannot make cities smart (Nam & Pardo, 2014). Nam and Pardo put additional emphasis on penetration of technology to infrastructure and services and claims that smartness depends on how well smart tools penetrate the urban context. Similarly, Ortiz-Fournier et al. comments on the subject as smartness can be measured through the smart citizens based on their educational level, their quality of social interactions and openness to the world (Ortiz-Fournier, Márquez, Flores, Rivera-Vázquez, & Colon, 2010). The focus on human element has been a major checkpoint for multitude of definitions in academia. Similar to Ortiz-Fournier et al. other definitions have been developed to enhance the role of citizens in smart cities. For instance, Smart City is considered as a tool to leverage ICT which in turn is used to improve multiple aspects of the city including administration, quality of life for the citizens and provision of sustainable and resilient public services (Corbett & Mellouli, 2017). Moreover, the use of technology can also be described in relation to operations of city's planning and development becoming smarter as well (Breetzke & Flowerday, 2016). Also, smart cities are considered as ultra-modern places where the needs of business, institution and citizens are met (Khatoun & Zeadally, 2016).

The concept of Smart City mainly become a discussion topic in the 1990s and to this day, it remains undefined and confusing on some parts (Anthopoulos & Vakali, 2012). The main focus of this concept was on Information and Communication Technologies, or more commonly known, ICT. Additionally, sustainability is often used hand-in-hand with Smart City concepts along with concerns about social capital, infrastructure and creative development as it can be seen from the work of Caragliu et al. or Hollands (Hollands, 2008), (Caragliu, Del Bo, & Nijkamp, 2011). Sustainability has become a strong focus for Smart Cities as preservation of the environment, natural resources and climate forms an important agenda for international and national political scenes as it has been discussed heavily in the past (Brundtland, 1987), (United Nations, 1972), (United Nations, 1992). Additional actions like Europe 2020 Strategy, IBM Smart Planet or Kyoto Protocol

have hastened the pace of smart city movement (Cocchia, 2014). The unclarity of the concept is caused by its nature which promotes strong relations with conceptual definitions of intelligent, creative and digital cities (Albino, Berardi, & Dangelico, 2015). Undeniably, Smart Cities have become a driving force in many environments including academia, politics and business (Desdemoustier, Crutzen, & Giffinger, 2019). Nevertheless, a consensus about the notion of Smart Cities, their requirements, standards or the simple definition has not been decided upon. Mainly, two major paths define the requirements of a Smart City. These paths are summarized in the works of Mora et al. quite clearly (Mora, Bolici, & Deakin, 2017). According to this study, the initial path is more concerned with the technological aspects of a Smart City and the integration of data driven ICT elements (sensors based on various technologies, network infrastructure and so on), as well as sustainability, governance and social capital. The second path is more involved with the non-technological elements required in a Smart City such as human infrastructure, education, intellectual capital, plurality, creativity, participation in public life. This path also heavily favors partnership, transparency, cooperation and well-laid engagement. To sum up, Smart City approach promotes and enables the emergence of creative industries, new market applications and new societal models which stems from concepts of sustainability, transparency, communication, diversity, pluralism and collaboration (Perez, 2004).

An alternative layering of Smart City elements has been performed by Camboim et al. in 2019, where the authors aimed to review the existing literature regarding Smart City concept to pinpoint the dimensions of the model (Camboim, Zawislak, & Pufal, 2019). Based on their categorization, four dimensions namely governance, environ-urban, socio-institutional and techno-economic, are derived and each dimension have driving forces.

The governance dimension stems from collaboration between various stakeholders to assist in the process of policy making to implement in public field (Gil-Garcia, Pardo, & Nam, 2015). Furthermore, improving government services for the public,

provision of e-government tools is used to achieve transparency, while enabling safety for citizens through installation of cameras, barriers or lighting units (Chiodi, 2016).

The environ-urban dimension is a combination of urban mobility, natural environment and facilities and is more related to the built environment (Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014). A successful application of environ-urban dimension should include efforts on sustainable development (Lee, Phaal, & Lee, 2013). Furthermore, a strong transportation network for an efficient mobility which allows citizens to access multimodal travel options within the city (Caragliu, Del Bo, & Nijkamp, 2011).

While the first two dimensions deal more with technology and built environment, following two dimensions deal with human element. The socio-institutional dimension is concerned with plurality and engagement of the citizens which presents an opportunity in access to different approaches and cultures, values and traditions. Especially, feedback from public regarding developed policies allows the creation of the highest public benefit and for that reason, engagement of citizens in a smart city helps improvement of the place itself (Capdevila & Zarlenga, 2015).

Lastly, techno-economic dimension is related to activities that flourish innovation through heavy support on research and education and stronger human capital which consists of start-up companies, technoparks and so on, in order to develop economy and create networks (Leydesdorff & Deakin, 2011).

As it can be seen from given definitions and approaches to Smart Cities, it is safe to assume that accepting that a city is "Smart" cannot be solely based on the definition. Certain indicators are needed to evaluate smartness especially in the fields of energy, carbon emissions, transportation, resource management, competitive power, economy, environment, infrastructure, participation of citizens or quality of life (Bilici & Babahanoğlu, 2018).

One of the most well-known and well-defined approach regarding Smart Cities has been laid out by the report of Giffinger and his team regarding development of a system to rank European cities with medium size based on their capability of being a Smart City (Giffinger, 2007). The definition of Smart City is discussed by Giffinger as it may be understood as a certain type of ability of a city, it should cover a broader sense and should be understood based on some sort of criteria. A similar touch upon the role of ICT can be observed in the report as it is regarded as an essential element, especially in regards to its role in industry. But addition to that, attention has been given to other aspects as well. For instance, the term "smart" can be applied to multitude of elements of urban spaces such as education of the citizens, implementation of modern technology to everyday lives as well as to government processes, advanced technologies in the fields of transportation, security measures, environmental applications, green energy technologies and so on. As a summary of such activities defined above, Giffinger provides six characteristics of a smart city with the addition of smart factors to realize each characteristic.

Smart Economy: Smart economy refers to the innovative competitiveness. Smart economy enables productivity by boosting entrepreneurs and catalyzes integration of international market.

Smart People: Smart people is not a characteristic that is simply being measured by the education level of the citizens of a city but also being measured by the social quality of life.

Smart Governance: Smart governance is mainly concerned with participatory activities of the government and the functioning of the administrative body.

Smart Mobility: Smart mobility defines the elements that allows accessibility and the use of information and communication technologies in a sustainable transportation network.

Smart Environment: Smart environment is defined in relation to climatic conditions, availability of green spaces in urban areas, pollution and waste management systems.

Smart Living: Smart living refers to cultural and social conditions provided by the city such as the sensation of safety, available housing conditions, tourism opportunities and so on.

Table 2: The Characteristics and Factors of a Smart City (Giffinger, 2007)

Smart Economy (Competitiveness)	**Smart People (Social and Human Capital)**	**Smart Governance (Participation)**
○ Innovative Spirit ○ Entrepreneurship ○ Economic Image & Trademarks ○ Productivity ○ Flexibility of Labor Market ○ International Embeddedness ○ Ability to Transform	○ Level of Qualification ○ Affinity to Life Long Learning ○ Social and Ethnic Plurality ○ Flexibility ○ Creativity ○ Cosmopolitanism / Open Mindedness ○ Participation in Public Life	○ Participation in Decision Making ○ Public and Social Services ○ Transparent Governance ○ Political Strategies & Perspectives
Smart Mobility (Transport and ICT)	**Smart Environment (Natural Resources)**	**Smart Living (Quality of Life)**
○ Local Accessibility ○ (Inter-)national Accessibility ○ Availability of ICT-Infrastructure ○ Sustainable, Innovative and Safe Transport Systems	○ Attractivity of Natural Conditions ○ Pollution ○ Environmental Protection ○ Sustainable Resource Management	○ Cultural Facilities ○ Health Conditions ○ Individual Safety ○ Housing Quality ○ Education Facilities ○ Touristic Attractivity ○ Social Cohesion

Giffinger's research is highly important due to its ability to gather multiple elements of a smart city and combine them in relation to each other, as well as to provide a strong standing point for future researches. Similarly, Boyd Cohen has developed an indicator framework for Smart Cities which is named "Smart City Wheel" that defines six main dimensions supported by three indicators each. These indicators are further detailed with a total of 62 assessment measures (Cohen, 2013). European Union also recognizes this model and the model embraces the notion of sustainable economic development and formation of human capital, social capital and ICT infrastructure for better quality of life (Bilici & Babahanoğlu, 2018). European Parliament's report on Smart Cities aligns the dimensions of a Smart City with Smart City Wheel model (Smart Cities Council, 2014). These dimensions are named Smart Economy, Smart Environment, Smart Government, Smart Living, Smart Mobility and Smart People and each dimension is explained below.

Smart Economy: Smart economy is evaluated by "Entrepreneurship & Innovation", "Productivity" and "Local & Global Interconnectedness" indicators. Flexibility of the job market is favored in smart economy. Support towards innovation which boosts development of new products and assisting integration with international markets to increase competitive power of the local market is valued.

Smart Environment: Smart environment is evaluated by "Green Buildings", "Green Energy" and "Green Urban Planning" indicators. Smart environment aims to counter the negative effects of climate change and to lower pollution and emission rates. Moreover, it is essential to be able to lower the use rate of natural resources while increasing the share of renewable sources is favored (Colldall, Frey, & Kelemen, 2013). Also, planning of green network in a well distributed manner promotes environmental sustainability.

Smart Government: Smart government is evaluated by "Enabling Supply & Demand Side Policy", "Transparency & Open Data" and "ICT & E-Government" indicators. Smart Government supports participation of all stakeholders which in

turn eases governmental processes and provides transparency. Government services are shared with public over the internet which helps with transparency and improve communication between authorities and general public. Smart government is, quite obviously, subject to good governance practices (Gonzalez, Ferro, & Liberona, 2019).

Smart Living: Smart living is evaluated by "Culturally Vibrant & Happy", "Safe" and "Healthy" indicators. Smart living allows provision of security for citizens through installation of monitoring cameras, number plate recognition systems. Additionally, intelligent disaster management and detection systems, health, education, culture and tourism services enabled through well communication are considered as parts of smart living. Furthermore, with inclusion of IoT technologies in homes, household management is simplified and made more pleasant.

Smart Mobility: Smart mobility is evaluated by "Mixed-Modal Access", "Prioritized Clean & Non-Motorized Options" and "Integrated ICT" indicators. Smart mobility entails logistics and transport services supported by ICT. Since high mobility to access job market is important for citizens, accessibility through well-planned public transportation, powered by environmentally friendly vehicles is also considered as an essential element of Smart Mobility. Establishment of sustainable transportation network can be considered within this context as well (Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014). Common smart mobility elements include traffic management, traffic directives, intelligent junctions, intelligent bus stops, parking directives, integrated fee collection systems for public transport, GPS and advanced driver information systems. Smart mobility entails multimodal transportation network and ability to develop fast responses to issues of transportation is one of the requirements.

Smart People: Smart people is evaluated by "21st Century Education", "Inclusive Society" and "Embrace Creativity" indicators. Smart People refers to the quality of social capital (Akdamar, 2017). Smart People provides access to a lifelong learning environment and helps citizens to participate in public issues and events through

the use of online platforms which boosts the sense of belonging to a place and its people.

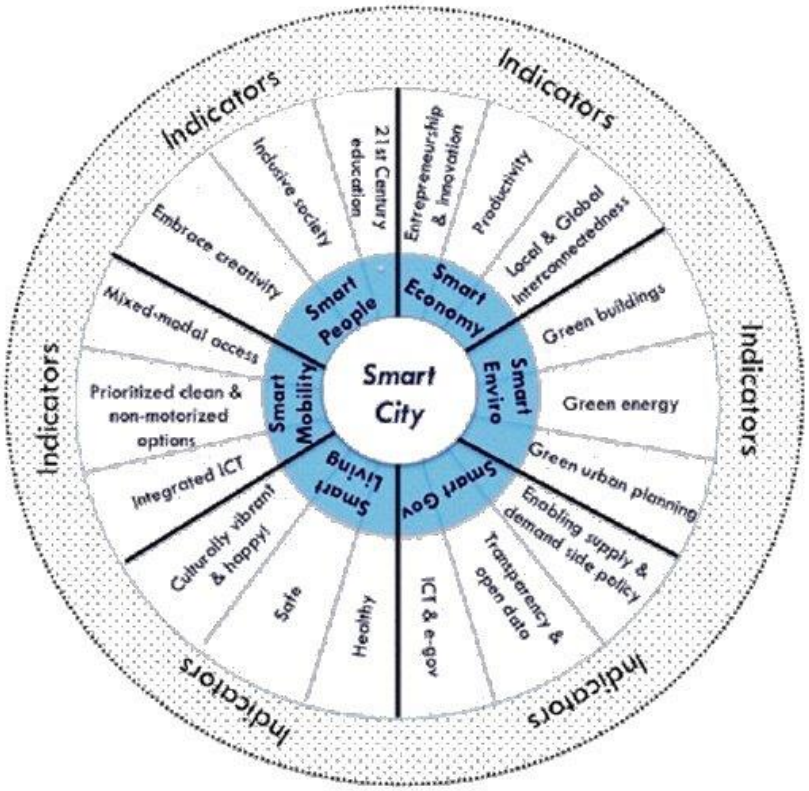


Image 1: Smart City Wheel (Cohen, What Exactly is a Smart City?, 2012)

II.III. A Dimension of Smart Cities: Smart Mobility

In a general point of view, we can comprehend that the smart city concept gives an opportunity to develop and generate more efficient and user-friendly infrastructures for cities, from utilities to transportation of cities. One of the most significant elements of smart transportation context is smart mobility, which is basically linked with developing more accessible transportation structure.

For defining smart mobility concept, first there should be a focus on mobility and its importance for better transportation systematic generated within the context of smart cities. The topic of mobility is an important aspect of today's growing cities. The transportation of people and goods within the city is crucial for the development of the economy and the everyday life on it. This issue makes mobility concept bigger than transportation or traffic (Mataix, 2010). Urban mobility has an increasingly important role in urban growth. The implementation of an efficient public transport system can solve part of congestion problems, but smart mobility wants to go one step further. Some solutions are based on searching innovative and sustainable ways to provide mobility to people in cities, such as the development of public transport fuels that respect environment, supported by advanced technology and proactive behavior of citizens (Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014); (Van Audenhove, Dauby, Korniichuck, & Poubaix, 2014). The importance of mobility and its impact on other pillars of the smart city, such as sustainability, economy and living, make this issue vital for citizens and local governments. A difference between mobility and smart mobility might be the public accessibility to the real time information in order to save time and improve the trip, save money and reduce CO_2 emissions as well as connect and guide transport to improve services and provide information to citizens (Manville, et al., 2014).

According to European Commission's Green Paper: Towards a New Culture for Urban Mobility published in 2007, urban mobility should make the economic development of towns and cities, the quality of life of their inhabitants and the protection of their environment possible (European Commission, 2007). Generating more mobile urban environment is an essential and urgent call for cities. European Commission determined specific goals and strategies for this which is shown on the table below.

Table 3: Goals and Strategies of European Commission's Green Paper: Adapted From (European Commission, 2007)

GOAL-1: Free-flowing towns and cities	**GOAL-2: Towards greener towns and cities**	**GOAL-3: Towards smarter urban transport**	**GOAL-4: Towards accessible urban transport**	**GOAL-5: Towards safe and secure urban transport**
- Intelligent and adaptive traffic management systems - Promoting walking and cycling - Optimizing the use of private cars with ITS - Local policy-making and institutional settings for freight transport	- Clean and energy efficient vehicle technologies and alternative fuels - Supported by green procurement - Intelligent cars (eco-driving, electronic driver support systems etc.)	- Smart charging systems - Better information for better mobility	- Collective transport meeting citizens needs - Building upon an appropriate EU legal framework - Balanced coordination of land use and integrated approach to urban mobility	- Safer behavior within the ITS usage for increasing safety - Safer and secure infrastructures - ICT for safe and intelligent vehicles

Based on Green Paper 2007, European Commission mostly focused and highlighted the usage of intelligent transportation systems also the integration of mobility/smart mobility implementations. The emphasis on mobility within the usage of intelligent methods and technologic structure is one of the main ideas behind generating a whole new perspective for cities and their understanding of mobility.

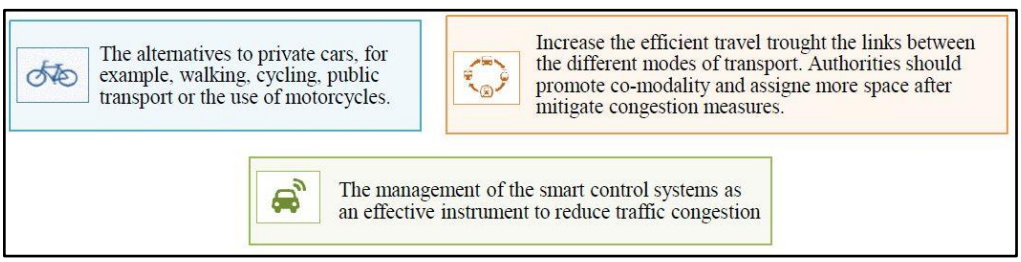


Image 2: Suggestions Regarding Implementation of Smart Mobility (European Commission, 2007), (Arce & Alonso, 2016)

Generally, mobility involves an evaluation of four factors related to smart mobility context. The basic indicators are related to:

- Sustainable Urban Transportation and Urban Mobility Plans
- Reducing the number of vehicles in city
- The use of ICT in traffic management
- The integration of alternative modes of transport.

Like any other complex socio-economic system, the mobility system can be described as a "set of connected changes, which reinforce each other but take place in several different areas, such as technology, the economy, institutions, behavior, culture, ecology and belief systems" (Rotmans, Kemp, & Van Asselt, 2001).

Mobility as a concept, highly focuses on providing more accessible, more equalitarian and more technology-based circulation network in cities. Recent technological developments in this field, are mostly supporting this goal under the framework of smart mobility context, but according to Marsden and Docherty, it should be recognized that none of the technological innovations in car-based mobility to date, have unlocked such a positive outcome, and so we should be wary of claims that the 'next big thing' – in this case 'Smart Mobility' – will automatically be more successful (Marsden & Docherty, 2013). In fact, because mobility is a system, many different potential Smart Mobility futures exist, even for any given package of technological innovations.

In order to enable the city operator and to introduce smart solutions capable of helping citizens in their daily activities, a set of heterogeneous and integrated tools are needed. These solutions have to be capable to support different scenarios in a smart and integrated way, to provide a mechanism to senses the context of the city, to drive the data in a singular or aggregated way, to provide at data scientists a set of tools for data analysis and a programming environment to computer scientist. A smart city platform should be capable to inform both city users (citizens, students,

commuters, workers, etc.) and city operators, to collect their feedback about city infrastructures and services, to provide an integrated info-portal for ad-hoc and personal visual applications (city dashboards) and finally to provide to the platform's admins a way to monitor the functionalities of the solution (Badii, Bellini, Difino, & Nesi, 2018)

From this point of view, generating and monitoring new advanced technologies becomes a necessity. Municipalities are increasingly using information and communication technologies (ICT) to enrich and enhance city life, which is paramount in planning the cities of the future. The rapid growth and expansion of the Internet of Things (IoT) result in a fundamental impact on the development of smart cities and their mobility options. The development of key enabling technologies, like Internet of Things (IoT) and Internet of Everything (IoE), is driving even more rapidly the growth of sustainable ecosystems. The switch to the IoT/IoE paradigm is going to dramatically change the way the citizens and city operators interact with its nearby infrastructure: how they move, how they get energy, how they make decisions, and how the city entities are managed and controlled (Badii, Bellini, Difino, & Nesi, 2018). The Internet of Things (IoT) is a base for collaboration, offering a convenient way to bring together actors in the private and public sectors, so new business models can emerge. Most of these IoT-driven initiatives focus on the emphasis of delivering transport services that are simple to use and provide easy access to valuable, real-time information. The widespread adoption of smartphones and other mobile devices plays into this as well, since so many people now carry or wear devices that support interactions with IoT-driven services.

The IoT drives efficiencies and delivers rich new services that have a positive impact in urban life. However, without effective strategies in place and lack of monitoring skills provided by the state, cities can be unable to capitalize on these benefits. In other words, the main conflict facing the state is managing smart mobility.

Smart mobility implementations as a socio-economic/socio-technical initiative there is a certain link between Geels' refinement of their theorizing about the role of governance in the unfolding of sociotechnical transitions, and the broader body of political science work seeking to understand the apparent shifting role of the state from one of the 'public administration' of directly provided services, through an intermediate phase of the '(new) public management' or the coordination of public services provided by a wider range of actors (Geels, 2011).

Therefore, because of that any attempt on replacing an existing system – in this case, smart mobility implementations- without changing economic structure requires important input and participation from state. Therefore, our understanding of the rationale for governance intervention in and management of the transition to smart mobility as being to harness the opportunities put forward by this particular socio-technical transition to maximize the benefits to individuals that mobility provides, to manage the distribution of these improved mobility opportunities according to democratically agreed objectives on equalities and social justice, and to do this within the framework of international agreements about reducing the impact of mobility on the environment (Docherty, Marsden, & Anable, 2018).

Table 4: Core Reasons of State Involvement in Transport Governance: Adapted From (Docherty, Marsden, & Anable, 2018)

Need for Intervention	Key Issues Today
Public Policy	
1. Setting overall direction of policy	Increasing recognition of the role of transport in supporting economic growth, social progress and health
2. Environmental, economic and social externalities exist	Climate change, air quality, congestion, social exclusion and inequity are not tackled through the market
3. Coordination of transport, land-use and economic goals	Planning to accommodate growth in many cities whilst maintaining or improving accessibility requires intervention
4. Setting standards and communicating with public about transport system operation	Defining levels of service and reporting on how these are met, justifying efficient spending of taxation, managing disruptive events
5. Balancing the needs of different transport systems and users	Decisions on infrastructure spend and maintenance, road space allocation and legal frameworks on rights
Market Failures	
6. Conditions for a free market do not exist	Managing monopoly infrastructure providers and limited service competition, preventing collusion
7. Acting as a provider or procurer of services which are not profitable	Often to ensure basic levels of service to some communities, evening and weekend services or for bespoke services such as school or hospital transport
8. Problems of co-ordination between modes exist	Competition can exist between public transport operators within and between modes. Limited ticketing integration
9. Basic standards of operation and rules of movement	Interoperability between systems, data, standardization of laws and enforcement
Investment as Policy	
10. Funding the provision and upkeep of infrastructure	Sets general taxes and mobility related taxes and charges at various levels of government to fund the upkeep of infrastructure and subsidy of some services. The state can borrow at lower rates than the private sector
11. Supporting the adoption of transport innovations	Innovations are sometimes expensive in their early stage adoption or require additional infrastructures, supported by state subsidy and investment or new regulation
12. The state is an aggregator of risk and has primary accountability	The state ultimately remains guarantor when private provision of public services fails and retains accountability via the ballot box

These are clustered into three broad headings of ‘public policy’, ‘market failure’ and ‘investment as policy’. Whilst the interventions involve the state this is not synonymous with being dominated by the state as governance is acknowledged to be a process conducted through networks. It is important to note that smart mobility innovations occur alongside existing systems of provision and rule sets and it is sometimes the incompatibility or insufficiency of existing ways of managing the mobility system which create tensions (Docherty, Marsden, & Anable, 2018).

In the context of this study, the main focus will be on Smart Mobility and how it became an important agenda for Konya Metropolitan Municipality in Turkey. Konya is one of the leading cities in Turkey for smart city transformation. Additionally, Konya mainly focuses on smart mobility trends and seeks to improve urban mobility conditions for its citizens.

For this study, a total of eight face to face interviews are done with administrators of Municipality, including the Mayor of Konya Metropolitan Municipality, three members of Konya Metropolitan Municipality Division of Traffic Signalization, the head of the Department of Transportation Planning and Traffic and one member of the department and two members of the Department of Information Technologies. The interviews are done with voice recording active and later on, all interviews are decoded. The content of the interview is aimed to understand Konya’s transformation process into becoming a city with strong focus on smart mobility. Questions covered basic questions such as roles and responsibilities within the Municipality administration as well as if any training has been taken in the subject of transportation. Majority of the interviews try to pinpoint the start of the smart transformation process, how it has been made, how it was received by the public, occurrence of challenges and negative responses, the transportation problems of the city and the problems that are solved or countered by the Smart Mobility tools, the expected result and future agendas. Throughout this study, responses gathered by Metropolitan Municipality officials will be provided and a critical evaluation of Smart Mobility policies in Konya will be discussed in detail.

CHAPTER III

EVALUATION OF SMART MOBILITY INITIATIVES OF TURKEY

III.I. Introduction

Having its roots in Garden City movement, an interest towards the concept of sustainability has become a trending political agenda for many cities since 1990s (Basiago, 1996). Similarly, Konya Metropolitan Municipality aimed to follow sustainable urban policies which focus on protection of natural resources, limitation of energy use, increasing efficiency of land use in urban areas, provision of integrated transportation and improvement of human life conditions (İçli, Karaşahin, Büyükçay, & Taner, 2018). In Turkey, application of transportation policies with such focus is enforced through Strategy documents and Transportation Master Plans. Turkey, following the changing trends in the world, has developed certain policy documents where Intelligent Transportation Systems are mentioned. One of such documents is Intelligent Transportation Systems Strategy and Action Plan, which is released in 2014 (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014). Following section will be discussing the development of Intelligent Transportation Systems in the world as well as in Turkey through policies. Following that, Intelligent Transportation Systems application in Konya will be explained with the contribution of interviews done with municipality representatives and with insights gathered from the Konya Transportation Master Plan.

III.II. Intelligent Transportation Systems (ITS): Global History

Intelligent Transportation Systems can briefly be described as the management for infrastructure and superstructure through active use of Information and Communication Technologies and engineering applications (Tufan, 2014). Intelligent Transportation Systems are mainly applied in road transport with certain capabilities, such as, interoperability, provision of various authorization levels, process of big data (in real-time where applicable) and provision of results, analyses, or findings with general public or authorities. The aim of these systems which are born out of the developments in the fields of electronics, robotics and signal or image processing, can be briefly summarized as shortening travel times, promotion of sustainable mobility, traffic and transport security as well as comfort, contribution to economy and increasing the efficient use of existing road infrastructure instead of bringing new infrastructure, hence, feeding travel demand on roads (Figueiredo, Jesus, Machado, Ferreira, & Martins de Carvalho, 2001). The initial application of an "intelligent" system for transportation, can be traced back to the first use of a traffic light, which in fact, was adapted from railway lights, in 1868 in London (BBC, 2014). Obviously, this cannot be fully accepted as an Intelligent Transportation System, but yet, it stands as the first implementation which was aimed to help smoothing the traffic. The first electric traffic light was installed in Baltimore, United States which was sonically actuated (Washington State Magazine, 2019).

A systematic development in Intelligent Transportation Systems began to be established starting from 1960s. The modern developments of such systems can be evaluated in three major eras which will be discussed briefly below.

- 1960-1980: The first era can be labeled as the preparation and research period. The basic layout of Intelligent Transportation Systems are

developed with applications such as Comprehensive Automobile Traffic Control System CACS in Japan which was developed to be able to control automobile based transportation in Japanese cities (Mikami, 1978). The project aimed to solve several problems such as lowering congestion, limiting the number of traffic accidents, route suggestion and driving information as well as provision of pre-emption for emergency vehicles. CACS was divided into several subsystems such as route display board, driving information, traffic incident information and vehicle priority which were all connected to a monitoring center, which corresponds to today's Traffic Management or Control Centers. Similar systems included Electronic Route Guidance System (ERGS) in United States, which was developed in 1970s by the Bureau of Public Roads, Federal Highway Administration (Rosen, Mammano, & Favout, 1970). The system was developed to further promote safer journeys compared to journeys with the assistance of only maps or traffic signs. The road network of the country was divided into regions, then further into links which represent roads and nodes which represent intersections. All the divisions were coded to develop a six-digit code for each location which in fact aimed to promote drivers with easy-to-remember guidance for their journeys. Both these systems, along with some others were not completely implemented due to limitations, yet they are considered as the standing point of technologies which we now call as "navigation" (Tokuyama, 1996). Another point to note about the first era is that the term of "telematics" has been developed to describe these systems which was formed by the merging of the terms "telecommunication" and "informatics" (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014).

- 1980-1995: The second era can be summarized as the era of standardization for Intelligent Transportation Systems. An international effort was made to define various standards and guidelines of development and implementation

of Intelligent Transportation Systems. Furthermore, in this era, Intelligent Transportation Systems as an approach became more widespread in the world. Some of the major research areas in this era were Automated Toll Collection, GPS Based Navigation Systems, Dynamic Traffic Signal Management Systems, Electronic Cruise Control, Road and Weather Condition Information Systems, Mobile Speed Detection Technologies and Traffic Cameras and so on (Katanalp, Yıldırım, Eren, & Uz, 2018). Additionally, this era focused on standardization of Intelligent Transportation Systems' application, or in other words, definition of the Rule Book of ITS. SCATS – Sydney Coordinated Adaptive Traffic System has been developed in this era by Australia in 1982, which mainly focused on dynamic junction management. This technology is now one of the most well-known and advanced traffic management tools in the world. The word "telematics" developed in the previous era, has left its place to the term of "Intelligent Transportation Systems" as of 1991 and this year also bears the mark of birth of ERTICO – ITS Europe which is an organization aiming to standardize Intelligent Transportation Systems all over Europe and to provide funding and training for Intelligent Transportation Systems R&D studies. Similar attempt has been made in United States and in the same year, Intelligent Transportation Society of America has been founded. In 1992, ISO TC204, Intelligent Transportation Systems Technical Committee has been formed. Finally, ITS World Congress, held in 1994 in Paris aimed to define worldwide implementation standards (Tufan, 2014). Furthermore, Japan followed the trend and their individual expertise in the field and formed VERTIS, The Vehicle, Road and Traffic Intelligence Society in 2001 which later on took the name of ITS Japan. Nowadays, ITS World Congress is held with the partnership of ERTICO, ITSA (ITS America) and ITS Japan (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014).

- 1995-Today: The last era is where development of Intelligent Transportation Systems is on the rise and implementation of such systems are becoming more and more common. Many new developments, such as mobile traffic information, intelligent pedestrian access, satellite technologies, 3G, Wi-Fi and Bluetooth based technologies were developed. Furthermore, products and systems developed in the previous era have been commercialized (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014). In 1997, NAHSC – National Automated Highway System Consortium have presented Demo'97 project which was developed to provide higher highway efficiency and traffic safety (Public Roads, 1997). The increasing competition has raised the attention of many sectors and firms, which eventually helped widening the focus of Intelligent Transportation Systems from just efficient highways and motorway management, to multi-modal solutions (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014).

Many notable developments in this field has been made by multiple countries and an organization named International Transport Forum (ITF), which acts above individual national governments has been formed and now has 60 members where the aim of the organization is described as to study on transportation strategies to improve quality of life and to combine all transportation modes in these strategies (International Transportation Forum, 2019). Similarly, Intertraffic, an annual event held in Amsterdam, China, Indonesia, Mexico and İstanbul gathers stakeholders from private and public sectors which focus on infrastructure, product development, traffic security, intelligent traffic management, smart mobility, electronic enforcement and so on (Intertraffic, 2019).

As it can be seen, multitude of developments in the field of Intelligent Transportation Systems have been observed since the beginning of 1960s and to this day, many researchers, governments and policy makers are focusing on this subject. According to European Commission, the milestones of political

developments and documents since the beginning of 21st century is described as following (European Commission, 2019):

- 2001- White Paper: European Transport Policy for 2010: Time to Decide
- 2006 – Keep Europe Moving: Sustainable Mobility for Our Continent
- 2007 – Keeping Freight Moving
- 2008 – Greening Transport
- 2009 – Maritime Transport
- 2009 – Future of Transport
- 2011 – White Paper: Roadmap to a Single European Transport Area – Towards a Competitive and Resource Efficient Transport System

Similar to the world, Turkey has also aimed to support smart mobility and ITS by developing nationwide policy documents prepared by mainly municipalities but also with the support from various organizations and public bodies. The following section will give brief information regarding these policy documents with the highlight of Intelligent Transportation Systems and Smart Mobility.

III.III. Intelligent Transportation Systems in Turkey

The development of Intelligent Transportation Systems in Turkey, in comparison to the advancements in Europe, United States and Japan, occurred relatively slower. Several institutions are responsible or involved with the development of these systems, which slows down efforts of forming a main organization which can act above municipalities or other related institutions while maintaining strong relationships with all the actors. To achieve a harmony between institutions, in 2016, "Innovative and Intelligently Communicating Vehicle Technologies Clustering Workshop" has been organized to decide upon all institutional actors which may directly or indirectly has authorization on Intelligent Transportation

Systems and as a result; General Directorate of Highways, Metropolitan Municipalities, Municipalities, Special Provincial Administrations, City Traffic Committees, General Directorate of Security, General Commandership of Gendarmerie, Ministry of Transportation, Maritime Affairs and Communications (MTMC), Ministry of Science, Industry and Technology, Turkish Standards Institute, MTMC General Directorate of Communications, Information Technologies Authority, GSM Operators and TÜRKSAT, has been deducted as authorized institutions. Furthermore, general outline of Turkey's Intelligent Transportation Systems implementation has been listed as (Meriç, 2018);

- Traffic Cameras
- Road and Road Side Sensors
- Traffic Occupancy Maps
- Variable Message Systems
- Mobile Information Systems
- Traffic Rule Violation Detection
- Horizontal and Vertical Road Traffic Markings and Signs
- Signalization Systems (countdown units, accessible pedestrian signals)
- Traffic Education and Awareness Raising Activities (Traffic training parks, traveling traffic education bus, traffic education activities).

It is possible to multiply events, institutional reports and implementations regarding Intelligent Transportation Systems such as the one discussed above. To have a better insight about how Intelligent Transportation Systems are perceived in Turkey, the following section will provide a brief overview of Intelligent Transportation Systems applications in the country. The section following that, will be providing insights from official documents prepared by a magnitude of institutions and authorities.

III.III.I. Historical Development of Turkey's Intelligent Transportation Systems Implementations

The first application of intelligent systems in Turkey dates back to 1984, where signal coordination and optimization of main arterial roads in İstanbul have been studied, based on traffic demand on these roads on different times of the day (Akbaş & Akdoğan, 2001). This initial application is very essential, since signal coordination and optimization concepts are the basis of actuated traffic signal control technologies. In 1992, on Turkish highways, Automated Highway Fee Collection Systems have been implemented which allowed drivers to pay a certain amount of fee, based on the distance they have travelled on the highway (Yardım & Akyıldız, 2005). One of the most notable developments in the field is the use of AKBİL by İstanbul Metropolitan Municipality which ultimately aimed to promote ease-of-use for public transportation in the city. This system is now converted to İSTANBULKART which is based on RFID (Radio Frequency Identification) technology and can be used on buses, metrobuses, trams and parking areas (Yardım & Akyıldız, 2005). Similar technologies have been applied in other cities, including Konya. Konya has started using Elkart, which is also RFID based starting from 2000 (Konya Metropolitan Municipality, 2007). The first Traffic Control Center in Turkey was also established in İstanbul in 1995 where 160 critical junctions were connected to the center for monitoring purposes and furthermore, image transmission through surveillance cameras installed at 10 predefined locations was also available within the center (Akbaş & Akdoğan, 2001). In 1999, RFID technology was used for Road and Traffic Notification System which allowed drivers to be notified about weather and traffic conditions in real time throughout the Bolu Mountain Range passages (DATEL, 1999). Again in 1999, Electronic Toll Collection System (OGS) has been realized for passages through intercity bridges and main arterials which was later on followed by Card Pass System (KGS), where drivers would have to register their personal cards through toll collection gates. This

application was then evolved into what is currently being used, Fast Passage System (HGS) which is based on assessment of number of axles and wheelbase of a vehicle and the amount of fee is decided upon automatically (Yalçın & Büyük, 2014).

Starting with 2000s, Intelligent Transportation Systems have been developed in Turkey with the partnership from private sector. For instance, development of Ankara Traffic Information System, ITS İstanbul project, implementations of Variable Message Signs by General Directorate of Highways, which aims to notify drivers about road conditions and share traffic information are some of the exemplary projects, developed through public-private partnerships (Çapalı, 2009). In 2006, General Directorate of Security and İstanbul Metropolitan Municipality have developed a partnership to install electronic enforcement systems in the city, which still is quite active in traffic safety management of the city (Ilıcalı & Kızıltaş, 2016). General Directorate of Highways has initiated a project between 2005-2010 to establish 144 automated, vehicle counting and classifying stations all over Turkey (Yılmaz, 2012). Starting from 2010, Intelligent Transportation Systems have become more widespread and was applied for public transport in the form of intelligent bus stops where bus arrival times, information and directions about alternative transit modes, bus occupancy level and route information. Additionally, mobile applications such as YOLBUL have been developed by many authorities (Katanalp, Yıldırım, Eren, & Uz, 2018).

Developments in the field of Intelligent Transportation Systems such as the ones given above, have also influenced the policy makers to define strategic and essential steps to be taken, to be able to guide the smart mobility transformation of the country. Next section will provide a detailed review of official documents which were aimed to govern smart mobility policies of Turkey.

III.III.II. Policy Overview of Turkey's Smart Mobility Agenda

Many policy documents which mention Intelligent Transportation Systems have been developed by Turkish official institutions starting from 2000s. The most important document about the subject is with no doubt, "National Intelligent Transportation Systems Strategies and Action Plan" (from now on, this document will be referred as ITS-SAP), which was released in 2014 by Ministry of Transportation, Maritime Affairs and Communications. This document can be considered as the first document of Turkey which completely focuses on smart mobility and Intelligent Transportation Systems. Other documents which will be highlighted below are also mentioned as milestones within the ITS-SAP while the purpose of ITS-SAP has been defined as the requirement of a separate, more detailed and focused strategy document which also could provide vision and guidance to transformation towards the use of Intelligent Transportation Systems.

The first official document where Intelligent Transformation Systems are referred is the 9th Development Plan, which covered the development strategies to be applied in the years of 2007-2013 and was created with the coordination of State Planning Organization and with the participation of all public bodies and authorities (Devlet Planlama Teşkilatı, 2006). The vision of 9th Development Plan was explained as *"Turkey that grows with stability, distributes income more evenly, has global competition ability, transforms into information society and completes the process of adaptation to the European Union".* 9th Development Plan put a specific emphasis on the effective use of information and communication technologies to stay competitive in the rapidly developing world. Additionally, EU Member countries' transportation was evaluated. In the 9th Development Plan it was stated that EU Member countries had an emphasis on sustainability principle which states that instead of increasing the capacity of the existing network, management of travel demand and traffic through information technologies is gaining importance and attention. One of the main development axes of the 9th Development Plan was

defined as Improvement of Energy and Transportation Infrastructure and within the transportation developments, it was stated that traffic safety for each transportation mode will be increased, existing infrastructure will be protected and the efficiency of the existing infrastructure will be increased through the maximum utilization of information and communication technologies. Furthermore, the document stated that Urban Information Systems will be developed and promoted to be able to satisfy information requests of the general public, to provide basis for transportation etudes and to gather and regularly update data regarding existing urban transportation network and travel demands.

Similarly, in 2009, Ministry of Transport has released the ministry's Strategic Plan targeting the years of 2009-2013 (Ulaştırma Bakanlığı, 2009). The document provided brief information about the Ministry itself and working principles and responsibilities. Additionally, the document is notable with multiple questionnaires with rural authority members as well as central officers. Furthermore, questionnaires and Ministry's activities were evaluated by outer stakeholders (stakeholders who represent another institutions) and each stakeholder was asked to share opinions and insights. One of the comments from outer stakeholders was provided by Konya Metropolitan Municipality which stated that there are (at the time) 8 ministries and 3 general directorates who had certain amounts of responsibilities regarding traffic and this number should be diminished (Ulaştırma Bakanlığı, 2009). A detailed SWOT analysis provided by the document defines one of the weaknesses as the limited ability to adapt to technologic innovations and applications in the world, which could directly be related to Turkey's much later adaptation to Intelligent Transportation Systems. Furthermore, limited attention on technological and scientific developments and the tendency towards applications based on short-term is represented as one of the threats in the same analysis.

The mission of the Ministry was defined as *"provision of transportation and information and communication technologies to all citizens in a high-quality, balanced, safe, environment-friendly, fair and affordable way"* while the vision was

explained as *"to leverage transportation and information and communication technologies at a high civilization level which promotes global competitiveness ability of the country while increasing the quality of life of its citizens".*

The strategic goals of the plan are given in the following sections of the document. The second strategic goal was defined as *"More efficient regulation, application and supervision to enable a sustainable transportation system where safety of people and goods is provided at the highest level".* In relation to this goal, Target 2.4 was defined as *"Utilization of Intelligent Transportation Systems to contribute towards higher safety of road and rail transport".* Key Performance Indicators as well as required public funding for all targets is included in the strategic plan document. Key performance indicators of Target 2.4 were defined as the number of Intelligent Transportation Systems being in use or the total value of such systems. In this regard the project of "Development and Implementation of Intelligent Transportation Systems" is claimed to require 10.000.000 YTL (roughly 2.630.000 TL at today's value) each year of the plan, adding up to 50.000.000 YTL (roughly 13.150.000 TL at today's value).

In 2010, TÜBİTAK (Türkiye Bilimsel ve Teknolojik Araştırma Kurumu – The Scientific and Technological Research Council of Turkey) under the authority of Ministry of Industry and Technology has released the "National Science, Technology and Innovation Strategy" (from now on referred as NSTIS) report, targeting the five years period between 2011 and 2016 (TÜBİTAK - Türkiye Bilimsel ve Teknolojik Araştırma Kurumu, 2010). The vision of NSTIS was defined as *"Turkey that can transform created knowledge and technology into innovative products, processes and services for the benefit of the country and humanity".* The report stated that information and communication technologies as a field was noticeable with its strong potential for research and development and innovation. Furthermore, it was elaborated that information and communication technologies had a high potential of finding markets in foreign countries. Additionally, it was concluded that research investments in this field had a high

potential of becoming a final product or service. Annually, according to the table provided in NSTIS, in regards to information and communication technologies, in 2008 422.000.000 TL has been spent on R&D, 3678 researchers have studied the topic, 3 billion US dollars have been gained through exports and 12 billion dollars have been spent on imports (TÜBİTAK - Türkiye Bilimsel ve Teknolojik Araştırma Kurumu, 2010). In 2011, Ministry of Transportation has released Turkey's Transportation and Communication Strategy, Target 2023" (T.C. Ulaştırma Bakanlığı, 2011). In report's general overview section, it was stated that developments regarding computer and communication technologies influenced transportation sector positively, through provision of Intelligent Transportation Systems which provide benefits to vehicles, roads, signalization and demand responsive governance of the system. The vision of the transportation sector was defined in the report as *"To develop a transportation system which supports competitive power of the country and increases society's quality of life through provision of safe, swift, environmentally friendly, uninterrupted, balanced and sustainable contemporary services".* The report also proposed strategies and suggestions for road transport sector. Under institutional structure and legal regulations chapter, it was proposed that a Master Traffic Management Center should be established to gather data of passenger and goods transport and to evaluate and analyze data. Also, under the operation and superstructure chapter, it was claimed that to improve mobility, Intelligent Transportation Systems and Traffic Management Systems are to be used. Finally, under the final evaluations chapter, infrastructural needs of Intelligent Transportation Systems have been mentioned and it was stated that fiber optic network provision will be supported for the communication needs of such systems. Furthermore, one of the sectoral expectations was defined as the provision of safe transport through the use of Intelligent Transportation Systems. Similarly, standardization of Intelligent Transportation Systems and promotion of such standards have been defined as one of the Research and Development targets of the report and a specific mention has been made for commonization of Electronic Enforcement Systems.

Another important document regarding Intelligent Transportation Systems is the "Road Transport Safety Strategies and Action Plan" which was released in 2012 with the leadership of General Directorate of Security, supported by various ministries and general directorates (Emniyet Genel Müdürlüğü, 2012). The strategy document can be divided into two main parts. The initial part described the strategies that are to be developed during the target years while the second part evaluated traffic safety in multiple parts and gave a table of summaries of related decisions. In the first part, Intelligent Transportation Systems were mentioned as one of the steps to achieve safer roads. According to the strategy, maximum utilization of Intelligent Transportation Systems such as traffic sensors, cameras, variable message signs, lane violation detection systems, sensors which are able to manage traffic lights; and also, to deliver incentives for research and development by industry and academia and do so while promoting international standards. Furthermore, traffic supervision and rule enforcement mentioned through the use of automated Intelligent Transportation Systems which can enforce speeding, use of alcohol, not wearing a seatbelt, red light violation, use of mobile phones while driving and so on.

The second part of the strategy document as mentioned earlier, provides general summaries regarding the actions mentioned within strategies. The main topics of the related were divided into the subjects of training, supervision, infrastructure, health, campaigns or projects. Under infrastructure subject, it was mentioned that by the decision of General Directorate of Highways, 18 Traffic Control Centers were planned to be built to spread the use of Intelligent Transportation Systems. It was stated that the building projects of these centers were initiated and by 2015, 3 out of 18 were intended to be built and by 2020, this number was expected to reach 18.

One of the more recent documents which mentions Intelligent Transportation Systems is the "Information Society Strategy and Action Plan" which was released by Ministry of Development, General Directorate of Information Society on

February, 2014 which was targeting the years of 2015-2018 (Kalkınma Bakanlığı, 2014). A noticeable quality of the document is that previous strategy documents are evaluated in the initial chapters. Each main axes of a previous strategy document are listed and success rate is evaluated. The strategy document claims its focus as growth and employment and continues by evaluating the global scene and orientations. Under "Innovative Solutions Powered by Information and Communication Technologies" section, it was explained that roughly 52% of the global population is residing in urban areas which fuel occurrence of problems in many sectors, including transportation sector. The section in following pages also evaluated the implementation of intelligent applications were observed mainly in transportation and urban services sector. According to a questionnaire completed with the participation of staff from 40 municipalities, the main implementation fields of Intelligent Transportation System were intelligent parking meters and fee collection, fleet tracking, maintenance and location services and integrated public transit ticketing systems. One of the outcomes of the section, Intelligent Transportation Systems were described as a contributor of safer, faster, highly comfortable, affordable and environmentally friendly transportation.

Following sections of the document are aimed to describe the strategies and targets of 2018. One of the targets were described as to boost development of Intelligent Transportation Systems through achieving coordination between applications of different institutions. Furthermore, one of the steps of this action was described as the development, creation and application of a coordinated and a holistic Intelligent Transportation Systems Action Plan.

This holistic plan was prepared on May 2014 Ministry of Transportation, Maritime Affairs and Communications which was named National Intelligent Transportation Systems Strategies and Action Plan (ITS-SAP)" (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014).

III.III.II.I. National Intelligent Transportation Systems Strategies and Action Plan (ITS-SAP)

ITS-SAP is an essential document since it is the first document that completely put the attention on Intelligent Transportation Systems. This "delayed" preparation is also mentioned in the beginning of ITS-SAP and it was claimed that even though multiple policy documents have mentioned implementations of Intelligent Transportation Systems, no document that discusses the subject with a holistic approach has been prepared. The document was prepared at a workshop which was participated by all stakeholders. ITS-SAP also provides a brief explanation about how Intelligent Transportation Systems are utilized. According to ITS-SAP, Intelligent Transportation Systems can generally be described as technologies which enable communication between passengers, road network and vehicles and these technologies are further elaborated as global positioning services (GPS), wireless/mobile/infrared communication technologies, closed circuit television (CCTV), various short-range communication technologies, and safe travel assistants for drivers (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014). An Intelligent Transportation Systems architecture was also defined as the methodology of how and where mentioned technologies should be applied, which ones should be used and which standards should be followed.

According to ITS-SAP, Turkey has available potential for application of Intelligent Transportation Systems due to its population structure, informatics, communication and industry infrastructure. Although Turkey has this potential, the lack of integration and coordination between application, limitations of regulations and standardization, lack of personnel who has expertise and the dependency to foreign industries are defined as major problems which limit the growth and spread of these technologies.

2023 vision of Intelligent Transportation Systems has been announced as *"Turkey, integrated with the world; where all transportation services are governed and directed with the use of information and communication technologies".* The general objective of ITS-SAP was further explained as *"Enabling easier mobility of people and goods which is integrated, safe, efficient, innovative, environmentally friendly, sustainable and smart, through the use of real time for all transportation modes"* (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014).

5 major strategic objectives are selected which are in line with the vision and the general objective as given below:

- Development of administrative and technical legislation based on national and international needs with the purpose of nation-wide planning and integration of Intelligent Transportation Systems,
- Development of a globally competitive Intelligent Transportation Sector,
- Increasing the mobility and traffic safety through the generalization of Intelligent Transportation Systems throughout the country,
- To ease the access to transportation services for citizens with reduced mobility,
- Lowering the fuel consumption and emissions caused by road transport (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014).

ITS-SAP is aware that to be able to apply the policies above, a legislative organization is needed. For that reason, it was suggested that a "Monitoring and Directing Committee" should be formed where all stakeholders are represented. This committee was formed later in 2015, by the release of a memorandum from the Prime Minister's office which defines the role of the committee as to evaluate applications of Intelligent Transportation Systems, serve as the authority to follow up on the strategy activities, to promote communication between private sector, universities, non-governmental organizations and the public, and lastly to promote cooperation between stakeholders (T.C. Resmi Gazete, 2015).

The committee serves under the authority of Ministry of Transportation, Maritime Affairs and Communication, General Directorate of Strategic Development.

ITS-SAP was completed with the participation of General Directorate of Highways, Council of Information Technologies and Communication, TÜRKSAT Satellite and Cable TV Inc., Ministry of Development, Ministry of Internal Affairs, Ministry of Science, Industry and Technology, Ministry of Finance, Ministry of Environment and Urbanism, Ministry of Energy and Natural Resources, TÜBİTAK, General Directorate of Security, General Commandership of Gendarmerie, Metropolitan Municipalities, Universities, related NGOs and private sector representatives; and under the coordination of Ministry of Transportation, Maritime Affairs and Communication.

ITS-SAP gives a very detailed explanation of the historical overview of Intelligent Transportation Systems applications as well as the worldwide development of systems, strategies and standards. Later on, individual examination of Intelligent Transportation Systems implemented in different countries. Lastly, policy documents prepared by Turkish Authorities are evaluated. Additionally, Turkey's implementations are briefly discussed.

ITS-SAP has included a detailed SWOT Analysis where strengths focused at the existing potential of the country while weaknesses focused towards the lack of legislative regulations and lack of strategies. Opportunities mostly focused on arising need for Intelligent Transportation Systems and threats focused on competitiveness of international scene and lack of a roadmap.

Table 5: SWOT Analysis on ITS-SAP (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014)

STRENGTHS	**WEAKNESSES**
1. Population structure being able to easily adapt to new technologies **2.** Will to apply Intelligent Transportation Systems of related institutions **3.** Entrepreneurship potential towards Intelligent Transportation Systems **4.** Turkey being an important automotive industry hub **5.** Common and modern communication infrastructure **6.** Turkey's advancement towards becoming an information society **7.** Investments in the field of informatics	**1.** Lack of integration between institutions and infrastructure **2.** Lack of common Intelligent Transportation Systems terminology and standards **3.** Lack of institutional and personal awareness towards Intelligent Transportation Systems **4.** Lack of expert personnel in Intelligent Transportation Sector **5.** Lack of legislations **6.** Lack of a national Intelligent Transportation Institute which covers all stakeholders **7.** Limitations of incentives toward Research and Development **8.** Lack of middle and long-term planning about Intelligent Transportation Systems **9.** Lack of coordination between university-industry-institutions **10.** Inexperience of hardware and software development about Intelligent Transportation Systems
OPPORTUNITIES	**THREATS**
1. International technology and knowledge transfer due to the partnership with ERTICO **2.** Need for Intelligent Transportation Systems due to increasing number of highways, viaducts, tunnels, bridges **3.** Increasing demand for transport due to increasing urbanism and young population **4.** Increasing mobility in work life **5.** Tendency towards increasing awareness for energy efficiency and environmental protection **6.** Turkey's approximation to markets where Intelligent Transportation Systems are not yet common	**1.** High cost of Intelligent Transportation Systems applications **2.** Dependency to foreign technology for development of Intelligent Transportation Systems **3.** Lack of active participation to international Intelligent Transportation Systems platforms **4.** Globalization and increasing international competitiveness

ITS-SAP, as mentioned before, has declared 5 main strategic objectives and for each objective, multiple targets have been defined. For the first strategic objective, "Development of administrative and technical legislation based on national and international needs with the purpose of nation-wide planning and integration of Intelligent Transportation Systems"; targets were basically about development of an Intelligent Transportation Systems architecture, definition of organizational and legislative regulations and to develop a systematic planning and coordination process for implementations.

The second main strategic objective, "Development of a globally competitive Intelligent Transportation Sector"; defined its targets as the commonization of Intelligent Transportation Systems through the participation of all stakeholders, promotion of domestic hardware and software development, promotion of entry to foreign markets with Turkish products of information and communication technologies, increasing the number of Intelligent Transportation Systems experts and promotion of research and development in smart vehicle technologies.

The third main strategic objective, "Increasing the mobility and traffic safety through the generalization of Intelligent Transportation Systems throughout the country", mainly discussed promotion of traffic safety and mobility through the use of Intelligent Transportation Systems. The targets of the objective were defined as, improvement of necessary infrastructure, increasing the efficiency of urban and intercity road network through applications, commonization of e-payment systems, increasing the use of Intelligent Transportation Systems on public transit and improvement of passenger notification systems, commonization of fleet management systems, improvement of communication between centers and in field equipment and services, promotion of traffic safety, improvement of incident and emergency management systems and promotion of Intelligent Transportation Systems for intermodal transport.

Fourth main strategic objective, “To ease the access to transportation services for citizens with reduced mobility” puts main focus on accessibility, especially for citizens with reduced mobility. In this main objective, the targets mention the regularization of transportation infrastructure and public transportation fleets to be able to provide a safer and more efficient service for elderly, children and disabled.

Lastly, the fifth main strategic objective, “Lowering the fuel consumption and emissions caused by road transport” similar to the fourth objective, had a brief explanation of targets, which were development of energy efficient, environmentally friendly Intelligent Transportation Systems, and developing solutions which will promote lowering the emissions caused by urban transport.

III.III.III. Final Remarks on Turkey’s Intelligent Transportation Policies

Turkish authorities have developed many policy documents which are discussed in previous chapter. The most noticeable aspect of majority of these documents is the focus on traffic safety. Intelligent Transportation Systems are mostly seen as a tool which will promote safety in traffic. To further strengthen this, some of the documents put a specific focus on commonization of electronic enforcement systems. It is obvious that automated tracking of rule violations would promote traffic safety and also increase efficiency of detection by decreasing the needed number of field personnel. But it would be wrong to assume that Intelligent Transportation Systems are only to be used for traffic safety.

More recent documents, especially ITS-SAP increased the span of policies regarding Intelligent Transportation Systems. Strategies regarding improvement of infrastructure or installation of modern Traffic Control Centers have been mentioned. Furthermore, Intelligent Transportation Systems have been mentioned in relation to mobility, which is a positive outcome since Intelligent Transportation

Systems are seen as a method of increasing mobility in a sustainable way (United Nations, 2012).

The concept of sustainability also comes across as a main strategy in most of the documents. Mainly, it can be seen that reduction of emissions and being environmentally friendly are mentioned in line with achieving sustainability.

Achieving efficient implementation of Intelligent Transportation Systems are closely related to the existing legislations and standardization. Often in the documents, these subjects are seen as an issue for Turkey. Lack of standardization in line with international standards, not having an organization which will maintain the applications of Intelligent Transportation Systems, the need for a rulebook which regulates such applications are mentioned. The establishment of a committee in 2015 should be seen as a positive step towards forming an authority for Intelligent Transportation Systems. Furthermore, development of ITS-SAP which is holistic in the sense of touching upon majority of the subjects related to Intelligent Transportation Systems should also be considered as an essential regulation attempt.

Nonetheless, ITS-SAP is also lacking in certain aspects. For example, ITS-SAP mentions the need for developing a nation-wide Intelligent Transportation Systems architecture. The action plan only refers to preparation of a "Intelligent Transportation System Terminology Dictionary" and with the participation of certain stakeholders, preparation of the architecture. It is stated that this architecture is in line with common standards and to provide interoperability but no method of achieving so, is discussed.

Furthermore, some targets defined in the document are not well-developed and does not represent a true roadmap. For example, under the third strategic objective, it is stated that necessary regulations should be made for infrastructure and road network. Yet, these essential regulations are not clear. The only mention is made about lane violation detection systems which were to be mandatory starting from

2014. For that reason, lanes on the roads should be standardized. Most importantly, the mention regarding promoting accessibility and lesser emissions are left very brief and the methods are not very clear either. A project named "Seeing Eye" has been developed in partnership of Ministry of Transportation, Maritime Affairs and Communication and Ministry of Family and Social Policies which covers the development of a mobile application for visually impaired citizens which is aimed to help them travel easier (Gorengoz.net, 2011). Within the action plans of ITS-SAP it was mentioned that within 2014-2016 period, feasibility studies for the projects will be finished. But there was no mention of elderly, children and their accessibility and increasing their mobility. Furthermore, one of the targets were defined as regulation of public transportation fleets in a certain way which will increase the efficiency and safe service to elderly, children and disabled. The only action in this regard was defined as provision of coordination for the implementation of the decisions since public transportation fleets are run by private entities. No clear definition about the transformation or detection of the sources of the problem is defined or a solution is proposed.

All this proves that, even though ITS-SAP is valuable in the sense of being the first detailed strategy document about commonization of Intelligent Transportation Systems, it still lacks a comprehensive roadmap to provide detailed solutions. Certain aspects of urban transportation are generally overlooked, and targets are very limited to a few actions. These actions also lack a broader scope. It can be said that, a new document should be prepared where all aspects of Intelligent Transportation Systems are taken into consideration in detail, in depth solutions are prepared to problems and how much of the actions defined in ITS-SAP is completed or achieved.

CHAPTER IV

TRANSPORTATION AND INTELLIGENT TRANSPORTATION SYSTEMS IN KONYA

IV.I. General Overview of Transportation in Konya

Konya, located in Central Anatolia Region is the largest city in Turkey by its area coverage (41.000 square kilometers) and the 7th most populated (2.205.609 as of 2018) (Turkish Statistical Institute, 2018). Konya has been a Metropolitan Municipality since 1987 and since 2014, city borders have become the Metropolitan borders as well.

According to the interviews, Department of Transportation Planning and Traffic of Konya Metropolitan Municipality is responsible for the complete bus management including the provinces and rail transport management systems. Additionally, they work on transportation planning and traffic signalization. One of the most important duties of the department has been defined by a municipal officer as making of Transportation Master Plans. Within the context of sustainable transportation, Konya Metropolitan Municipality has had Konya Transportation Master Plan of Konya Metropolitan Urban and Nearby Area prepared in 2000 which had the target year as 2020. Later on, the plan was revised in 2015.

The revised Transportation Master Plan has had the focus on increasing mobility and accessibility while boosting transportation comfort for all citizens. Meanwhile, the plan also has had the aim of creating sustainable solutions to all urban

transportation problems without damaging the natural resources (İçli, Karaşahin, Büyükçay, & Taner, 2018). The strategy of the plan was to provide high and effective accessibility while supporting regional economy, protecting and developing socio-cultural values of the city.

The contents of "Konya Transportation Master Plan Results Report" has been acquired from the representatives of Konya Metropolitan Municipality, Department of Transportation Planning and Traffic, Division of Transportation Planning for the sole purpose of furthering research for this study.

The purpose of the Transportation Plan has been announced as to develop the basis for planning decisions regarding expected transportation and traffic system of Konya, which takes expected travel demands for the projection year into consideration while deciding on primary investments that are preliminary focuses on public transportation, and following the proposed strategies of Konya's Master Development Plan (Boğaziçi Proje, 2015).

According to Address Based Population Registration System data acquired from Turkish Statistical Institute, 2017-2018 population of Konya is 2.205.609 (Turkish Statistical Institute, 2018). Roughly 75% of the population lives in the Konya Central Urban Area while 25% lives outside of this area (Boğaziçi Proje, 2015).

When officials are asked about if any personal education effort is pursued, one of the officials have said that they have a M.Sc. degree in urban transportation systems from Bahçeşehir University and currently they are working on Ph.D. degree in Business Management in Trade Chamber University. Furthermore, one of the officials also mentioned municipal trainings. According to the official, technical team is sent to trainings hosted in Turkey or in other countries. Motivation for pursuing different informative activities, and ease of access to new information is always provided. Especially, participation in fairs, events, conventions is very important for the Municipality as well as provision of municipal seminars.

The city of Konya is within the jurisdiction of 3rd Regional Directorate of Highways. This authority has control over a total of 1397 kilometers of State Road and 1654 kilometers of Provincial Road. The main inter-city road network of the city is D-300 State Road which connects İzmir to Iran. Some other State Roads such as D-330 and D-715 are also passing through Konya. This indicates that Konya is located at the crossroads of multiple inter-city routes. The connection of these roads through the Konya Metropolitan Municipality borders is provided with 2 or 3 lanes separated roads and this brings more pressure on urban transportation in Konya. Furthermore, some parts of these roads are under the responsibility of the Metropolitan Municipality authorities. The metropolitan area has a total of 194 signalized junctions. Currently, 15 of these junctions have signal coordination (green-wave) system, 49 of them have Dynamic Junction Control System and additional 14 junctions are connected to Konya Traffic Control Center (Konya Traffic Control Center, 2019). Below image shows the signalized junctions in Konya Central Urban Area with red dots.

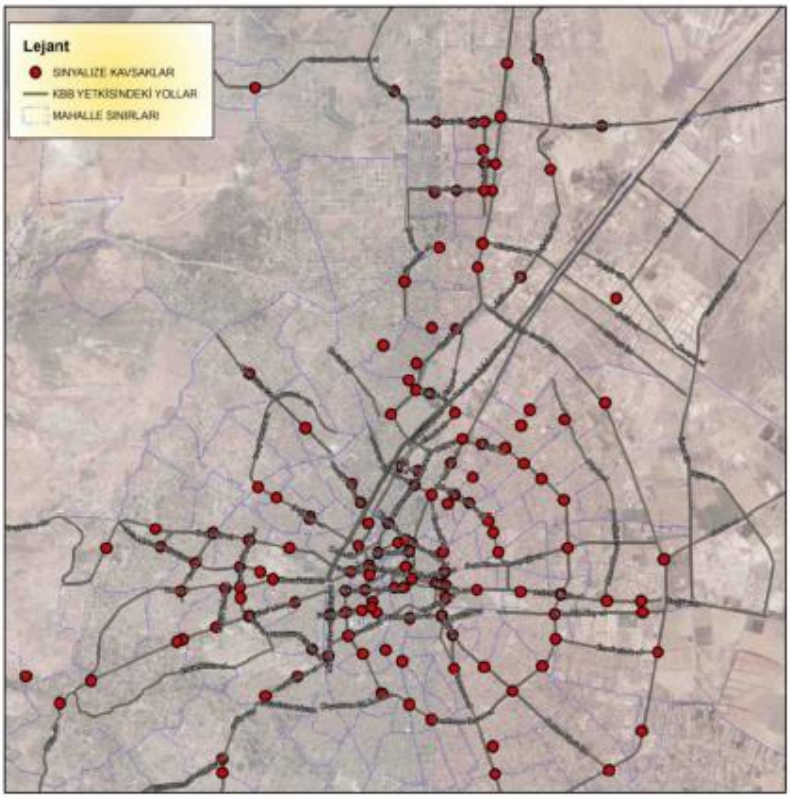


Image 3: Signalized Junctions in Konya (Boğaziçi Proje, 2015)

Konya Metropolitan Municipality officials, when asked about the most important transportation problem in the city or for the municipality, they have said that Konya currently does not have a Traffic Control Center. They have shared comments about how current system is being controlled. According to the municipal officers, they keep the systems in check by sparing from personal times and putting in extra effort since they do not have traffic operators to monitor the systems 24/7. They have said that a Traffic Control Center similar to the examples in other metropolitan cities, such as İstanbul, they will be able to manage all junctions from a single center and increase the efficiency of the system and have much lower response times when any type of problem occurs. They also have said that having a Traffic Control Center, will allow them to govern Smart Mobility implementations in a much professional manner. Currently, there is an active project for the design of a modern

Traffic Control Center where traffic operators will be able to work professionally to monitor the transportation network.

IV.I.I. Public Transportation

Public Transportation in Konya is controlled through Municipality Bus Management, Municipality Tramway Management and Minibus Cooperative (Boğaziçi Proje, 2015). Metropolitan Municipality serves the public with 325 busses and 60 tram vehicles. Municipality owned public transportation can be used through "Elkart" the smart boarding card. Elkart provides discount transfers between services and varying fees for students, elderly or disabled. There are 7 Bus Mobility Centers throughout Konya, namely Alakova, Aydınlık, Eski Garaj, Erenköy, Meram, Samanpazarı and Yazır Bus Movement Centers. Tramway paths have reached to 18,9 km on Cumhuriyet-Selçuk Üniversitesi line and 3,5 km within the Campus. Tramway system has two Mobility Centers and one depot and the total number of stops are 31. Tramway is active 24 hours a day and on average 312 trips are made with 60 vehicles and 95.700 passengers are carried (Boğaziçi Proje, 2015). Konya Metropolitan Municipality seeks to improve the quality of public transportation and for that reason, Konya Metropolitan Municipality participates in research and development activities. Konya Metropolitan Municipality currently has two active projects, one of which is done in cooperation with a private company where all data from Elkart, covering 15 months (May 2018 to July 2019) is given for further analysis. The R&D project aims to detect inefficient public transportation lines, lines that are used mainly for transfer to other lines, seasonal passenger behavior analysis, bus stops with high demand and optimization of the lines. Additionally, Elkart data is aimed to be used for OD detection from only boarding information.

There are 530 minibuses used within Konya on 26 different lines. Minibuses cannot serve on different lines other than the defined lines but minibuses can change their frequency of service and the number of trips. Lastly, there are 892 service vehicles operating in Konya, 70% of which are operated by private companies and the remaining are operated personally. There are 687 taxis operating in Konya at 76 taxi stops. There are 412 available taxi number plates under the ownership of Municipality. Finally, there are two intercity bus terminal in the city in which rural area buses are also dispatched, as well as railways connecting Konya directly to Adana, Afyon, Kütahya, Eskişehir, Uşak, Manisa and İzmir, and high speed railway, connecting Konya to Ankara, and an airport serving since 2000 located on the northwest of the city with 28 km distance from the City Center (Boğaziçi Proje, 2015). Parking areas are mainly concentrated in the central urban area of the city. All of the central parking areas are integrated to Konya Traffic Control Center as assets of the Municipality and information regarding parking area occupancy information can be published through Variable Message Signs (VMS) in Konya Central Urban Area (Konya Traffic Control Center, 2019). Below image shows some of the central parking area locations in Konya.

When officials are asked about integration of smart mobility implementations which are mainly focusing of transportation with automobiles, they mentioned that they intend to increase the efficiency of multi-modal transportation. For instance, they have mentioned a Bicycle Master Plan project which is expected to be over in a short amount of time, is developing policies for multi-modal integration. Elkart, which is used for public transportation boarding, will be integrated with bicycles, and bicycle parks will be built with parking enabled through Elkart. Next boarding after usage of Elkart at a bicycle park is intended to be free for one hour. Furthermore, the officials are planning to build parking areas near tramway stations which should ease the use of different transportation modes. To further elaborate, the officials have said that another plan for public transportation is to optimize public bus lines and vehicle frequencies to lower the waiting durations in bus stops. This was also considered as one of the most important future plans since outside

the holiday seasons, roughly 107 thousand kilometers are covered through public transportation. For that reason, they are working on optimization studies to diminish the total distance covered by municipal buses.

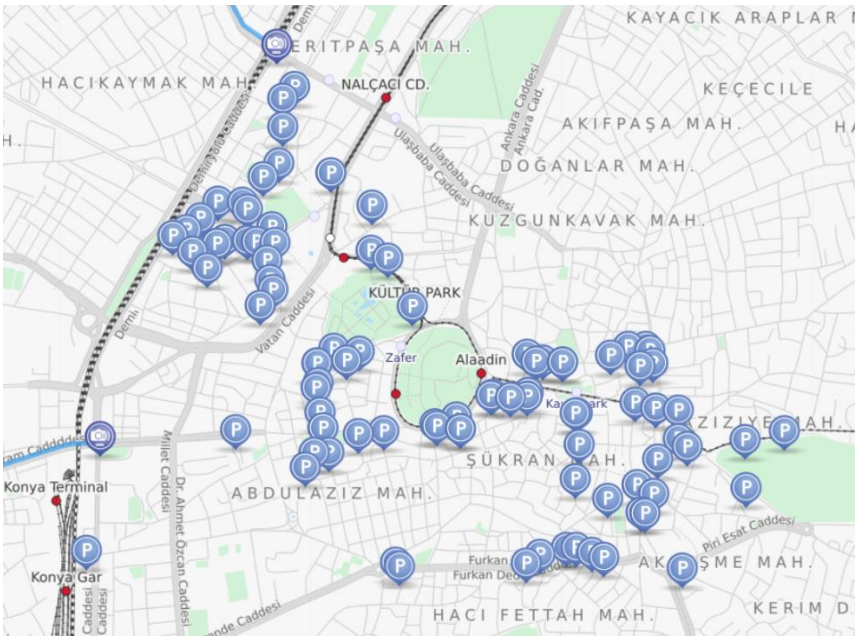


Image 4: Some of the Parking Areas in Konya Central Urban Area (Konya Traffic Control Center, 2019)

IV.I.II. Pedestrian Access

Pedestrian access in Konya Metropolitan Area is also an important focus for Konya Metropolitan Municipality. An important pedestrianization project of Konya Metropolitan Municipality has been completed on Kazım Karabekir Street (Zafer) where social amenities such as shopping areas, restaurants and cafes are located and this project is considered as a successful addition to recreative areas in Konya. Lastly, Konya Metropolitan Municipality has also invested in Intelligent Bicycle System. The implementation of the system has started in 2010 and finished in roughly 18 months. The system serves with 500 bicycles and has a total of 38

bicycle stations throughout the Konya Central urban Area. The system had 24.000 members registered but has 12.000 active users (Boğaziçi Proje, 2015). In 2001, bicycle roads have been started to be built in Konya which currently adds up to 144.300 m. in distance.

VI.II. Key Statistics for Transportation of Konya

According to household surveys, average household size in Konya is 3,67 (Boğaziçi Proje, 2015). The table below shows the population and household size information for three Central Urban provinces.

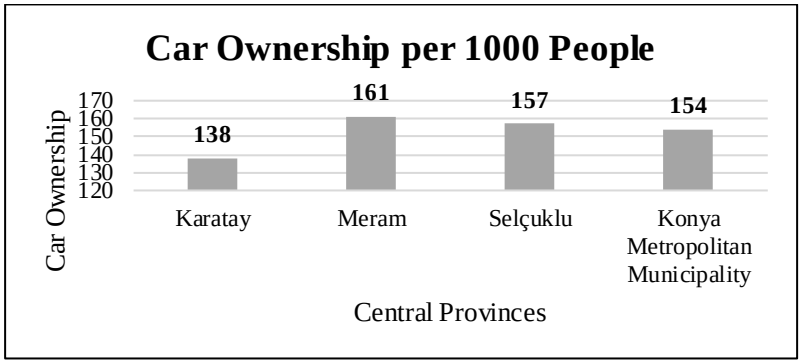
Table 6: Population and Average Household Sizes of Konya (Boğaziçi Proje, 2015)

Province	Population	No. of Residences	Household Size
Karatay	249.461	63.758	3,91
Meram	295.967	82.163	3,60
Selçuklu	507.359	141.010	3,60
TOTAL	**1.052.787**	**286.931**	**3,67**

As an addition to the household size statistics, it is important to understand the car ownership rates of Konya as it provides some key information regarding current transportation trends of Konya Metropolitan Area. At the time of the household surveys, it was detected that there are 276.295 vehicles in Konya and 58% of these vehicles are cars while 30% of it are bicycles (Boğaziçi Proje, 2015). As of 2018, the number of motorized vehicles in Konya was 724.139 and the number of cars registered in Konya was 353.301 (Turkish Statistical Institute, 2019).

Based on Turkish Statistics Institute, in 2012, average car ownership in Turkey per 1000 people is 114 (Turkish Statistical Institute, 2012). In Europe, the same rate is 419 (EUROSTAT, 2009), which shows that Turkey is quite below the average car ownership rate when compared with Europe. A previous household survey completed in the provinces of Konya Central Urban area, for which the results are presented above, shows that car ownership per 1000 people was 102 in 2000. In 2012, average car ownership per 1000 person in Konya is around 154 (Turkish Statistical Institute, 2012). According to this, car ownership has increased by 50% in 12 years (Boğaziçi Proje, 2015).

Average car ownership per 1000 person in Konya has risen to 160, while the number is 151 for Turkey (Turkish Statistical Institute, 2019).

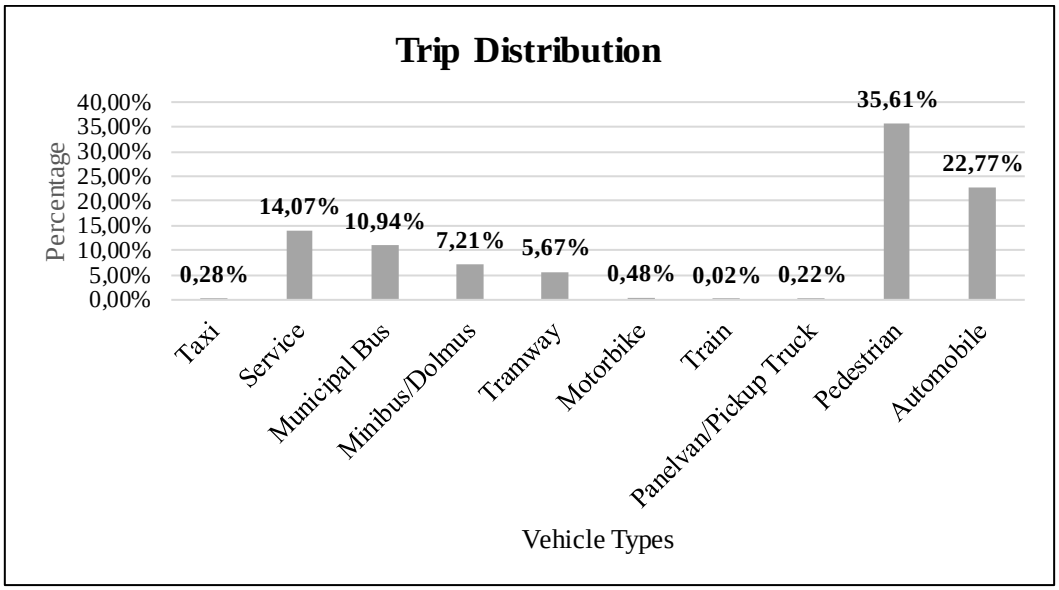


Graph 1: Car Ownership of Central Provinces (Boğaziçi Proje, 2015)

Gross and net mobility statistics are also gathered in the context of Konya Transportation Master Plan. According to household surveys gross mobility rate in Konya is 1,45 while net mobility rate is 2,21 (Boğaziçi Proje, 2015).

Table 7: Mobility Rates Based on Household Surveys (Boğaziçi Proje, 2015)

Trip Purpose	Gross Mobility Rate	Net Mobility Rate
Home-Based Work	0,45	1,97
Home-Based School	0,52	2,01
Home-Based Other	0,42	2,08
Not-Home-Based	0,06	1,52
Total Trips	**1,45**	**2,21**



Graph 2: Trip Distribution Based on Preferred Vehicle (Boğaziçi Proje, 2015)

According to the household survey completed for Konya Transportation Master Plan, it can be seen that pedestrian activity is quite high in Konya with 35,61% trips are done by walking. The second highest preferred transportation mode is automobiles with a rate of 22,77%.

IV.III. Overview of Smart Mobility Initiatives in Konya

As stated before, Konya Metropolitan Municipality has advanced in Smart Mobility field. The transformation process towards Smart Mobility has been asked to all interviewees to be able to understand the process. One of the municipal officials have also mentioned that higher numbers of automobile use is putting too much pressure on the transportation infrastructure. As a solution, improving smart mobility elements and increasing the provided number of systems has been offered by the officials. Furthermore, it was claimed that improvement on municipal side would not be enough, for that reason, traffic culture seminars are devised by the municipality to inform the public.

When officials are asked to evaluate their transformation process, one of the interviewees have claimed that they are the leading Turkish city in Smart Mobility field. But, to be able to keep this leader position if all steps are taken with caution. He also mentioned that the biggest problem of smart cities is being vulnerable to cyber-attacks. He claimed that Konya Metropolitan Municipality is always aware of such risks and considerate of precautions. Also, technical infrastructure to be able to implement Smart Mobility incentives is quite important and Konya is most likely to be the first city which has quite high lengths of fiber-optic infrastructure. Still, another official mentioned that Konya is in need of enhancing and training the technical team. This allows faster data transmission which enables a faster analysis of these collected data. Furthermore, when the value of the transformation is asked to the officials, they have replied with the contribution to a cleaner environment. They have claimed that the efficient use of resources makes smart city implementations essential.

According to the officials in Signalization department, the initial step towards Smart Mobility has started with the participation of the officials to an international annual transportation fair named Intertraffic. During the fair in 2011 which took

place in İstanbul, Konya metropolitan Municipality officials had the chance to see various Smart Mobility implementations. One of which, developed by ISSD, a company based in Ankara, have described their systems, which are detailed in following sections. Previously, Konya Metropolitan Municipality has been approached by an Austria-based company named SWARCO for a similar system but due to their system requiring heavier infrastructural work hence, more financial sources, Konya Metropolitan Municipality did not prefer to evaluate this offer. Furthermore, the financial aspect is quite important for Konya Metropolitan Municipality since for many years, Konya Metropolitan Municipality has sought to develop their own, local and cheaper solutions instead of buying a solution from abroad. Instead of considering the offer by SWARCO, Konya Metropolitan Municipality decided to implement a Proof of Concept on 2 junctions with ISSD's solution. After the Proof of Concept installation, a technical specification document has been prepared by Konya Metropolitan Municipality. The preparation has been followed by tender process, which has been awarded to the local firm. It is important to note that the tender has been prepared solely by this department, which provides some insights regarding the municipal organization. Konya Metropolitan Municipality allows individual branches to develop an idea, and while getting suggestions from other branches, if the idea is valid, entire municipality supports idea owner and gives them complete freedom in policy and decision making. Especially in transportation field, according to an official, any implementation to be made, has to be agreed upon by the transportation management council, which is formed by the members of the Department, decision making can be quite efficient and swift. It was claimed that other municipalities, perform such decisions with dozens of municipal officials, whereas in Konya Metropolitan Municipality, the decision makers are not divided in various branches, instead they work with each other very efficiently.

According to the comments of the officials, in around a year, dynamic junctions and green wave implementations have been completed in 25 junctions. The systems, due to being quite new, were very problematic. Officials claim that they

worked closely with the company in improving the systems. The problems were solved hand-in-hand with the company and many suggestions for research and development were stemmed from the municipal officials. Still, the company works closely with Konya Metropolitan Municipality and municipal officers open up new research and development fields, such as improvement projects for public transportation.

When the officials are asked to share their comments regarding the feedback from the public during that time, was quite harsh. For example, on dynamic junctions traffic light countdown devices cannot work since dynamic junctions regulate green light durations differently on each phase. When the existing countdown devices were removed following the installation of dynamic junctions, public reacted to the officials quite heavily. Also, the junctions were often not functioning, due to system errors, regulation of traffic have been quite difficult which forced the municipal officials to go to the field and visit junctions to detect the source of the problem. Another negative response from the public was received when VMS screens were first installed. The public did not know how the screens will be used and questioned the necessity of the screens in tough economic conditions. But as the systems were online and travel time and available parking space information was accessible for drivers on the go, the reactions have diminished. Even some drivers, have contacted the officials of Konya metropolitan Municipality and demanded an arrangement where screens would represent longer travel times with red, average travel times with yellow and regular travel times in green color. The public has said that this can allow them to change routes accordingly and this would also help with less driving times, hence less emissions and fuel consumption. Lastly, according to the officials' comments, the feedback from the public is usually gathered through research studied and questionnaires, but public can also call "Open Door" hotline to deliver their demands or comments to the municipality 24/7.

When officials were asked about their future Smart Mobility implementations, they have mentioned that, they intend to invest more in research and development. For

instance, they intend to partner with the company once more and improve communication between dynamic junctions. Their intention is to make dynamic junctions notify the next one with the information about approaching vehicles and allow the next junction to update the signal plan of the incoming phase. Furthermore, central government has an ongoing plan for implementing a metro system for Konya. The officials have said that this may bring forth a public service which could be more effective for the next 50 years. They have also claimed that they get inspiration from other cities, especially European cities. Moreover, they have said that they value cooperation with universities and NGOs, within the context of official commissions, depending on the needs of the subject. It was also claimed that NGOs are also working hand in hand with Transportation Management Councils and a participatory decision making is possible.

IV.III.I. Green Wave Application

Green wave implementation is a system where multiple junctions are coordinated through network connection to achieve maximum number of vehicles being able to pass through the junctions. As long as vehicles travelling through the road segment have their speed at an approximately at a given speed limit, the vehicles would always meet green light without having to stop at the green light. The benefit of green wave system is that they lower the waiting times at signalized junctions drastically and promote road safety as the drivers are forced to travel at the speed limit for the urban areas. Green wave systems are unique for every road segment that they are installed. Before installation of a green wave system, the initial step would be to perform vehicle count studies on the road segment to optimize green light durations. Based on the results of these vehicle counts, traffic engineers can define the suitable speed limit, allowing the implementation of a green wave corridor. Theoretically, green wave systems can work adaptively, and change the green light duration for a given speed limit, based on the number of vehicles

travelling at a given direction. Currently, there are no such dynamic applications in Konya except for a static green wave system. The junctions with green wave system installed are; Demiryolu Street, Ali Ulvi Kurucu Street, Fetih Street, Mevlana Street, Şefik Can Street, Karaman Periphery Road, Karaman Street, Aslanlı Kışla Street, Doç. Dr. Halil Ürün Street, Safahat Street and İstanbul Street.

IV.III.II. Dynamic Junction Management

Similar to green wave system, Konya Metropolitan Municipality also has installed Dynamic Junction Control Systems. The working principle of these systems are to count approaching vehicles through means of loop detectors (an infrastructure placed under the roads to measure the number of vehicles) or sensors (such as camera or laser-based systems). Vehicles approaching to junctions are measured through the means given above. A central unit collects all data gathered from each approach of the junctions and defines the optimal green light duration for each cycle (ISSD, 2019). These systems require evaluation and analysis for each junction before installation. Similar to green wave system, traffic engineers are required to evaluate average vehicle counts of the junctions for peak hours and for each approach. Simulations of the junctions are done based on the data gathered by traffic engineers and where necessary, suggestions regarding geometric optimization of the junctions are provided. After completion of analysis process, dynamic junction control systems are installed and through fiber-optic network connection, gathered data is transmitted to the Traffic Control Center. The intelligent junction installations in Konya is provided on below image, taken from the interface of Traffic Management Software. Additionally, without the implementation of dynamic junctions or green wave system, it is possible to remotely monitor the junctions. As it can be seen from the image, dark green icons show the junctions with fixed phase. This means that these junctions are not dynamically controlled, instead they have fixed durations for different times of the day (usually different

signal plans are used on peak hours or after midnight). Through installation of a communication module in the junction, traffic operators of the Municipality are able to view the status of the junction or change signal plans accordingly without having to physically be at the junction. This allows operators to develop fast responses to any unexpected situation, or change signal plans on specific events such as football games, concerts or different weather conditions such as snowy days or days with heavy rain. Furthermore, an interface provides details of each junction, giving information about the phases, green light durations, camera installation points as well as current traffic light situation. The first image below, shows the main interface of the system where dynamic junctions and green wave installation can be seen. The second image shows the detailed screen where junction information can be viewed by operators.

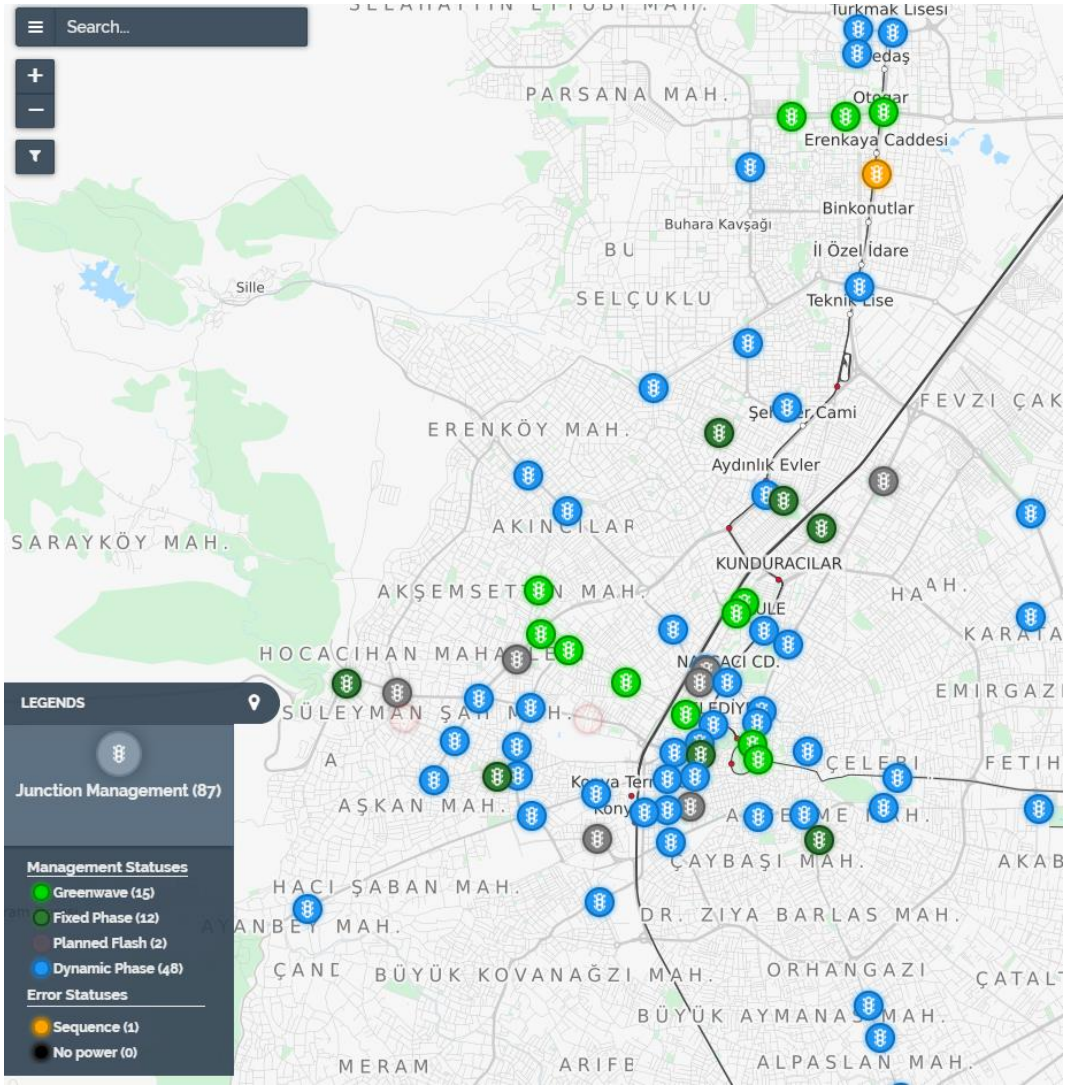


Image 5: Some of the Dynamic Junction and Green Wave Locations (Konya Traffic Control Center, 2019)

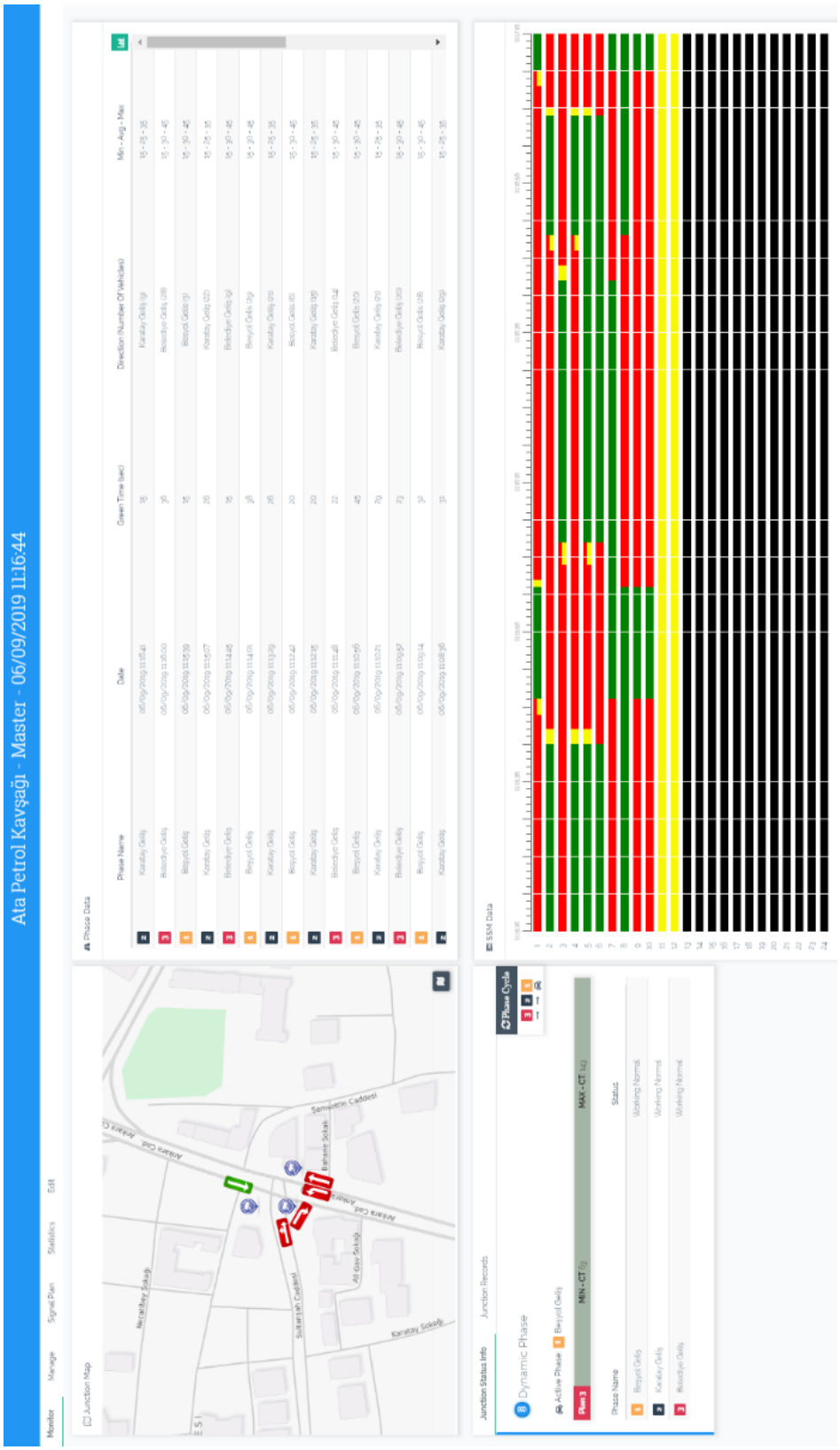


Image 6: Dynamic Junction Monitoring Screen (Konya Metropolitan Municipality, 2019)

IV.III.III. Enforcement Systems

Additionally, Konya Metropolitan Municipality has installed corridor speed enforcement systems on five corridors. This system consists of at least two Automated Number Plate Recognition camera installation points. A vehicle detected through the initial recognition camera is captured by the camera on the exit point. Through matching of number plates, calculation of difference between the second and the first capture times and with the additional information of the length of the corridor, average speed of the vehicle is calculated and if the driving speed is above the designated average speed for a certain type of vehicle, an automated ticket is sent to traffic operators of Konya General Directorate of Security for approval. After the approval, the ticket is submitted to the driver (ISSD, 2019). The total length of these corridors are 12.159 meters and the corridors are placed on Çevreyolu Street, Yeni İstanbul Road and Adana Periphery Road (Boğaziçi Proje, 2015). Enforcement systems such as number plate recognition systems, parking violation systems, red light violation systems and so on are intended to discourage violations while at the same time, promoting public safety and lowering accident risks due to violations.

Similar to corridor speed enforcement system, Konya Metropolitan Municipality has recently installed Parking Violation Detection Systems as well. On a total of 8 locations, areas with parking prohibition are monitored for possible violations. The system consists of Pan-Tilt-Zoom cameras, continuously controlling an area with 75 meters radius while also recognizing the number plates of the vehicles in their line of sight. Traffic operators pre-define the allowed parking duration for the system. In the case of a vehicle exceeding the allowed parking duration, or violating a no parking zone, are identified through continuous entries of number plates. Identified vehicle information is then transmitted through fiber-optic network connection to a remote center which is governed by the Konya General Directorate of Security. An automated ticket is sent to the operators at the center when a vehicle

is identified to be violating the rules and once the tickets are approved, the ticket is delivered to the driver (ISSD, 2019).

IV.III.IV. Bluetooth Based Traffic Analysis Systems

Konya Metropolitan Municipality also provides drivers with average travel time estimations through Bluetooth Technology (ISSD, 2019). A total of 87 Bluetooth devices are installed on main arterials of Konya Urban Area. These devices communicate with devices with Bluetooth such as cars, phones, wireless earphones and so on. Location of installation points, similar to green wave and dynamic junction systems, are pre-defined by traffic engineers and the distance between the devices are known. Each Bluetooth device, when it connects to another device with Bluetooth enabled, records the unique and anonymous MAC ID number. When the same MAC ID is captured by another device, given the distance between the installation points are known, travel time can be defined. With the use of multiple MAC IDs travel time between urban areas can be calculated. A similar system is also being used in Ankara, İstanbul, Gaziantep, Mersin and Bursa (ISSD, 2019). Konya Metropolitan University has also installed a total of 55 Variable Message Signs (VMS) in the urban area to be able to publish the travel time information through the signs, as well as number of available parking spaces in parking lots, warnings and notifications for drivers and so on. VMS installations are also monitored through surveillance cameras in case a malfunction is observed on the screens. Installation locations are also accessible in Konya Traffic Control Center. The picture below, shows some of the Bluetooth and VMS installation locations in Konya as well as exemplary image from VMS and from a surveillance camera.

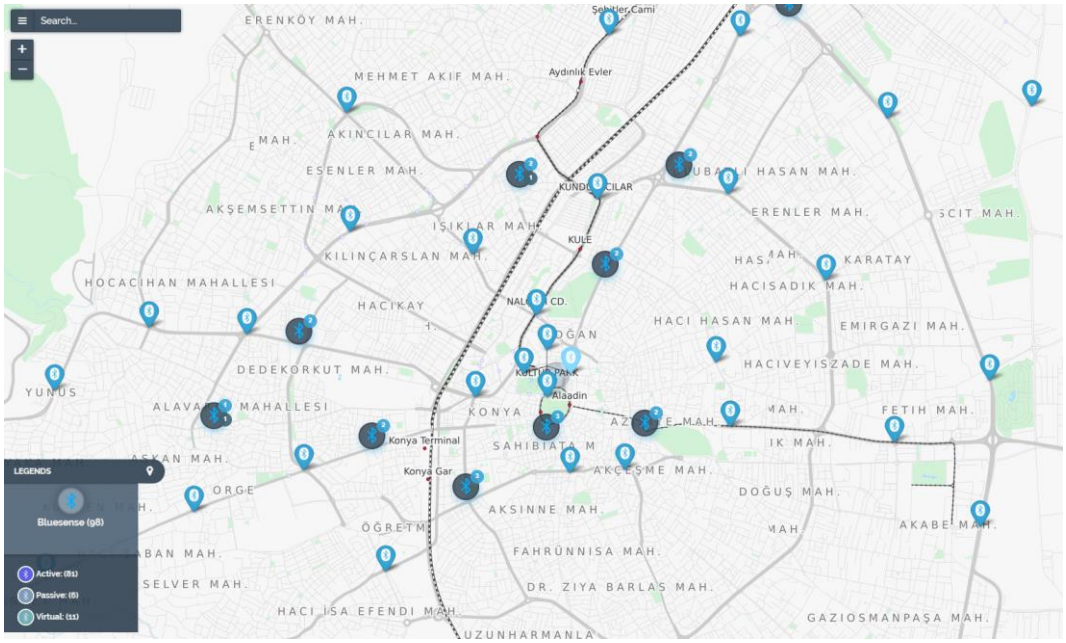


Image 7: Bluetooth Device Locations in Konya (Konya Traffic Control Center, 2019)

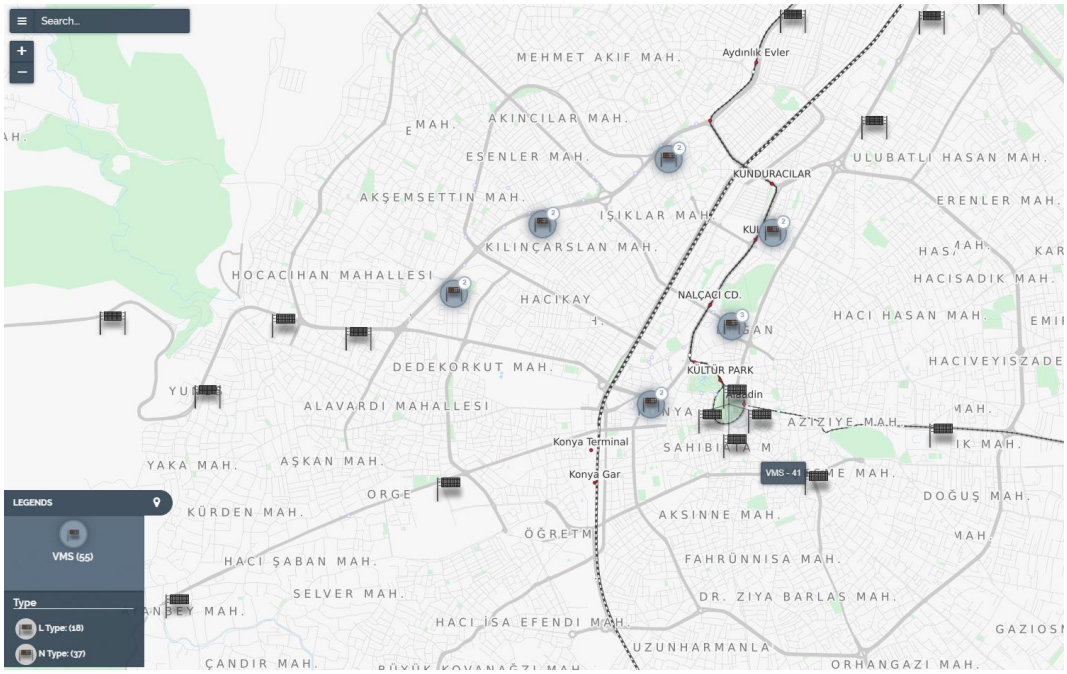


Image 8: VMS Installation Locations (Konya Traffic Control Center, 2019)

The Bluetooth devices are also used to estimate OD Matrices for the urban area as whenever same MAC ID is captured, travel pattern can be deducted from Bluetooth devices. Currently, OD Matrix algorithm provides a travel pattern based on capture zones, which does not fully cover the Origin and Destination of the citizens. For that reason, certain research and development activities are being supported by the Metropolitan Municipality to improve the accuracy of the algorithm. Additionally, historical data can be stored for future analysis, which is also being used in Konya Metropolitan Municipality. Pictures below show the OD Matrix and the analyses screen of the interface.

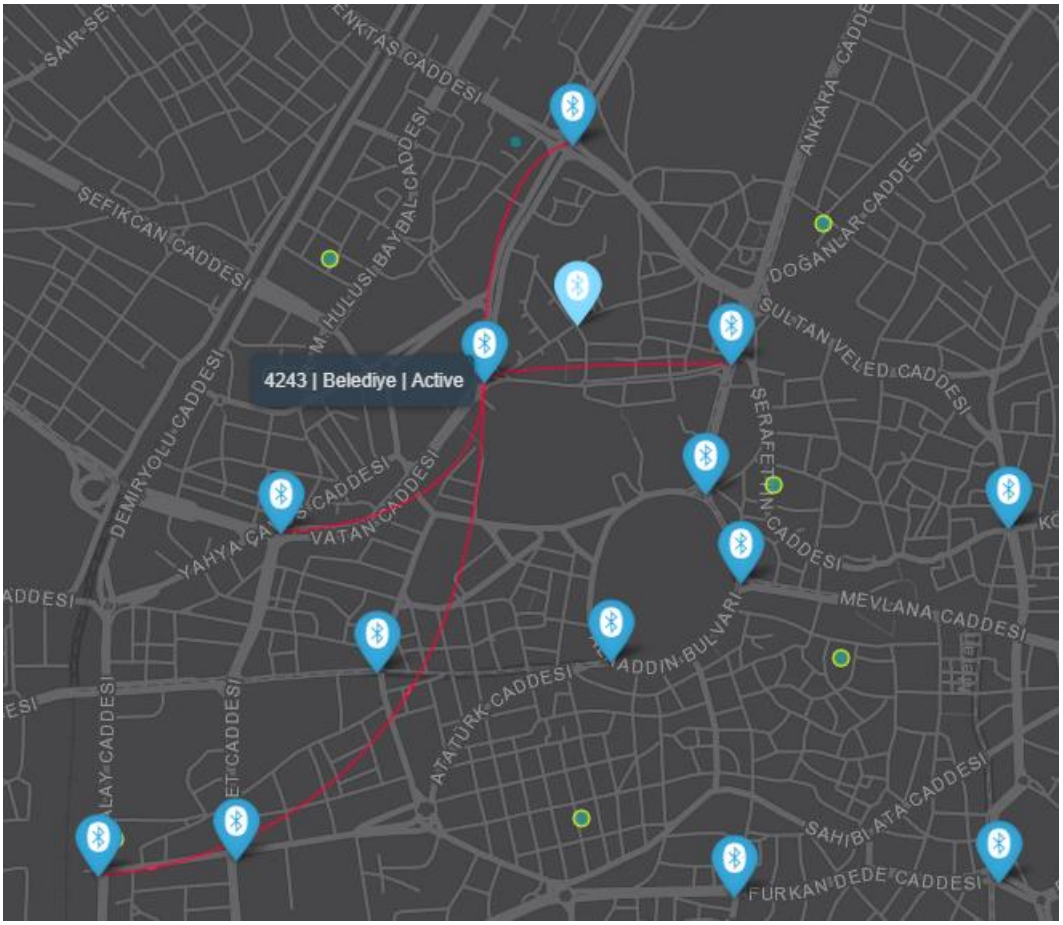


Image 9: OD Matrix Capture Zone of Bluetooth Devices (Konya Traffic Control Center, 2019)

IV.III.V. Accessible City Surveillance Cameras

Lastly, Konya Metropolitan Municipality has provided access to city surveillance cameras where citizens can connect a website a watch a live stream (Konya Metropolitan Municipality, 2019). The website allows access to two types of cameras. Touristic cameras allow viewers to monitor high activity areas within the urban area which have touristic value. The second type of cameras are named traffic cameras, where viewers can access to cameras monitoring a total of 20 junctions. The image below is taken live from one of the junctions where traffic camera is accessible to the public. Through this system, citizens can review the junctions themselves and choose their most suitable path accordingly.

Image 10: Live View From İhsaniye Junction (Konya Metropolitan Municipality, 2019)

IV.IV. Estimations of Konya Transportation Master Plan

Konya Transportation Master Plan provides insights for future transportation scene of the city. For the Master Plan a relationship has been formed between car ownership per 1000 person and household income and a formula which determines car ownership estimation is defined. According to this formula, it has been estimated that the current car ownership rate of 154 cars / 1000 people will increase to 329 cars / 1000 people in 2030 (Boğaziçi Proje, 2015). Estimations for both the number of cars in each Central Urban province and car ownership rates are provided below.

Table 8: 2030 Estimation for Number of Cars & Car Ownership per 1000 People (Boğaziçi Proje, 2015)

Provinces	**2012 Cars**	**2030 Cars**	**2012 Car Ownership**	**2030 Car Ownership**
Karatay	34.451	211.139	138	298
Meram	47.696	216.837	161	311
Selçuklu	79.623	421.934	157	359
Metropolitan Area Total	**161.770**	**849.911**	**154**	**329**

Additionally, Konya Transportation Master Plan has estimated the transportation mode selection of the users based on trip purpose. According to the estimation, pedestrian trips with 31% will be the first mode selected, followed by automobile use with 30%, public transportation with 28%, and services with 11%. When only trips done with motored vehicles are considered, it can be seen that automobile use will heavily dominate the mode selection with 51%, followed by public transportation with 39% and services with 10%. The number of average trips in

Konya is currently around 1,6 million and the expected average trips in 2030 is estimated as 4,7 million. Meanwhile, population of Konya is expected to increase to 2,6 million. This also means that average trip per person is expected to be 1,82 trips. Furthermore, it is expected that the trips with automobile is estimated to increase by four times, from roughly 373.000 to 1,4 million. The number of trips with public transportation currently is around 352.000 and it is expected to increase by four times and reach 1,3 million (Boğaziçi Proje, 2015).

Municipal officials have been asked about if their activities are in line with Transportation Master Plan. One of the officials has said that he believes that mostly they perform in line with the policies of such plans but some of the policies suggested in these plans are quite challenging in financial means which makes implementations nearly impossible.

CHAPTER V

SURVEY ANALYSIS OF KONYA

V.I. Introduction

Previous chapters mainly discuss the policy implementation of Intelligent Transportation Systems in the world and in Turkey. Basically, the general aim to be able to capture the current state of Intelligent Transportation Systems implementations in Konya Metropolitan Area and also how it is perceived by the city's administrators. From this point of view, it is possible to assess that Konya Metropolitan Municipality has the potential of implementing Intelligent Transformation Systems and in some cases, such as attention to Dynamic Junction Systems or provision of systems such as ATUS for the promotion of public transportation in Konya.

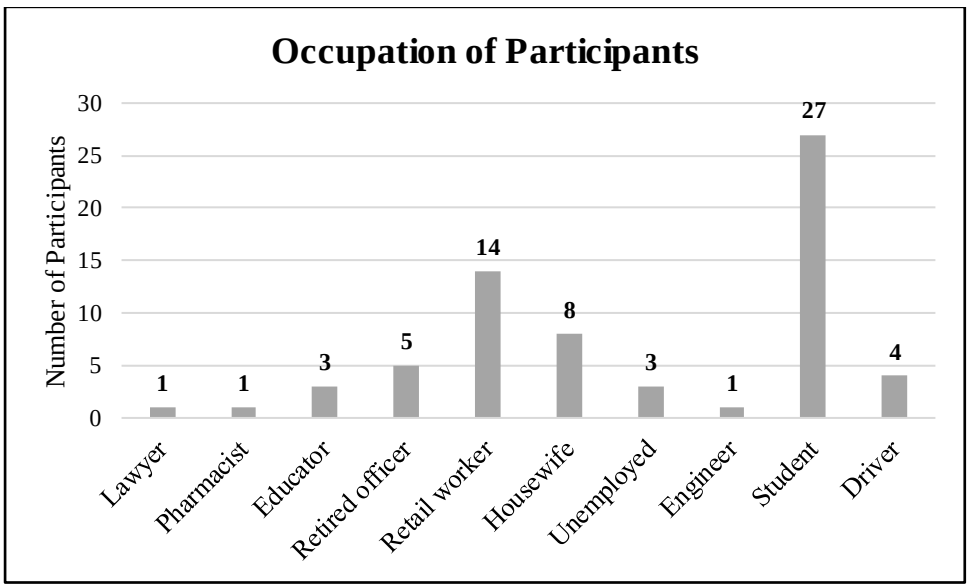
Nonetheless, simply overviewing the policy-makers' actions and decisions cannot be efficient to understand the scope of Intelligent Transportation Systems implementations. It was deemed necessary to get the opinion of general public to understand how such implementations reflect on Konya citizens. For that reason, a questionnaire has been completed with the general public of Konya through random selection. A total of 67 questionnaires have been completed which are important to understand the view of the public.

This chapter will be giving the results of these questionnaires in detail while also, where related, referring to another questionnaire that was done by the Municipality

to understand traffic culture of Konya's citizens. In 2018, Konya Metropolitan Municipality has cooperated with a private company to perform a research study in Konya Metropolitan Area, including the districts of Selçuklu, Meram and Karatay, regarding traffic and traffic culture. This study also had the intention of contributing to developing a traffic strategy (ASARDA, 2018). This questionnaire's report has been acquired from Konya Metropolitan Municipality, Division of Traffic Signalization.

V.II. Overview of the Questionnaire

The questionnaire was performed with a total of 67 participants who have various occupancies. The highest number of participants include students, followed by retail workers. The occupation of participants is given on the chart below.

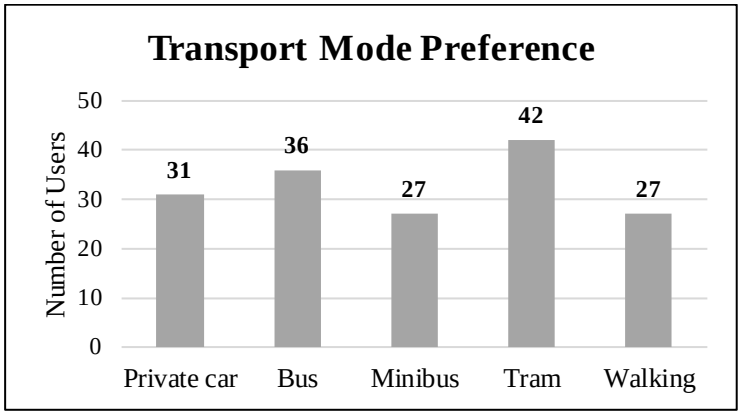


Graph 3: Occupation of Participants of the Questionnaire

The questionnaire consists of a total of 19 questions which can be grouped into four general groups. The first group of questions which will be discussed first consists of questions that refer to general overview of Intelligent Transportation Systems, transportation mode choices of the public and how the Metropolitan Municipality is sharing the information regarding their Intelligent Transportation Systems actions. The second group of questions will be looking into Intelligent Transportation Systems applications related to public transportation. Here, ATUS usage, value of smart bus stops in the city, and questions about Elkart will be evaluated. The third group will be generally focusing on some other Intelligent Transportation Systems applications of the Metropolitan Municipality which cover Dynamic Junction System, Electronic Enforcement Systems and Konya City Guide mobile application which provides cultural information, public bike network and is also connected to ATUS. Lastly, the discussion will turn to the open-ended questions in the questionnaire, which are aimed to find insights about general problems regarding transportation in Konya and possible solutions to these problems.

V.II.I. General Overview of Konya's Transportation and Intelligent Transportation Systems Structure

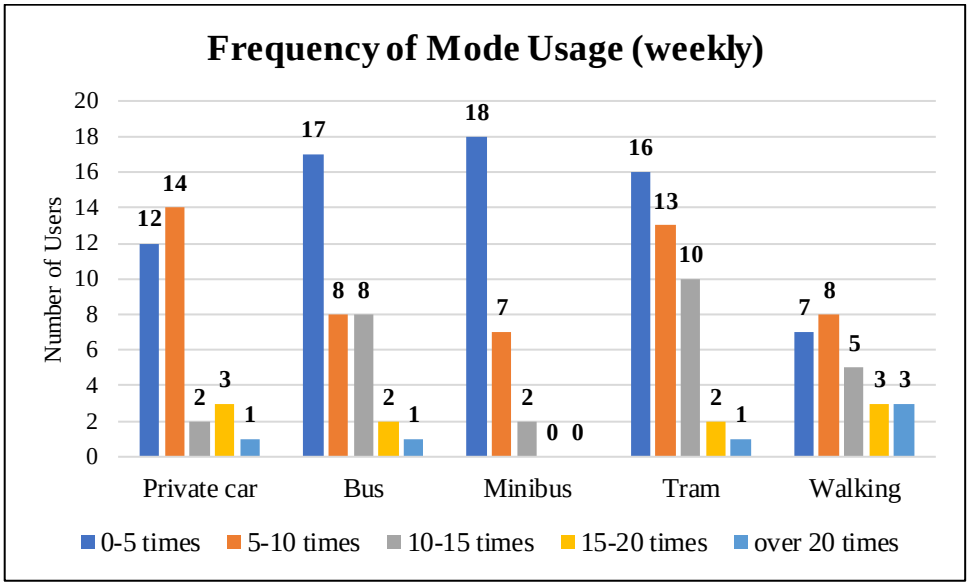
One of the questions from the questionnaire was aimed to understand transportation mode selection of users. According to survey results, the highest usage rate was observed for tram usage, followed by bus and private car usage. Preference of minibus and walking were observed as the lesser choice of the public, according to the results.



Graph 4: Transport Mode Preference

According to these results, people are generally choosing public transportation modes. Even though private car usage is also high, it is important to note that, investments on public transport, especially tram, can provide high returns to the city.

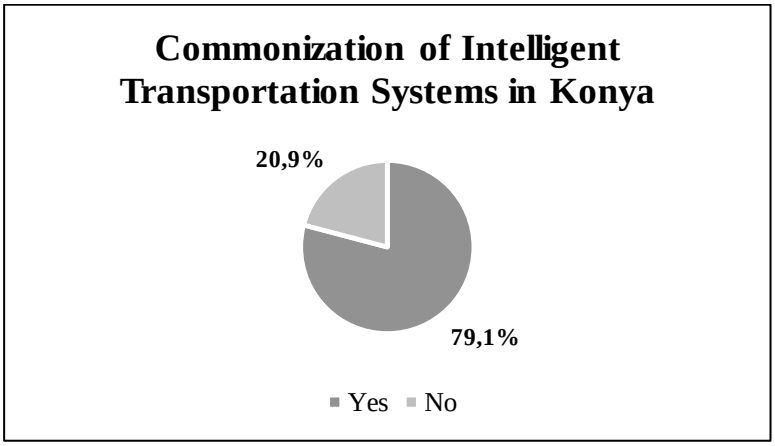
Following question was aimed to understand how often the participants are using the transportation modes that they have given above. The responses, for the sake of clarity, were grouped into intervals of 0-5 times, 5-10 times, 10-15 times, 15-20 times and over 20 times a week. Each transportation mode was evaluated individually as well.



Graph 5: Frequency of Mode Usage

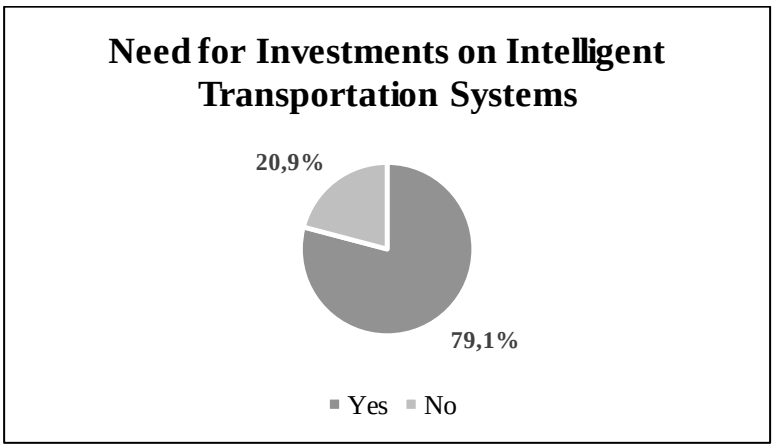
The results have shown that tram has been observed as the most preferred transportation mode and the frequency of usage is also in line with this outcome. It can be said that almost all participants who claimed to use tram for transportation, use tram every single day. Similarly, bus usage is following the trend where users are choosing this mode almost every day.

Another question was aimed to understand if the commonization of Intelligent Transportation Systems in Konya was seen necessary by the public. 79% of the participants were in favor of the commonization while 21% of the participants deemed it unnecessary. 21% is higher than the expected results but it could be assumed that this high percentage is related to either the lack of access to information about Municipality's Intelligent Transportation Systems actions (which will be discussed in the next question) or investments are seen more important in other fields compared to Intelligent Transportation Systems. The results are given in the chart below.



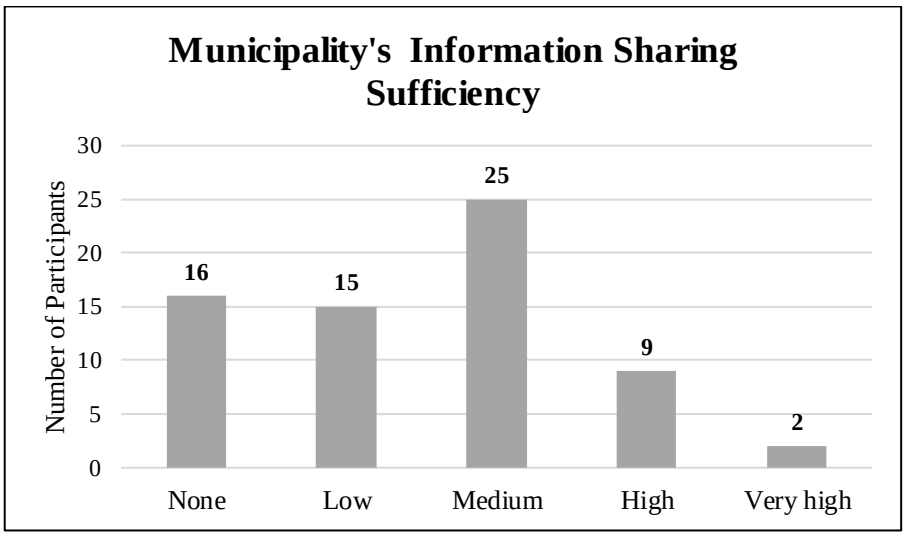
Graph 6: Commonization of ITS

The question above is followed up by the necessity of investments in the field of Intelligent Transportation Systems. It was observed that the results are exactly the same with the question above. This shows that the refusal of investments in this field and the claim of Intelligent Transportation Systems should not be commonized, might be related to how much information the public has regarding the implementations and their benefits.



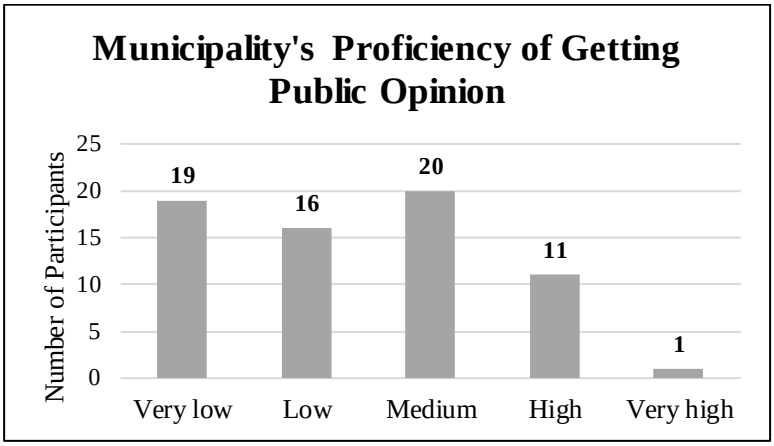
Graph 7: Investments on ITS

These results are directing the attention to how well the Municipality is sharing what is being done about Intelligent Transportation Systems. The results show that only 11 participants adding up to 17,4% of the total participants believe that information sharing sufficiency is high or very high. Remaining 83,6% believes that it is not enough. This can explain why over 20% of the participants deem Intelligent Transportation Systems unnecessary.



Graph 8: Dissemination of Information

Furthermore, participants were asked if their opinion was being asked enough by the Municipality. Similar to the question above, majority of the participants (%81 of the participants) believe that their opinions are not being asked well enough. Some interviewees said that their main focus was usually on the implementation themselves instead of sharing their plans with the public. The questionnaires also prove to that point. The results of this question are given below.

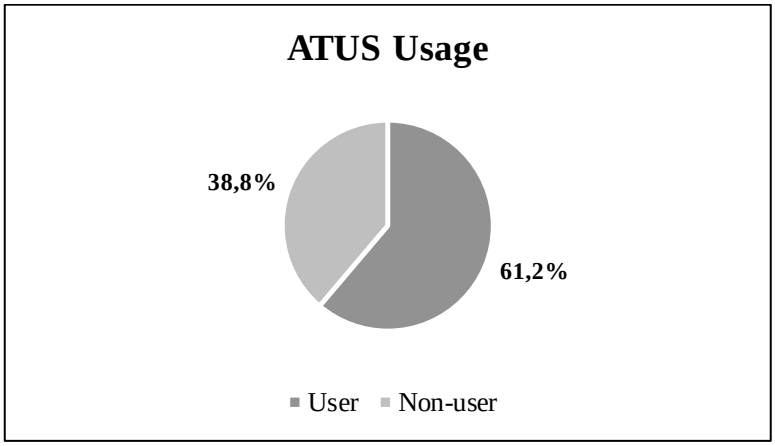


Graph 9: Gathering Public Opinion

V.II.II. Details Regarding Public Transportation of Konya

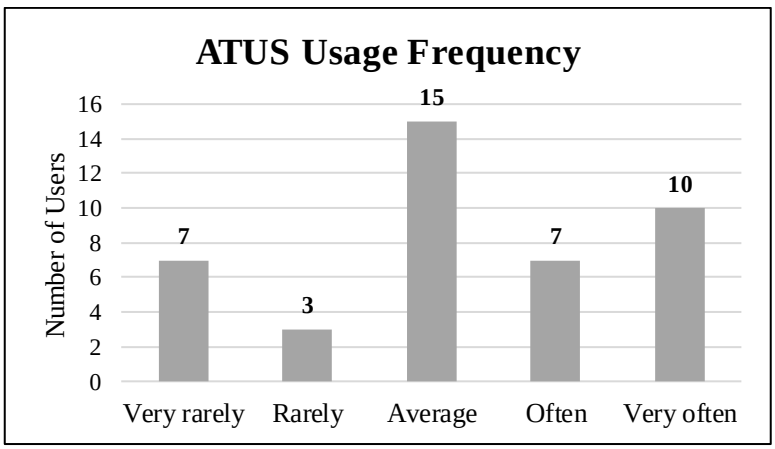
This section will overview Intelligent Transportation Systems applications of Konya Metropolitan Municipality in the field of public transportation. The questions regarding this subject are focused on ATUS usage, Smart Bus Stops and opinions about Elkart.

The participants were initially asked if they were using ATUS (Intelligent Public Transit System). ATUS, as mentioned in earlier chapters, provides information about bus tariffs, frequencies, bus stops and bus lines. According to the results, 61% of the participants have said that they use ATUS while the remaining 39% said that they do not use ATUS. The high usage rate of ATUS should be considered as a successful implementation of the system.

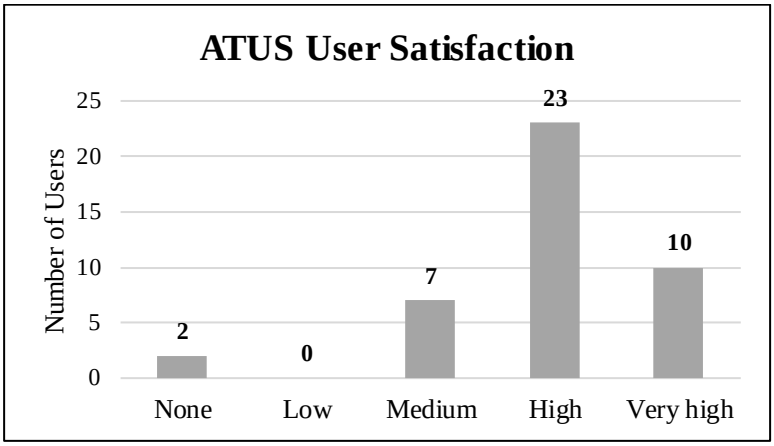


Graph 10: ATUS Usage of the Participants

Following that, participants who said that they use ATUS, were asked how often they refer to this system. Roughly, 24% of the participants have said that they rarely use ATUS while 76% of the participants have said that they use ATUS more often. This also shows that participants who use ATUS can find the information they need which leads them to use the system more often and their satisfaction rate of the system should be high. This was also asked to the participants and the results are given on charts below.



Graph 11: ATUS Usage Frequency



Graph 12: ATUS Satisfaction

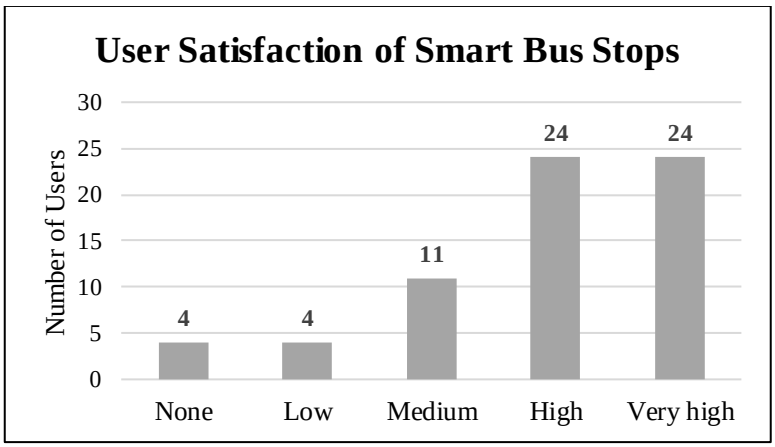
Participants who do not use ATUS were further asked if they use any other mobile application. Majority of the participants who do not use ATUS did not choose to use any other mobile application either (92,5%). Only 2 participants have said that they use "Gezi Rehberi Türkiye" while 3 participants have said they use "Moovit" which adds up to 7,5%.

Based on the answers given by the participants, it was controlled if the participants who heavily use public transportation use ATUS and if they are satisfied with ATUS service. It was observed that 73% of the participants heavily use bus and trams and 75% of these participants use ATUS. 83% of the participants who use public transportation often and use ATUS are satisfied with the service as well.

Table 9: ATUS Usage and Satisfaction of Public Transport Users

Characteristics of Participants	Number of participants	Percent
Total Participants	67	100,00
Participants who use public transportation modes on a daily basis (bus and tram)	49	73,13
Public transportation users who also use ATUS	37	75,51
Public Transportation user satisfaction of ATUS (High and Very High)	31	83,78

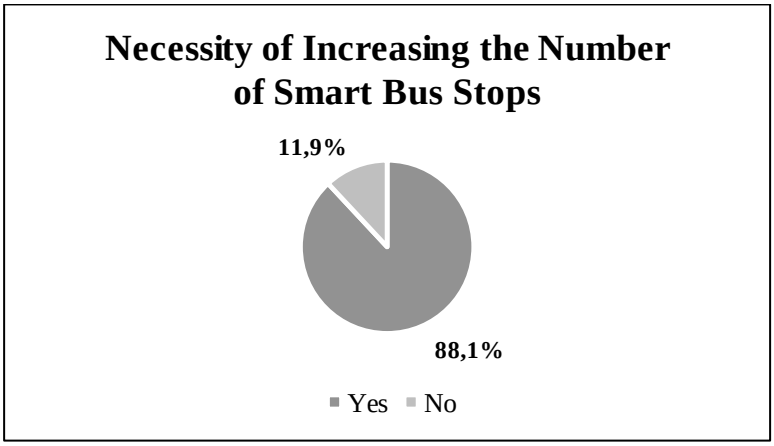
Smart bus stops were also evaluated by the participants. Participants were asked if they are satisfied with installations of smart bus systems. Generally, 54% of the participants are highly satisfied with smart bus stops remaining 46% have less satisfaction with the system.



Graph 13: Satisfaction from Smart Bus Stops

The participants who claimed to have less satisfaction of smart bus stops were further asked about the reasons behind their dislike. 58% of participants have said that there are some technical issues with the bus stops. For example, the displays

show wrong information on panels and the information is only limited to the line number and estimated time of arrival of the next bus. Some participants said that not all bus lines are displayed at the screens so sometimes they cannot get the information they need. 16% of the participants have said that the number of smart bus stops are not enough. Remaining 25% did not give a reason. Another question was then asked to the participants about if they think it is necessary to increase the number of smart bus stops. 88% of the participants agreed while 12% did not think it was necessary. It is possible to claim that, since installation and required investment for smart bus stops would not be too high, it could be a good investment for the Municipality to increase public satisfaction and also to boost the usage rates of public transportation.



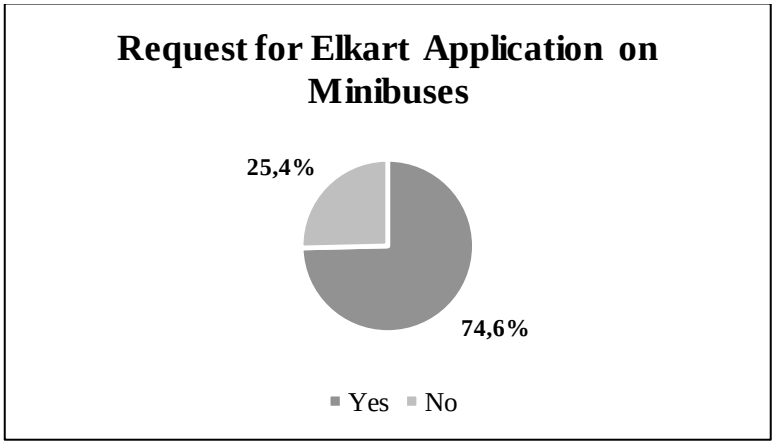
Graph 14: Necessity of Smart Bus Stops

The answers given about smart bus stops were compared with the number of participants who use public transportation often. 73% of the participants have claimed to use public transportation often while 89% of these emphasized the necessity of increasing the number of smart bus stops and 68% of them have also stated that their satisfaction of smart bus stops is high.

Table 10: Opinion on Smart Bus Stops by Public Transportation Users

Characteristics of Participants	Number of participants	Percent
Total Participants	67	100,00
Participants who use public transportation modes on a daily basis (bus and tram)	49	73,13
Public transportation users who emphasis the necessity of increasing the number of Smart Bus Stops	44	89,80
Public Transportation user satisfaction of Smart Bus Stops (High and Very High)	30	68,18

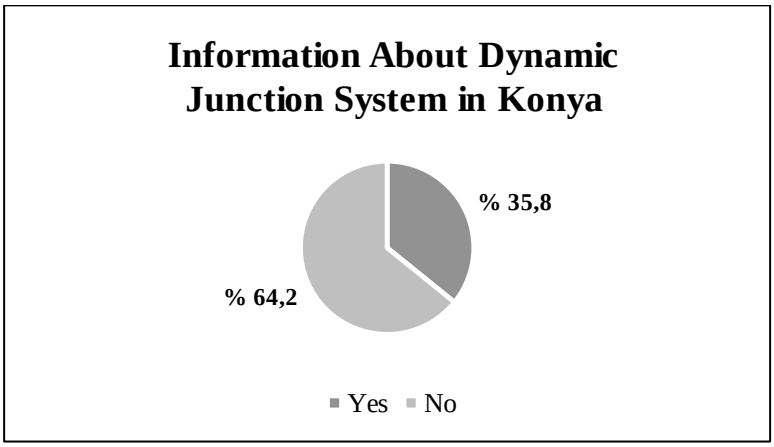
Finally, a question about Elkart usage on minibuses was asked to participants. Usage of Elkart in minibuses could be useful in terms of having a unified public transportation fee and to be able to gather detailed data about minibus usage. The results show that majority of the participants prefer Elkart on minibuses as well.



Graph 15: Elkart on Minibuses

V.II.III. Intelligent Transportation Systems Applications

Participant were also asked questions about direct implementations of Intelligent Transportation Systems in Konya. The questions aimed to gain insights about Dynamic Junction System, Electronic Enforcement System and Konya City Guide mobile application of the Municipality. Initially, participants were asked if they are aware of the existence of Dynamic Junction System. It was seen that 64% of the participants did not know about this implementation. This can be considered as a further proof regarding the lack of information sharing of the Municipality.



Graph 16: Dynamic Junction System Awareness

The participants who know about Dynamic Junction System were asked about their satisfaction of the system. 62,5% of the participants are highly satisfied while the remaining 37,5% of the participants are not very satisfied. A cross control for the participants who use private car on a daily basis, their awareness of the system and their satisfaction of the system has been performed and it was observed that 46% of the participants use their car on a daily basis while 58% of them were aware of

dynamic junction installations and 66% of them had high satisfaction of dynamic junctions.

Table 11: Awareness and Satisfaction of Dynamic Junctions for Private Car Users

Characteristics of Participants	**Number of participants**	**Percent**
Total Participants	67	100,00
Participants who use their private cars in daily basis	31	46,27
Private car users who know about Dynamic Junctions	18	58,06
Private car user satisfaction of Dynamic Junctions (High and Very High)	12	66,67

Through sharing information about the benefits of the system and how they are actually in line with national policies, could increase the satisfaction rates and also help increase the awareness. Konya Metropolitan Municipality officials, during one of the interviews have said that, due to being actively involved in improvement of dynamic junction systems, they did not have the time opportunity to advertise the systems. Additionally, municipal officials have said that when the Mayor or high ranked officials put such implementations to their agenda, it is more likely that the awareness rates are bound to be improved.

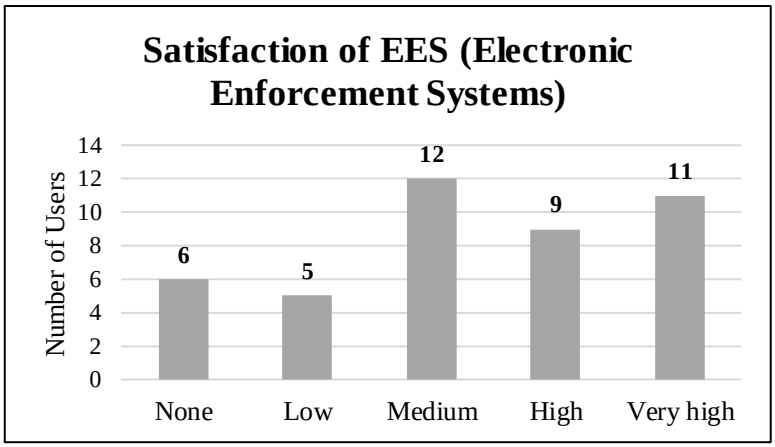
Another questionnaire study which was done by a private company by the demand of Konya Metropolitan Municipality had questions regarding the same issue. The study was performed through meetings with different research groups, in depth interviews as well as face-to-face questionnaires. The study focused on four main research groups, namely, disabled citizens, drivers, pedestrians, and municipal traffic police officers. Additionally, drivers are divided into six subgroups, namely,

automobile drivers, light commercial vehicle drivers, heavy commercial vehicle drivers, emergency vehicle drivers, bicycle and motorbike drivers, public transport vehicle drivers and commercial taxi drivers. The driver groups were asked questions regarding awareness of Dynamic Junction System, if it is considered necessary and if the applications are sufficient. According to the results, dynamic junction awareness is 26% for automobile drivers, 59% for taxi drivers, 43% for public transport vehicle drivers, 37% for light commercial vehicle drivers, 25% for heavy commercial vehicle drivers, 25% for motorbike drivers which all in all adds up to 35% total awareness rate (ASARDA, 2018). We can see that apart from taxi drivers, the findings of the survey are quite in line with traffic culture report. Especially for heavy commercial drivers, automobile drivers and motorbike drivers, it can be seen that their awareness rate is even lower.

Also, when all participants of the survey for this study, (including the ones who were not aware of the system) were asked about whether the Municipality should increase the number of Dynamic Junction System, 76% of the participants agreed while 24% disagreed. Again, the high number of participants who believe that more implementation is necessary can guide future policies of the Municipality. Similarly, in traffic culture report, on average 74% of the drivers have said that implementation of Dynamic Junction Systems is necessary. Furthermore, when the sufficiency of the system is asked, on average 56% of the drivers have claimed that it was not sufficient, 37% have said that it was partially sufficient and the remaining 7% have claimed that it was sufficient. These results also show that the survey done for this study is mostly representative of the general public.

Another set of questions were aimed to understand public's opinion about Electronic Enforcement Systems. Participants were asked if they know about Electronic Enforcement Systems in Konya. 54% of the participants have said that they were aware while remaining 46% were not aware. Even though by law, Electronic Enforcement Systems are marked with vertical traffic signs on the locations that they are placed, it is possible to see that awareness level is lower than

expected. It can be deducted that Municipality should definitely take the time to promote their implementations and share the benefits while also asking public's opinion. Furthermore, the people who were aware of Electronic Enforcement Systems were asked about their satisfaction with the implementation.



Graph 17: Satisfaction of EES

It was seen that 34,4% of the participants were not very satisfied with the system while 29,8% of the participants were satisfied with the implementation. Municipality should further evaluate the reasons behind unsatisfaction of the public in this regard, and try to provide solutions. This can also allow easier implementation of policies with higher public support. Furthermore, private car users' awareness of electronic enforcement systems and their satisfaction of the system is evaluated, it was observed that 31 out of 67 participants who use their private cars on a daily basis, 64% were aware of the installation of the system while 55% of them had high satisfaction from electronic enforcement systems.

Table 12: EES Awareness and Satisfaction of Private Car Users

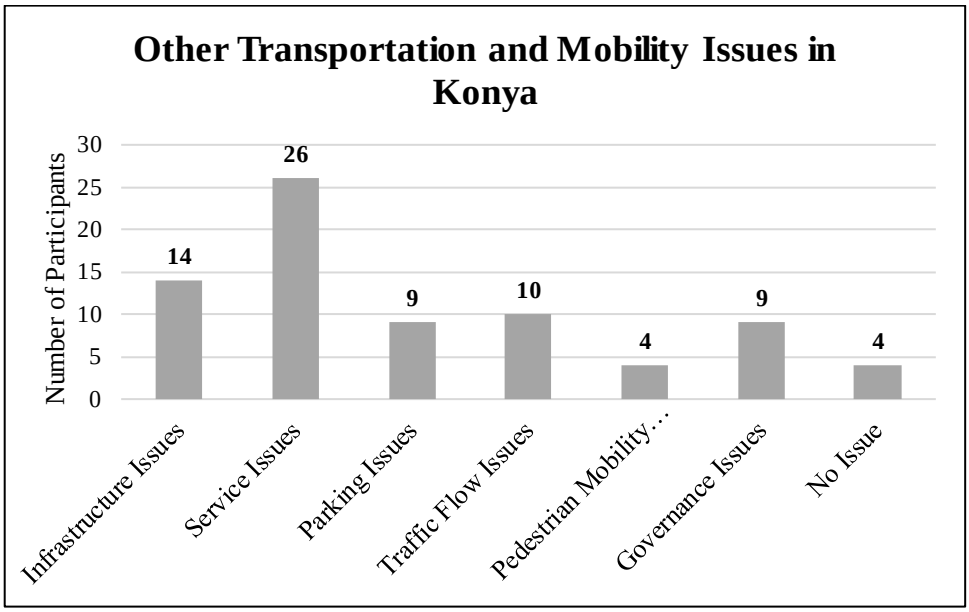
Characteristics of Participants	Number of participants	Percent
Total Participants	67	100,00
Participants who use their private cars in daily basis	31	46,27
Private car users who know about EES (Electronic Enforcement System)	20	64,52
Private car user satisfaction of EES (High and Very High)	11	55,00

Finally, participants were asked if they were using Konya City Guide mobile application. This application includes not only details from ATUS, but provides access to municipal services such as news, messages of the Mayor, publications, online applications, e-government tools and so on. Also, application provides information about the city itself, including places to see, to go shopping or to go eat. According to the survey results, 69% of the participants did not use the application while 31% of the participants use the application. This could again be a promotional issue, since the application provides many services to the public but these services through mobile application is in fact, not accessible.

V.III. Final Remarks

To have a clear idea about general public's issues regarding Intelligent Transportation Systems as well as Konya's transportation have been asked to participants in an open-ended question. The question demanded the participants to share their insights about Konya's transportation. The answers, for the sake of easier understanding, were divided into seven main groups. The groups are named as, infrastructure issues, service-related issues, parking issues, traffic flow issues,

pedestrian mobility issues, governance issues and finally no issues. The number of responses for each category is given on the graph below.



Graph 18: Other Related Transportation Issues in Konya

The results show that majority of the issues are related to service issues, followed by infrastructure issues and traffic flow issues. Some of the answers regarding service issues were requests about more frequent bus services, having too many red lights which reduce service effectiveness, lack of alternative road connections, low efficiency of public transport and limited number of buses, minibuses and taxis, minibuses being too crowded and buses driving too fast, bus tariffs being unbalanced and not aware of the changing demand throughout the day, trams having to wait at red lights which increases travel times, public bikes not being enough, lack of new and more efficient public transport lines, minibus lines not providing efficient service, tram services not being adequate at nights and public transport vehicles not arriving at designated times.

Infrastructure issues, mostly refer to lack of alternative routes for drivers, need for higher number of dynamic junctions, the need for better tram lighting for easier detection, high distance between tram stops, not having a better transportation network (especially considering that the city is quite flat and lack of high provision of public bike stations and bikes.

Pedestrian accessibility issues are mainly focusing on vehicles parking on pedestrian areas, not having a proper application of pedestrian priority and pedestrian crossings and requests about increasing the number of pedestrian overpasses. When government officials are asked about if they integrate smart mobility implementations with other transportation modes, the answers were unfortunately negative. They claimed that the majority of signalized junctions have pedestrian crossings, but pedestrian passage is not perfectly integrated with the phases. For example, a phase for pedestrians exist on every cycle of the traffic lights. Konya Metropolitan Municipality has the intention to skip the pedestrian light phase if there are no pedestrians at the time, which should further lower the waiting times at signalized junctions.

Regarding traffic flow issues, some of the problems stated by the participants were one-way application on some roads have increased the travel distances, traffic flow is too high and red-light durations are too long. Some problems regarding governance of the traffic were noted as speeding problems (especially for public transit drivers) should be enforced with radars, public transit should be promoted, public transit prices are too high and not many people are aware of traffic and transportation implementations.

All these provide valuable insights for this study. These answers can provide important hints about the expectations of the people and how the local government should proceed or what they should bring to the attention of the public. More comments about the answers of the questionnaire will be discussed in the final chapter.

CHAPTER VI

CONCLUSION

It is no doubt inevitable, for cities to follow the transformation towards smart cities, considering the common problems observed in almost any urban area. Modern societies are struggling with many problems caused by the increasing population and one of which is definitely observed in transportation sector. As Buuse and Kolk clarifies that without governing bodies taking necessary steps towards prevention of problems relating to energy, mobility, wastewater treatment and so on, the problems occuring now, will increase over time and become harder to manage (Buuse & Kolk, 2019). In literature, it can be seen that more and more studies now turn to discussions about smart mobility which is able to counter majority of issues related to transportation.

This trend, obviously has also hit Turkey, even though the process occurred much slower. Starting from 1960s, the world has started discussing smart mobility implementations, such as use of technology and information and communication technologies, better ways of governing traffic, sharing information with the drivers and so on. Turkey has caught up in the trend especially after 1990s. Official bodies in Turkey such as ministries have released many policy documents and strategic plans and even though their context is wide, smart mobility as a part of the context is mostly associated with traffic safety. Also, it should be noted that adaptation process to EU and funneling financial supports through EU funded projects has increased the pace of transformation of transportation sector.

Many cities in Turkey have started implementing the technological advances in transportation scene and one of the most notable cities in this sense is Konya. Konya, since mid-2000s, provides many implementations for its citizens. For example, one of such implementations are Dynamic Junction Systems where traffic lights are controlled in an actuated sense and green light durations are arranged based on the number of vehicles approaching the junctions. Also, Bluetooth Based Traffic Analysis System can calculate average travel times on installed corridors and this information can be shared through Variable Message Signs to enable drivers to switch to alternative routes, if necessary. Similarly, Electronic Enforcement Systems are becoming more common on arterials of the city. Furthermore, Konya Metropolitan Municipality provides other services to the citizens such as mobile application of Konya City Guide or ATUS.

There is no question that Konya Metropolitan Municipality has a progressive approach towards the applications mentioned above and these applications are very essential and helpful in many ways. But the methods of application should be questioned. It is obvious that Turkey does not have a fully separated legislative and administrative infrastructure for Intelligent Transportation Systems applications or the standardization efforts are nearly enough. But Konya Metropolitan Municipality, which was also mentioned by the authorities during interviews, does not linger with bureaucratic steps and processes and is able to put implementations in motion easily. For that reason, it is understandable to assume that the local government should perform in a more efficient way when it comes to provision of Intelligent Transportation Systems. In fact, the authority is very much supportive of research and development activities through open provision of data and providing necessary permissions to stakeholders. Furthermore, Konya Metropolitan Municipality considers itself as one of the more innovative municipalities with their attempts at preparing a bicycle master plan and so on. Also, Konya Metropolitan Municipality does not simply consider smart mobility implementations as a method to promote traffic safety unlike the policy trend in Turkey. For these reasons, Konya Metropolitan Municipality is perhaps, one of the more progressive authorities. But

still, their approach to Intelligent Transportation Systems is based on road transport and mostly at the service of private cars. An intermodal approach is one of the corner stones of Intelligent Transportation Systems and smart mobility. For example, Dynamic Junction System is based on vehicles without putting specific attention at public transit or more sustainable transportation modes. Surely, buses can benefit from actuated junction management, but this is done at the cost of a faster tram service. As mentioned by participants of the questionnaire, trams have to wait at red light for private cars, even though technologically it is possible to allow passage for trams instead of private cars. Furthermore, a commonly shared payment method is not provided for the city since minibuses do not have integration to Elkart system. This, not only limits the commonization of public transport fees but it also costs valuable data that could be gathered from minibus usage.

ATUS and Konya City Guide mobile application (which also includes ATUS mobile version in it) are two very important elements of Konya's Intelligent Transportation System implementations. Questionnaires show that ATUS usage is very common but the same cannot be stated for the mobile application. Still, having access to information is considered an important element of smart mobility and it is also in line with general intelligent transportation strategies of Turkey. But it would be wrong to say that these two applications are nearly enough. Increasing the number of smart bus stops, providing public announcement systems within public transportation for disabled citizens are important policies which should be implemented in the near future. Questionnaire results show that especially smart bus stops are well perceived by the public and since the cost of implementation of smart bus stops are relatively low, it should be considered as a quick, beneficial policy.

Of course, when new projects are taken into consideration, assistance from researchers would be very essential. Academic supervision can provide important insights and have a positive impact on the success of the project since research-policy dialog would be boosted. Unfortunately, not much proof of such partnerships

is acquired. Furthermore, not only participation from academia, but also participation from the public is important. This, as mentioned in interviews and found out in questionnaires is not being done nearly enough. General public are not being asked about planned projects so no feedback can be acquired by the local government. Additionally, this could benefit the local government in the sense that public would be aware of their implementations. Survey results show that majority of the public do not know about new and technological Intelligent Transportation Systems implementations of Konya Metropolitan Municipality. The municipality also lacks the will to share their implementations after they are completed. Without full participation of the public, smart mobility initiatives cannot be fully successful since benefits and how to more efficiently participate in intelligent transportation will be unknown to them. It would be suggested that activities should be shared with the public before and after the implementations, workshops, meetings and cultural activities should be promoted to achieve participation of the public. This allows switching the role of the public from "user" to "decision maker" and an active part of the smart mobility transformation of the city. Furthermore, an approach to Smart City should include all six dimensions of the concept as discussed by Giffinger and Cohen which are evaluated at Chapter II. Smart City as a concept, divided into six major dimensions (Smart Mobility, Smart Governance, Smart People, Smart Environment and Smart Economy) by both Giffinger and Cohen with small variations under each dimension. Participation of the public in decision making process will assist Konya Metropolitan Municipality to also improve in Smart Governance dimension, not just Smart Mobility. This will also allow the Municipality to move on to softer forms of policy implementations, rather than harder forms such as dynamic junction management which requires intense infrastructural work.

It should be noted that, Intelligent Transportation Systems should be integrated centrally and be followed by traffic operators at all time. Most of such systems aim to ease the workload for the operators which should enable them for faster responses. But currently, Konya Metropolitan Municipality does not have a modern

Traffic Control Center and according to the interviews, local government representatives perform the duties of traffic operators during their personal times. Traffic is monitored through few screens at the Municipality which in fact, reduces response times of the representatives to any possible problem which may occur at the transportation network.

Another issue to be mentioned is that Konya Metropolitan Municipality has a project-based approach rather than taking smart mobility into consideration as a holistic approach. Through the improvement of communication between research facilities, private sector and the Municipality, a holistic approach is achievable but this surely requires a strong road map for implementation. It is suggested to Konya Metropolitan Municipality that the European trend of preparation of Sustainable Urban Mobility Plans (SUMP) which includes all policies and actions with strong staging for a defined target year, can provide a strong, holistic and well-designed road map. As stated by European Commission, Sustainable Urban Mobility Plans can bring together different parts of local government, other stakeholders and the public together to counter important transportation and mobility related issues such as high congestion, air and noise pollution, accidents or climate change (European Commission, 2020).

Lastly, Intelligent Transportation Systems should also be used for preventive and predictive maintenance of the transportation network. Today, with the help of advancements on big data management, it is possible to forecast future scenarios, based on data gathered by multiple field sensors. Such an application would act as preventive solutions, which could further boost service levels and surely have a positive impact on general public's satisfaction.

Based on the answers of the questions asked to general public, many issues can be named for Konya's transportation. Careful attention should be given to pedestrian access, improvement of existing infrastructure and increasing the service quality of traffic. Consideration of an intermodal approach could help solving this problem but it requires a more transparent local government where information is being

shared with the public. It is suggested to the Municipality that a council formed under the Municipality, should put attention on this issue and govern dissemination of information to the public. Also, closer ties with researchers should be sustained in order to achieve higher success rates of implementations. A better public transportation network, powered by Intelligent Transportation Systems, a stronger bike network and Elkart integrated bike-sharing system, integration of Elkart to minibuses, could benefit the city and the local government as a whole.

Smart mobility is very achievable for Turkey's cities and it is promoted by political and strategic documents. A holistic approach to how such strategies can be applied efficiently, would benefit the country, as well as Konya as a city. The potential of the innovative government should be put to use, and the problems of transportation sectors should be solved with modern, technological and scientific methods.

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APPENDICES

APPENDIX A: QUESTIONNAIRE TEMPLATE

Q1- Do you use ATUS application?

Yes	No

Q2- (If yes) How often do you use ATUS application? (1: Very rarely, 2: Rarely, 3: Average, 4: Often, 5: Very Often)

1	2	3	4	5

Q3- (If yes on Q1) How satisfied are you with ATUS application? (1: None, 2: Little, 3: Average, 4: High, 5: Very High)

1	2	3	4	5

Q4A- (If no on Q1) Are there any other applications you are using for public transportation information?

Yes	No

Q4B- (If yes on Q4A) (Open Ended) What is the name of the application you are using?

Q5- Are you aware of (informed about) intelligent junction implementations in Konya?

Yes	No

Q6- (If yes on Q5) How satisfied are you with intelligent junction implementations? (1: None, 2: Little, 3: Average, 4: High, 5: Very High)

1	2	3	4	5

Q7- Currently in Konya, there are 65 junctions with intelligent junction system installed. There are 340 signalized junctions in Konya. Do you think the number of intelligent junctions should be increased?

Yes	No

Q8- How satisfied are you with smart bus stops in Konya? (1: None, 2: Little, 3: Average, 4: High, 5: Very High)

1	2	3	4	5

Q9A- (If score is 3 or below on Q8) (Open Ended) What are the reasons of your dissatisfaction with smart bus stops?

Q9B- Do you think it is necessary to increase the number of smart bus stops?

Yes	No

Q10A- Should implementations such as Konya Elkart, smart bus stops of audio warning systems on busses and trams be commonized?

Yes	No

Q10B- Do you think the Metropolitan Municipality should invest in such implementations?

Yes	No

Q11- Do you think minibuses should have Elkart in use for payment?

Yes	No

Q12- Are you aware of (informed about) Electronic Enforcement Systems in Konya?

Yes	No

Q13- How satisfied are you with Electronic Enforcement Systems implementations? (1: None, 2: Little, 3: Average, 4: High, 5: Very High)

1	2	3	4	5

Q14- (Multiple Selection) Which modes do you prefer to travel in the city?

Private Car	Bus	Minibus	Tram	Walking

Q15- How often do you use the selected modes in a week?

Private Car	_____ Times a Week
Bus	_____ Times a Week
Minibus	_____ Times a Week
Tram	_____ Times a Week
Walking	_____ Times a Week

Q16- Do you use the Konya City Guide mobile application?

Yes	No

Q17- Do you think the dissemination of information to general public, by the Municipality regarding intelligent mobility implementations is enough? (1: None, 2: Little, 3: Average, 4: High, 5: Very High)

1	2	3	4	5

Q18- How well do you think the Municipality gathers opinion from the general public regarding transportation? (1: None, 2: Little, 3: Average, 4: High, 5: Very High)

1	2	3	4	5

Q19- (Open Ended) Is there anything else you wish to add regarding mobility and transportation issues in Konya?

APPENDIX B: SEMI STRUCTURED INTERVIEW QUESTIONS

Q1- Name and surname of the interviewee

Q2- The role fulfilled within the Municipality, departments and responsibilities

Q3- If any training, course or education is taken in transportation field

Q4- If any personal research study has been completed

Q5- How did the Smart City transformation begin in Konya Metropolitan Area, the influences behind the initial decision

Q6- How does the decision-making process is done in Konya Metropolitan Municipality, and which departments get involved in the process

Q7- Why Smart City and Smart Mobility initiatives have become an important agenda, and what was the expected result of such implementations and what were the problems in Konya urban transportation

Q8- What kind of improvements have been observed in provision of transport services or urban transportation itself

Q9- What were the transportation problems of the city and how are these solved through the means of Smart Mobility

Q10- How does the Municipality cover the financing of Smart Mobility projects

Q11- What kind of new networks are enabled through Smart City initiatives

Q12- Does the Municipality link the implementations with the other transportation modes

Q13- What kind of plans are being made for the future in transportation field

Q14- If any political, economic, infrastructural or social problems occurred during the implementation

Q15- How does the Municipality gather feedback from the public about such implementations

Q16- How does the Municipality increase the awareness of the implementations

Q17- If the implementations are in line with Konya Transportation Master Plan goals and strategies

APPENDIX C: TURKISH SUMMARY / TÜRKÇE ÖZET

Bireylerin ortak çıkarlarının olması, kentsel alanların, daha özel olarak kentlerin oluşumunu desteklemiş, günümüzde ise kentler, özellikle inovasyon, teknoloji ve toplumsal değişimlerin merkezi haline gelmiştir (Sharifi, 2019). Elbette, toplumun her kesimine yayılmış olan bu ortak çıkarlar, gün geçtikçe daha fazla sayıda bireyin şehirlerde yaşamayı tercih etmesine neden olmuştur. Özellikle sanayi alanında yaşanan gelişmeler ile sosyo-ekonomik çıkarların kuvvetlenmesi bu hareketin destekleyicisi olmuştur. Kentlerin bu çekiciliği yakın zamanda ortadan kalkacak gibi görünmemektedir. Benzer biçimde, Birleşmiş Milletler 2050 yılında kentlerde yaşayan nüfusun yaklaşık 6,5 milyara ulaşacağını öngörmüştür (Streitz, 2015). Bu nüfus aynı zamanda 2050 yılında beklenen toplam dünya nüfusunun yaklaşık %66'sına tekabül etmektedir (Hashem, et al., 2016).

Kaçınılmaz bir biçimde hızla artan bu nüfus, beraberinde kentsel alanlarda kolaylıkla gözlemlenebilecek olan pek çok problem de getirmektedir. Bu sorunların başlıcalarını atık yönetiminde yaşanan sıkıntılar, ulaşım ve trafik problemleri, kaynakların eşitsiz paylaşımı ve dağıtımı, kamusal hizmetlerin sunumunda yetersizlikler, altyapı yetersizliği, toplumdaki bireylerin sağlığının bozulması, çevre kirliliğinde artış, enerji israfı ve konut sunumunda yetersizlik şeklinde özetlemek mümkündür (Chourabi, et al., 2012).

Bu tür problemlere karşı bir çözüm önerisi olabilecek pek çok yaklaşım akademik çevreler tarafından tartışılmış ve kamu kurumları tarafından da uygulamaya koyulmuştur. Bu kapsamda, özellikle 1990'lı yılların başından itibaren öne çıkan ve dünya çapında yaygınlıkla prensiplerine başvurulan bir konsept olan "Akıllı Şehirler" yaklaşımı dikkat çekmektedir. Özellikle teknolojik alanda gözlemlenen RFID teknolojisi, çeşitli türdeki sensörler, nesnelerin interneti, akıllı telefonlar ve giyilebilir akıllı cihazlar gibi gelişmeler, Akıllı Şehirler kavramını daha cazip hale

getirmektedir (Evans, 2011) ve bu sebepten ötürü Akıllı Şehirler yaklaşımları yaygınlıkla hem uygulama olarak hem politika ve strateji dokümanlarında karşımıza çıkmaktadır.

Akıllı Şehirler kavramının tanımlanması, literatürde üzerinde karar birliği sağlanamayan bir konu olarak göze çarpmaktadır. Yapılan çalışmalardaki bazı tanımlamalar özellikle teknolojinin kullanımından bahsetmektedir. Örneğin, bir çalışmada Akıllı Şehirler için taşıt teknolojileri, akıllı telefonlar, ağ altyapısı ve büyük veri alanlarındaki gelişmelerin kullanımına vurgu yapılırken (Peng, Nunes, & Zheng, 2017), bir başka çalışmada kentte bulunan varlıkların kontrol edilmesi ve yönetilmesinde bilgi ve iletişim teknolojilerinin kullanıldığı bir vizyondan söz edilmektedir (Guo, Ma, Li, Zhang, & Zhang, 2017). Ancak elbette, tek başına teknolojinin varlığı ve etkin kullanımı bir kenti "akıllı" yapmaya yeterli olmayacaktır. Örneğin Nam ve Pardo, teknolojinin kullanımının altyapıya ve hizmetlerin sunumuna, yani kentsel ögelere akıllı teknolojilerin ne derece penetre olabildiğine göre kentlerin akıllı olup olmadığının anlaşılabileceğini öne sürmüştür (Nam & Pardo, 2014).

Bazı diğer çalışmalarda ise teknolojinin kullanımına ek olarak, insan ögesinin üzerinde durulduğunu görmek mümkündür. Örnek olarak, bir çalışmada kentte yaşayan vatandaşların eğitim seviyesine, sosyal ilişkilerinin kaliteli olup olmadığına ve bu vatandaşların Dünya'ya ne derece açılabildiğine göre akıllı olma durumunun anlaşılabileceği öne sürülürken (Ortiz-Fournier, Márquez, Flores, Rivera-Vázquez, & Colon, 2010), bir başka çalışmada ise Akıllı Şehir bilgi ve iletişim teknolojilerini bir araç olarak kullanarak kentte yaşayan bireylerin çeşitli açılardan (örneğin yönetişim, yaşam kalitesi, sürdürülebilir ve dirençli kamusal hizmetler gibi) hayatlarının iyileştirilmesini sağlayan şehir olarak tanımlanmaktadır (Corbett & Mellouli, 2017).

Daha önce de bahsedildiği gibi, Akıllı Şehirler kavramı özellikle 1990'lı yıllardan itibaren üzerinde fazlaca tartışılan bir konu olarak literatürde yer bulmuştur. Ancak o zamandan beri net bir biçimde veya genel geçer olarak karar birliğine varılmış bir

tanımı yoktur. Akıllı Şehirler kavramlarında çoğunlukla teknoloji, sürdürülebilirlik, hareketlilik, yönetişim, yaratıcılık, inovasyon gibi terimlerin sıklıkla kullanıldığını görmek mümkündür. Özellikle çevrenin korunması için teknolojinin kullanımı öne çıkmakta ve iklim değişikliğinin altında yatan sebepleri ortadan kaldırılması amacı güdülmektedir. Bu kapsamda iki ana çalışma, Akıllı Şehirler kavramında büyük gelişmelerin sağlanmasına neden olmuştur.

Bunlardan ilki Giffinger ve ekibinin, orta büyüklükteki Avrupa kentlerinin ne derece "akıllı" olduğunu ölçmeye çalıştıkları bir çalışmadır (Giffinger, 2007). Giffinger'ın yaklaşımına göre Akıllı Şehirler geniş çaplı belli kriterler çerçevesinde özetlenebilmelidir. Buna göre "akıllı" sıfatı, kentlerin belli elemanları ile birlikte kullanılabilir ve bu elemanların bütünü Akıllı Şehirleri yaratabilir. Giffinger'ın çalışmasında bahsedilen bu elemanlar ise "Akıllı Ekonomi", "Akıllı İnsan", "Akıllı Yönetişim", "Akıllı Hareketlilik", "Akıllı Çevre" ve son olarak "Akıllı Yaşam" olarak özetlenmektedir. Bu elemanların ilki olan akıllı ekonomi inovatif rekabetçilik olarak tanımlanmış ve uluslararası marketlere, girişimlerin dahil olabilme yeteneği olarak açıklanmıştır. Akıllı insan elemanı, kentte yaşayan bireylerin eğitim seviyesi ve yaşam kalitesi olarak özetlenirken, akıllı yönetişim olgusu katılımcı çalışmalar ve yönetim yapısının işlerliği olarak detaylandırılmıştır. Akıllı hareketlilik, erişilebilirlik ve bilgi ve iletişim teknolojilerinin sürdürülebilir bir ulaşım altyapısına erişmek için kullanılması olarak tanımlanmıştır. Akıllı çevre iklim koşullarına gösterilen özen, yeşil alanların varlığı, kirlilik ile mücadele ve atık yönetim sistemlerinin kullanımı olarak anlatılmış ve son olarak akıllı yaşam elemanı kent tarafından sunulan güvenlik hissi, kültürel ve sosyal koşullar, mevcut konut alanlarının durumu ve turizm fırsatları olarak tanımlanmıştır.

Bu çalışmanın en önemli özellikleri Akıllı Şehirler olgusunu pek çok farklı kriter ile değerlendirmiş olması ve bunları birbirleriyle ilişkili olacak bir biçimde kurgulamış olmasıdır. Buna benzer biçimde Cohen da Akıllı Şehirler Çemberi olarak tanımlamış olduğu ve Giffinger'ın kullandığı aynı altı ana elemente göre Akıllı Şehirler olgusunu tanımladığı bir çalışma yapmıştır (Cohen, 2013). İlk

eleman olan akıllı ekonomi, Cohen tarafından girişimcilik, inovasyon, üretkenlik ve yerel ve global bağlantılar olarak tanımlanmıştır. Özellikle sektör içinde esnekliğin sağlanması bu eleman için önemlidir. Akıllı çevre elemanı yeşil binalar, yeşil enerji ve yeşil kentsel planlama olarak alt başlıklara ayrılmıştır. Akıllı çevre, iklim değişikliği ve kirlilik gibi olgulara karşı geliştirilen çalışmalar ile açıklanabilirken, doğal kaynakların kullanım oranlarının azaltılabiliyor olması, yenilenebilir enerji kaynaklarının kent içinde fazlaca kullanılabiliyor olması ve çevresel sürdürülebilirliği ön plana çıkarma becerisine sahip olan yeşil bir kentsel ağın planlanması ve örülmesi özellikle üzerinde durulan başlıklar olarak öne çıkmaktadır. Akıllı yönetişim, arz ve talep politikalarında gözlemlenen başarı, şeffaf yönetim anlayışı, toplanan verilere halk tarafından erişilebilirlik ve son olarak bilgi ve iletişim teknolojilerinin kullanımı ile e-devlet türevi uygulamaların varlığıyla ölçülmektedir. Akıllı yönetişimde yönetimsel hizmetler internet üzerinden kullanıcılar ile yani vatandaşlar ile paylaşılmalı, tüm paydaşların katılımı ile kararlar alınmalı, şeffaflık desteklenmeli ve korunmalı, özet olarak halk ve yöneticiler arasında açık ve sürekli iletişim ile iş birliği sağlanmalıdır. Akıllı yaşam kültürel olarak canlı ve mutlu olmak, güvenli olmak ve sağlıklı olmak gibi kavramlarla değerlendirilmiştir. Kentte yaşayan halkın güvenliği için kamera türevi çeşitli sensörlerle kentsel alanların donatılması, kentte yaşanabilecek felaketlerin gözlemlenmesi ve gerekli önlemlerin alınması için çalışmalar yürütülmesi, eğitim, kültür, sanat, turizm alanlarına yatırım yapılması ve bu alanların geliştirilmesi akıllı yaşam için öne çıkan olgulardır. Akıllı hareketlilik karma ulaşım modlarına erişimin arttırılması, temiz ve motorsuz ulaşımın desteklenmesi ve son olarak bütünleşik bilgi ve iletişim teknolojileri altyapısı olarak tanımlanmıştır. Özellikle kentte yaşayanların iş piyasalarına erişiminin kolaylaştırılması için ulaşımın önemi üzerinde durulmuştur. Son olarak akıllı insan, 21. yüzyıl standartlarında eğitime erişilebilirlik, katılımcı toplum ve yaratıcılığın benimsenmesi olarak özetlenmiş ve sosyal sermayenin hayat boyu öğrenmeye erişebilmesinin altı çizilmiştir. Bu sayede kente aidiyet duygusunun da artacağı vurgulanmıştır.

Bu çalışmada, yukarıda kısaca tartışılmış olan akıllı hareketlilik kavramının üzerinde durulmaktadır. Akıllı hareketlilik en kısa ve özet biçimde, daha erişilebilir ve sürdürülebilir bir ulaşım altyapısına erişmek olarak tanımlanabilir ve hiç şüphesiz ki Akıllı Kentler olgusu için büyük önem taşımaktadır. Günümüzün gelişen kentleri için hareketlilik kavramı, insanların ve malların kent içinde etkin taşınması, kent ekonomisi ve kentteki günlük yaşam için oldukça kritiktir. Bu gerçeklik hareketlilik kavramını ulaşım ve trafik kavramlarının dahi önüne geçirmektedir (Mataix, 2010). Kentsel ulaşım sorunlarının çözülmesinde akıllı hareketlilik kavramı öne çıkmaktadır. Klasik yaklaşım olan toplu taşıma hizmetlerinin geliştirilmesi akıllı hareketlilik için yeterli olmamakta, bunun ötesine geçilerek teknolojinin ulaşım alanında yaygınlaştırılması, erişilebilir ve sürdürülebilir bir ulaşım ağının yaratılması gerekmektedir. Hareketlilik ile akıllı hareketlilik arasındaki en büyük fark da belki de bu noktadan çıkmaktadır. Vatandaşların ulaşım alanında gerçek zamanla bilgiye erişebilmeleri akıllı hareketlilik ve hareketlilik kavramları arasındaki belki de en büyük farkın altını çizmektedir. Bu durum, seyahat sürelerinin kısalmasına, seyahatlerin daha keyif alınabilir ve kaliteli olmasına, karbon salınım oranlarının düşürülmesine, maliyetlerin azaltılmasına ve genel olarak kentsel ulaşım hizmetlerinin iyileştirilmesine yardımcı olmaktadır (Manville, et al., 2014). Avrupa Komisyonu tarafından 2007 yılında yayınlanan Kentsel Hareketlilik İçin Yeni Bir Kültüre Doğru (Green Paper: Towards a New Culture for Urban Mobility) çalışması bu anlamda önemlidir (European Commission, 2007). Bu çalışma teknolojinin kullanımı, çevrenin korunması ve erişilebilirlik gibi temel hedeflere ulaşmanın yolu olarak özetlenebilecek olan belli kavramları tartışması bakımında önem taşımaktadır. Bu çalışma aynı zamanda Sürdürülebilir Kentsel Ulaşım ve Sürdürülebilir Kentsel hareketlilik planları, kentteki taşıt sayısının azaltılması, bilgi ve iletişim teknolojilerinin trafik yönetiminde kullanımı ve farklı ulaşım modlarının birbiri ile entegre edilmesi gibi incelemeye değer başlıkların üzerinde durması açısından dikkat çekicidir.

Bu durum açıkça yeni teknolojilerin geliştirilmesi ve takip edilmesini kent yöneticileri için önemli bir noktaya getirmektedir. Buna istinaden belediyeler gittikçe artan bir biçimde ulaşım ve trafik alanındaki gelişmeleri takip etmek durumundadır. Özellikle nesnelerin interneti gibi teknolojik ilerlemeler bu alanda çığır açacak yaklaşımların doğmasına sebep olmuştur. Aktörlerin bir araya getirilmesi, kentteki ulaşımın daha iyi anlaşılması, takip edilmesi ve hali hazırda var olan sorunlara çözüm bulunması gibi konularda teknolojinin kullanımının gerekli olduğu kaçınılmaz bir biçimde anlaşılmıştır. Geliştirilen politikalar çerçevesinde pek çok kamu kurumu, akıllı hareketlilik elemanlarını kendi kentlerinde uygulamaya koymaya başlamıştır.

Dünya'da yukarıda bahsedilen politikaların ve uygulamaların yaygınlaşması özellikle 1960'lı yıllardan itibaren başlamış ve 1960'lardan günümüze kadar olan geliştirme ve uygulama süreci üç ana dönem çerçevesinde tanımlanabilmektedir. Bu dönemlerin ilki olan 1960-1980 zaman diliminde özellikle araştırma ve akıllı hareketlilik uygulamalarına hazırlık ön plana çıkmıştır. Bu dönemde Japonya'da, Kapsamlı Otomobil Trafiği Yönetim Sistemi adı verilen bir uygulama geliştirilmeye başlanmıştır. Bu uygulamanın amacı ise Japonya'daki taşıt trafiğinin izlenmesi ve kontrol altında tutulması, ulaşım kaynaklı çevre kirliliğinin azaltılması, trafik kazalarının azaltılması şeklinde özetlenebilir. Benzer şekilde Amerika Birleşik Devletleri'nde de Elektronik Rota Yönlendirme Sistemi geliştirilmeye başlanmıştır. Bu çalışma yol ağının küçük parçalara bölünmesi ve her yol parçasına altı haneli bir numara vererek taşıt trafiğinin akışının ve rota takibinin kolaylaştırılması amacına sahiptir. Bu dönemin en önemli özelliği ise, telekomünikasyon ve enformatik kelimelerinin bir araya getirilmesiyle türetilen "telematik" kavramının bu tür sistemlerin tanımlanmasında kullanılmaya başlanmasıdır.

1980-1995 zaman diliminde akıllı ulaşım sistemlerinde standardizasyon dönemine girilmiştir. Ayrıca elektronik ücret toplama, global konumlama servislerine dayalı navigasyon uygulamaları, dinamik trafik yönetim sistemleri, yol ve hava

koşullarının izlenmesini sağlayan sistemler, mobil hız ölçüm ve hız ihlali tespit sistemleri ve trafik izleme kameraları gibi teknolojiler geliştirilmeye başlanmıştır. SCATS (Sydney Coordinated Adaptive Traffic Management System) adı verilen bir uygulama Avustralya'da geliştirilmiştir. Bu uygulama günümüzde hala kullanılmakta olup, akıllı trafik yönetim modelleri geliştirmekte ve yazılım olarak satılarak Dünya'nın pek çok ülkesinde kullanılmaktadır. Ek olarak ERTICO adı verilen Avrupa Akıllı Ulaşım Sistemleri Birliği de kurulmuş ve akıllı ulaşım sistemleri ile ilgili eğitimler ve konferanslar düzenlemiştir.

1995'ten günümüze uzanan zaman diliminde ise akıllı ulaşım sistemlerinin hızla yaygınlaştığı görülmektedir. Mobil trafik bilgisi paylaşımı, akıllı yaya erişim sistemleri ve uygulamaları, 3G, Wi-Fi ve Bluetooth tabanlı akıllı trafik ve ulaşım sistemleri gibi teknolojik gelişmeler hızla yayılmıştır. Ayrıca multimodal ulaşım yaklaşımı, sürdürülebilirliğin korunması amacıyla akıllı ulaşım sistemlerine başvurulması gibi politik gelişmeler de bu dönem içerisinde yaşanmış ve ek olarak Intertraffic gibi uluslararası ölçekte, üreticileri ve kullanıcıları bir araya getiren akıllı ulaşım sistemleri fuarları başlatılmıştır.

Türkiye'de de benzer biçimde akıllı ulaşım ve akıllı hareketlilik kavramları gitgide daha çok önem kazanmaktadır. Ancak Türkiye'de akıllı ulaşım sistemlerinin yaygınlaştırılması Dünya'nın diğer ülkelerine göre çok daha geç olmuştur. Türkiye'de genel olarak kullanılan akıllı ulaşım sistemleri ögeleri ise trafik izleme kameraları, yol ve yol kenarı sensörleri, trafik yoğunluk haritaları, değişken mesaj işaretçileri, değişken trafik işaretçileri, mobil bilgilendirme sistemleri, trafik kurallarının ihlallerini tespit eden sistemler, yatay ve düşey yol trafik işaretlemeleri ve levhaları, sinyalizasyon sistemleri (geri sayım üniteleri, erişilebilir yaya işaretleri) ile trafik eğitimi ve bilinçlendirici çalışmalar olarak özetlenebilir (Meriç, 2018). Türkiye'de ayrıca 1980'lerden itibaren trafik sinyallerinin optimizasyonu, otoyollarda otomatik ücret toplama sistemlerinin kullanılması, İstanbul'da Akbil ve daha sonra İstanbulkart uygulamasının devreye alınması gibi uygulamalar başlatılmıştır.

Türkiye'de ayrıca farklı kurum ve kuruluşlar tarafından hazırlanan pek çok strateji ve eylem planı dokümanında akıllı ulaşım sistemlerinin kullanımı ve geliştirilmesi adına politikalar üretilmiştir. Bu dokümanların başlıcaları arasında; Devlet Planlama Teşkilatı'nın koordinasyonunda hazırlanmış olan ve 2007-2013 yılları aralığını kapsayan 9. Kalkınma Planı (Devlet Planlama Teşkilatı, 2006), Ulaştırma Bakanlığı tarafından hazırlanmış olan ve 2009-2013 yılları aralığını kapsayan Stratejik Plan (Ulaştırma Bakanlığı, 2009), 2010 yılında TÜBİTAK (Türkiye Bilimsel ve Teknolojik Araştırma Kurumu) tarafından hazırlanmış olan ve 2011-2016 yılları aralığını kapsayan Ulusal Bilim, Yenilik ve Teknoloji Stratejisi (TÜBİTAK - Türkiye Bilimsel ve Teknolojik Araştırma Kurumu, 2010) ve son olarak 2012 yılında Emniyet Genel Müdürlüğü'nün koordinasyonunda hazırlanmış olan Karayolları Trafik Güvenliği Stratejisi ve Eylem Planı dokümanları gelmektedir. Bu dokümanların en göze çarpan ortak özelliği ise, akıllı ulaşım sistemlerinin sıkça trafik güvenliği olgusu ile birlikte anılması ve akıllı ulaşım sistemleri ürünlerinin yaygınlaştırılmasıyla trafik denetimlerinin arttırılması yaklaşımının benimsenmiş olmasıdır. Emniyet Genel Müdürlüğü tarafından hazırlanmış olan Karayolları Trafik Güvenliği Stratejisi ve Eylem Planı dokümanında öne çıkan bir nokta ise kapsamlı ve bütüncül bir akıllı ulaşım sistemleri eylem planının hazırlanmasına yönelik öneridir.

Bu plan 2014 yılının mayıs ayında Ulaştırma, Denizcilik ve Haberleşme Bakanlığı tarafından hazırlanmış ve Ulusal Akıllı Ulaşım Sistemleri Strateji Belgesi ve Eki Eylem Planı olarak adlandırılmıştır (T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, 2014). Bu plan akıllı ulaşım sistemlerini tamamıyla odak noktası olarak alan ilk doküman olması bakımından önem taşımaktadır. Bu çalışmanın gecikmişliği, dokümanın kendisinde de bahsedilen bir unsur olmuştur. Dokümana göre Türkiye'nin akıllı ulaşım sistemlerini uygulama konusunda nüfus yapısı, enformatik ve iletişim alanında gelişmişliği ve sanayi altyapısı sayesinde yüksek potansiyeli bulunmasına rağmen, kurumlar arasındaki iletişimsizlik ve koordinasyon eksikliği, standartlaştırma konusundaki yetersizlikler ve alanında uzman personel eksikliği sebepleriyle akıllı ulaşım sistemlerinin yayılması ve

geliştirilmesinde sorunlar yaşanmaktadır. Bu doküman kapsamında idari ve teknik yasal düzenlemelerin geliştirilmesi, küresel ölçekte rekabet edebilir bir akıllı ulaşım sistemleri sektörünün geliştirilmesi, bu sistemlerin yaygınlaştırılmasıyla hareketlilik ve trafik güvenliğinin arttırılması, düşük hareketliliğe sahip vatandaşların ulaşım modlarına erişiminin kolaylaştırılması ve yakıt tüketimi ile karbon salınımının azaltılması gibi hedefler koyulmuş ve bir İzleme ve Yönetim Komitesinin kurulması önerilmiştir.

Akıllı ulaşım sistemlerinin belki de en yaygın olarak kullanıldığı ve uygulandığı Türkiye kentlerinin başında ise Konya gelmektedir. Anadolu'nun merkezi bir noktasında bulunan ve ana yolların kesiştiği bir yerde konumlanmış olan Konya kentinin, 2018 rakamlarına göre yaklaşık nüfusu 2.205.609 olmakla birlikte, nüfusun %75'i Konya metropoliten alanında yaşamaktadır (Boğaziçi Proje, 2015).

Konya kentinde toplu taşıma Büyükşehir Belediyesi'ne bağlı olan belediye otobüsleri, tramvay ve dolmuş ile yapılmaktadır. Belediye bünyesinde çalıştırılan otobüsler ve tramvayda RFID teknolojisini kullanan ve temassız ödeme sağlayan Elkart sistemi 2000 yılından itibaren kullanılmaya başlanmıştır. Konya Büyükşehir Belediyesi, toplu taşıma hizmetlerinin iyileştirilmesine önem vermekte, bu sebepten ötürü toplu taşımada kullanılan Elkart'tan alınan verileri araştırma ve geliştirme amacıyla, kullanıcılara ait bilgiler şifrelenmiş bir biçimde özel sektör ile paylaşmakta ve hat uzunluğu, sefer sayısı, sefer sıklığı, hatta yolculuk yapan yolcu sayısı, güzergah gibi parametrelere göre iyileştirme çalışmaları yaptırmaktadır. Ek olarak toplanan bu veri yolculara dair Başlangıç-Varış Matrisleri hazırlanması için de kullanılmaktadır. Kentteki dolmuşlar ise özel firmalar tarafından kontrol edilmekte ve Elkart entegrasyonuna sahip bulunmamaktadır. Konya Büyükşehir Belediyesi'nde yapılan derinlemesine görüşmelerde, dolmuşlarda Elkart kullanılmamasına rağmen paylaşımlı bisikletlerde Elkart entegrasyonunun başlatılacağı ve hazırlanmakta olan Bisiklet Ana Planı aracılığıyla multimodal bir ulaşım anlayışının yaygınlaştırılacağı öne sürülmüştür.

Konya Büyükşehir Belediyesi tarafından kullanılmakta olan pek çok akıllı ulaşım sistemleri ürünü bulunmaktadır. Bu sistemlerin kullanımına nasıl başlandığı derinlemesine görüşmelerde Belediye çalışanlarına sorulmuştur. Akıllı ulaşım sistemlerinin kullanımında Türkiye'nin lider kentinin Konya olduğu yetkililer tarafından dile getirilirken, bu sistemlerin kullanımına ise daha önce bahsedilen Intertraffic fuarına katılımın sağlanmasından sonra başlandığı belirtilmiştir. Bu fuarda kamu ve özel sektörün bir araya gelmesi ve burada tanışılan yerli akıllı ulaşım sistemleri üreticileri, Konya Büyükşehir Belediyesi'nin akıllı hareketliliğin geliştirilmesi yolunda attığı ilk adımın kaynağı olmuştur. 2011 yılında ilk defa, Konya metropoliten alanında bulunan iki kavşakta, demo olarak bir dinamik kavşak yönetim sistemi kurulumu yapılmış ve sonrasında tamamen Sinyalizasyon Şube Müdürlüğü tarafından dokümanların hazırlanması ile ihaleye çıkılmıştır. Belediye yetkilileri ayrıca, belediyenin en büyük avantajlarından biri olarak belediye içinde bürokratik engellerin olmadığını, diğer birimlerce başarılı bulunan fikirlerin, fikir sahibi birim tarafından kolayca hayata geçirilebildiğini ve dinamik kavşak yönetimi uygulamasında da bu sebeple tamamen Sinyalizasyon Şube Müdürlüğü tarafından ihale ve alım süreçlerinin takip edildiğini belirtmişlerdir. İhale sonrasında 25 kavşakta dinamik kavşak yönetim sistemi ve yeşil dalga uygulaması hayata geçirilmiştir.

Dinamik kavşak yönetimi, kavşak yaklaşım kollarındaki taşıt sayısına bağlı olarak her turda yeşil ışık sürelerinin değiştirilebildiği sistemlerdir. Bu sayede taşıtların sinyalize kavşaklarda uzun süreli beklemelerinin önüne geçilebilmekte, seyahat süresi, yakıt tüketimi ve karbon salınımı azaltılmaktadır. Hali hazırda Konya'da 48 kavşakta bu uygulama bulunmaktadır (Konya Traffic Control Center, 2019). Benzer biçimde yeşil dalga uygulaması da ana arterinde yoğunluk bulunan koridorlar üzerinde hız limiti içinde seyreden taşıtların birbirini takip eden kavşaklar boyunca yeşil ışık ile karşılaşmasını sağlayan bir sistemdir. Bu sistemler Demiryolu Caddesi, Ali Ulvi Kurucu Caddesi, Fetih Caddesi, Mevlana Caddesi, Şefik Can Caddesi, Karaman Çevre Yolu, Karaman Caddesi, Aslanlı Kışla Caddesi,

Doç. Dr. Halil Ürün Caddesi, Safahat Caddesi ve İstanbul Caddesi'nde yer alan toplam 15 kavşakta uygulanmaktadır.

Konya'da koridor ortalama hız ihlal tespit sistemleri de bulunmaktadır. Bu sistemler, iki nokta arasına yerleştirilen plaka tanıma ünitelerinin aynı taşıt plakasını yakalaması sonucunda, cihazlar arasındaki mesafe ve yakalanmalar arasında geçe süreye göre hız hesabı yapılması ile çalışmaktadır. Doğrudan İl Emniyet Genel Müdürlüğü'ne bağlı olan bu sistem ile otomatik olarak ceza kesilebilmekte ve emniyet güçlerinin onayından sonra sürücülere iletilmektedir (ISSD, 2019). Çevreyolu Caddesi, Adana Çevre Yolu ve Yeni İstanbul Yolu'nda hali hazırda bu sistemler çalıştırılmakta ve sistem alımını üstlenmiş olan Konya Büyükşehir Belediyesi de toplanan cezalardan belli oranda pay almaktadır. Ek olarak, park ihlal tespit sistemleri de kentte kurulma aşamasında olup kısa sürede devreye alınması hedeflenmektedir.

Konya'da ayrıca Bluetooth tabanlı trafik analiz sistemi kullanılmakta ve bu sistemlerin kurulu olduğu noktalarda Bluetooth üzerinden eşleşen cihazlar vasıtasıyla ortalama seyahat süresi hesabı yapılmaktadır. Bu süreler aynı zamanda şehrin pek çok noktasına kurulmuş olan değişken mesaj işaretleri aracılığıyla paylaşılmaktadır. Değişken mesaj işaretleri aynı zamanda, merkezde yer alan park yerlerinde bulunan boş park alanlarının sayısını da gösterebilmektedir. Bluetooth cihazları ek olarak Başlangıç-Varış matrislerinin belirlenmesine de katkı sağlamaktadır.

Tüm bu sistemler ve bunlara ek olarak belediye tarafından kendi sitelerinde ve geliştirilmiş olan mobil uygulamada halk tarafından erişilebilir olan kent ve kavşak izleme kameraları, Konya Büyükşehir Belediyesi Trafik Kontrol Merkezi'ne entegre edilmiştir. Kentin modern bir trafik kontrol merkezi bulunmamakta ve belediye yetkililerinin kendi zamanlarını ayırmalarıyla trafik takip edilebilmektedir. Trafik kontrol merkezi yazılımı üzerinde sistemlerin bulunduğu tüm kavşaklar, ortalama hız ihlal tespit koridorları, değişken mesaj işaretçileri,

Bluetooth cihazları gibi tüm akıllı ulaşım unsurları erişilebilir ve kontrol edilebilir vaziyettedir.

Konya Büyükşehir Belediyesi metropoliten alanı içinde yaşayan halkın kentteki akıllı ulaşım çalışmalarına bakışının anlaşılması için kentte bir anket çalışması da yapılmıştır. Bu anket çalışması toplamda 19 soru içermekte ve toplu taşıma, ulaşımda yaşanan sıkıntılar, akıllı ulaşım unsurlarının bilinirliği gibi araştırma soruları içermektedir. Öncelikli olarak katılımcıların hangi ulaşım modunu tercih ettikleri anlaşılmaya çalışılmıştır. Katılımcılara birden fazla modu seçme şansı da verilmiştir. Alınan sonuçlara göre katılımcılar en çok tramvay kullanmakta (41), ve daha sonra sırasıyla otobüs, özel araç, dolmuş ve yürüme tercih etmektedir.

Katılımcılara ayrıca akıllı ulaşım sistemlerinin yaygınlaştırılması gerekip gerekmediği sorulmuş ve katılımcıların yaklaşık %80'i yaygınlaştırılması gerektiğini ve bu alanda belediye tarafından yatırımlar yapılması gerektiğini öne sürmüştür. Buna bağlı olarak belediye yetkililerinin bu alanda yapılan çalışmalar hakkında halkı yeterli oranda bilgilendirip bilgilendirilmediği sorulduğunda katılımcıların yaklaşık %81'i bu yatırımlarla ilgili kendilerinin fikirlerinin alınmadığını dile getirmiştir.

Katılımcılara ayrıca toplu taşıma alanına dair sorular da yöneltilmiştir. Konya Büyükşehir Belediyesi tarafından geliştirilen Akıllı Toplu Ulaşım Sistemi (ATUS) uygulaması, kullanıcılara hat, güzergah, sefer saatleri ve duraklar ile ilgili bilgi sunmakta, internet ve Konya Şehir Rehberi mobil uygulaması üzerinden erişilebilmektedir. Katılımcıların yaklaşık %61'i bu uygulamayı kullandıklarını belirtmişler ve ATUS'u kullananların yaklaşık %76'sı uygulamayı sıklıkla kullandıklarını dile getirmişlerdir. Ek olarak, kentte bulunan akıllı otobüs durakları ile ilgili sorular da katılımcılara yöneltilmiştir. Bu duraklarda yaklaşan otobüsün durağa gelmesi için kalan süre ve hangi hatta çalışan otobüsünün geldiği bilgisi paylaşılmaktadır. Anket sonuçlarına göre katılımcıların %54'ü akıllı duraklardan yüksek oranda memnun olduklarını dile getirmişlerdir. Memnun olmayan kullanıcılar ise çoğunlukla duraklarda yaşanan teknik sorunları

memnuniyetsizliklerinin sebebi olarak belirtmişlerdir. Katılımcılara akıllı durakların sayısının arttırılmasının gerekip gerekmediği sorulduğunda ise %88 oranında olumlu yanıtlar alınmıştır.

Kullanıcılara ayrıca dinamik kavşak sistemlerinden haberdar olup olmadıkları sorulduğunda %64 oranında sistemlerin bilinmediği anlaşılmıştır. Yetkililerle yapılan görüşmelerde de yetkililerin sistemlerin kurulmasına ve çalıştırılmasına fazlaca odaklandıkları ve bu sebeple bilgilendirme çalışmalarına genellikle vakit ayıramadıkları dile getirilmiştir. Bu durum da anketlerle anlaşılabilmektedir. Katılımcılara ayrıca dinamik kavşak uygulamasının sayıca arttırılmasının gerekip gerekmediği sorulduğunda %76'sının arttırılmasının gerektiğini dile getirdikleri görülmüştür. Ayrıca, kentte bulunan elektronik denetleme sistemlerinin bilinirliği sorulduğunda katılımcıların %54'ü sistemleri bildiklerini dile getirmiş ve yaklaşık %30'u ise sistemlerden memnun olduklarını belirtmiştir. Kullanıcılara ayrıca Konya Şehir Rehberi uygulamasını kullanıp kullanmadıkları sorulduğunda katılımcıların %31'inin uygulamayı kullandığı gözlemlenmiştir. Son olarak kullanıcılara sorulan açık uçlu sorulardan kentteki ulaşım problemleri olarak neleri belirttikleri anlaşılmaya çalışılmış ve verilen cevaplar yedi ana başlıkta gruplanmıştır. Buna göre kentteki ulaşım sorularının başında servislerin sunumuna dair sorunlar (26 kişi) gelmekte ve bu sorunlar altyapı sorunları (14 kişi), trafik akımına dair sorunlar (10 kişi), yönetişim sorunları (9 kişi), parklanma sorunları (9 kişi) ve yaya erişimi sorunları (4 kişi) olarak özetlenmiş ve 4 kullanıcı ise hiçbir sorun bulunmadığını dile getirmişlerdir.

Tartışmasız olarak, Konya Büyükşehir Belediyesi akıllı ulaşım sistemlerinin uygulanmasında ilerici bir yaklaşıma sahiptir ve uyguladığı politikalar çok çeşitlidir. Ancak genellikle bu uygulamaların taşıt trafiğine yönelik olduğunu söylemek mümkündür. Örneğin dinamik kavşak sistemleri, elektronik denetleme sistemleri, ortalama seyahat süresinin paylaşımı gibi yatırımlar genelde özel araç kullanıcılarını hedeflemektedir. Dinamik kavşak uygulaması aynı zamanda önceliği toplu taşımaya vermediğinden, tramvaylar hemzemin geçitlerde taşıt trafiğini

beklemek zorunda kalmaktadır. Ancak bu tür uygulamalara ek olarak yaya ve toplu taşıma odaklı uygulamalara da yer verilmesi önem taşımaktadır. Örneğin halkın yüksek memnuniyetini kazanmış olan ve kıyasla düşük maliyete sahip olan akıllı otobüs duraklarının sayısı arttırılabilir ve tüm toplu taşıma unsurlarında Elkart yaygınlaştırılarak dolmuşlar da bu sisteme dahil edilebilir. Bu sayede dolmuş kullanıcılarına dair veriler de toplanabileceğinden, dolmuş güzergahlarının optimizasyonu gibi çalışmalar da kolayca yürütülebilir ve servis kalitesi arttırılabilir. Konya Şehir Rehberi uygulamasının aktif bir biçimde tanıtımı, hem ATUS kullanım oranlarını arttırma potansiyeline sahiptir hem de uygulamanın e-belediye hizmetleri içermesi sebebiyle yüksek kullanımı belediye hizmetlerine erişimi de kolaylaştıracaktır.

Belediye tarafından yapılan uygulamaların genellikle proje bazlı olduğu ve bütüncül bir yaklaşımla değerlendirilmediğini söylemek mümkündür. Bu sebeple belediyenin özellikle Avrupa ülkelerinde sıkça başvurulan Sürdürülebilir Kentsel Hareketlilik Planları hazırlaması ve ulaşımın tüm unsurlarını bir arada değerlendirmesi önemlidir. Ayrıca bu süreç içinde akademik çevreler ve sivil toplum örgütleri ile iş birliğine önem verilmesi de gerekmektedir. Bu sayede araştırma ve politika üretimi arasında daha gelişmiş bağların kurulması mümkün olabilir.

Belediye ayrıca, planladığı uygulamaları halk ile paylaşmayı önemli bir politika olarak ele almalıdır. Bu sayede sadece akıllı hareketlilik unsurlarının uygulanmasının ve fiziksel uygulamaların öne çıkmasının bir adım önüne geçilebilir ve kentin Akıllı Şehir olması için akıllı yönetişim alanında da adımlar atılabilir. Bu sayede vatandaşlar kullanıcı olarak görülmekten ziyade, karar verici konumuna geçecektir.

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TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English) :

CRITICAL EVALUATION OF SMART MOBILITY POLICIES OF KONYA METROPOLITAN MUNICIPALITY

TEZİN TÜRÜ / DEGREE: **Yüksek Lisans** / Master ☒ **Doktora** / PhD ☐

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