MAPPING OUT SMART CITY INITIATIVES IN THE TURKISH CONTEXT

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

DENİZ CAN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
CITY PLANNING

SEPTEMBER 2019

Approval of the thesis:

MAPPING OUT SMART CITY INITIATIVES IN THE TURKISH CONTEXT

submitted by **DENİZ CAN** in partial fulfillment of the requirements for the degree of **Master of Science in City Planning in City and Regional Planning Department, Middle East Technical University** by,

Prof. Dr. Halil Kalıpçılar
Dean, Graduate School of **Natural and Applied Sciences** _____

Prof. Dr. Çağatay Keskinok
Head of Department, **City and Regional Planning** _____

Assoc. Prof. Dr. Osman Balaban
Supervisor, **City and Regional Planning, METU** _____

Examining Committee Members:

Prof. Dr. Serap Kayasü
City and Regional Planning, METU _____

Assoc. Prof. Dr. Osman Balaban
City and Regional Planning, METU _____

Prof. Dr. Ela Babalık
City and Regional Planning, METU _____

Assist. Prof. Dr. M. Anıl Şenyel Kürkçüoğlu
City and Regional Planning, METU _____

Prof. Dr. Çiğdem Varol Özden
City and Regional Planning, Gazi University _____

Date: 10.09.2019

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Surname: Deniz Can

Signature:

ABSTRACT

MAPPING OUT SMART CITY INITIATIVES IN THE TURKISH CONTEXT

Can, Deniz
Master of Science, City Planning in City and Regional Planning
Supervisor: Assoc. Prof. Dr. Osman Balaban

September 2019, 157 pages

In 2008, urban population exceeded rural population for the first time in history due to rapid growth in urban areas. While urban population constituted only 34% of the world population in 1960, this ratio is projected to outpace 68% by year 2050. Constantly increasing population in cities becomes the main generator of social, economic and environmental values, thus creating a vicious cycle of migration to urban areas in pursuit of these generated values. Worldwide population increase trends in cities created manifold complicated problems. With the excessive populations in cities, both consumption of resources and production of waste also increased to a critical point. These anthropocentric activities cause irreversible environmental deterioration, unequal social structure as well as management and infrastructure problems that increased consumption and production necessitates. This situation unveiled that traditional urban planning and development approaches would not be enough for complex urban problems emerged with rapid urbanization processes. The recent developments in innovative technologies direct to the constitution of a new planning and development approach which would acknowledge contemporary issues of cities and respond to complex urban challenges. An umbrella term, "smart city" recently emerged in order to initiate an attempt to tackle the complex problems in cities with the development of new technologies. Smart city approach in city planning

addresses issues, which stem from urbanization and, uses the opportunities information and communication technologies offer, in order to seek sustainability in economic, social and environmental contexts.

This research aims to compile and assess smart city initiatives in the Turkish context with regards to several different global trends in this domain. While first National Smart City Policy document has been prepared in 2019 by the Ministry of Environment and Urbanization, the understanding of this concept has gained major importance. Smart city strategies, initiatives and attempts of all relevant Turkish administrative bodies are examined in-depth (both at national and local levels) to portray a holistic framework of smart city approach in Turkey. This framework is thus critically evaluated with reference to global trends and approaches in smart city vision.

Keywords: Smart City, Smart Growth, National Smart City Policies, Turkey, ICT

ÖZ

AKILLI ŞEHİR GİRİŞİMLERİNİN TÜRKİYE BAĞLAMINDA İNCELENMESİ

Can, Deniz
Yüksek Lisans, Şehir Planlama
Tez Danışmanı: Doç. Dr. Osman Balaban

Eylül 2019, 157 sayfa

2008 yılında, tarihte ilk kez kent nüfusu, kentlerdeki hızlı büyümenin sonucu olarak kırsal nüfusu aştı. Kentsel nüfus 1960 yılında dünya nüfusunun yalnızca %34'ünü oluştururken, bu oranın 2050 yılına kadar %68'in üstüne çıkaracağı öngörülmektedir. Şehirlerde sürekli artan nüfus; sosyal, ekonomik ve çevresel değerlerin ana üreticisi haline gelmekte, ve böylece kentte üretilen değerlerin peşinde kentsel alanlara göç ile bir kısır döngü oluşturmaktadır. Dünya çapındaki kentsel nüfustaki artış, çeşitli karmaşık problemlere yol açmaktadır. Şehirlerdeki aşırı nüfus ile birlikte, kaynak tüketimi ve atık üretimi kritik bir noktaya yükselmektedir. Bu insan kaynaklı faaliyetler geri dönüşü olmayan çevresel bozulmalara, eşit olmayan sosyal yapıya, artan tüketim ve üretimin ihtiyaç duyduğu yönetim ve altyapı sorunlarına neden olmaktadır. Bu durum, hızlı kentleşme süreçleri ile ortaya çıkan karmaşık kentsel sorunlar için geleneksel şehir planlama ve gelişme yaklaşımlarının yeterli olmayacağını ortaya koymaktadır. Yenilikçi teknolojilerdeki son gelişmeler, şehirlerin çağdaş sorunlarını kabul eden ve karmaşık kentsel zorluklara cevap verebilecek yeni bir planlama ve gelişme yaklaşımının oluşturulmasına yol açmaktadır. Kapsayıcı bir terim olarak "akıllı kentler", yeni teknolojilerin gelişmesiyle şehirlerdeki karmaşık sorunların üstesinden gelme girişiminde bulunma amacıyla son dönemlerde ortaya çıkmıştır. Şehir planlamada akıllı şehir yaklaşımı,

ekonomik, sosyal ve çevresel sürdürülebilirlik arayışını sağlamak için, şehirleşme sonucu oluşan sorunları ele alarak, bilgi ve iletişim teknolojilerinin sunduğu fırsatları kullanmaktadır.

Bu araştırma, akıllı şehir girişimlerini Türkiye bağlamında, bu alandaki farklı küresel eğilimler açısından derlemeyi ve değerlendirmeyi amaçlamaktadır. İlk Ulusal Akıllı Şehir Politikası dokümanı 2019 yılında Çevre ve Şehircilik Bakanlığı tarafından hazırlanırken, bu kavramın anlaşılması büyük önem kazanmıştır. Türkiye'deki akıllı şehir yaklaşımını bütünsel bir çerçevede tanımlamak için, Türkiye'nin ilgili tüm idari organlarının akıllı şehir stratejileri, girişimleri ve çabaları (hem ulusal hem yerel düzeyde) derinlemesine incelenmiştir. Bu çerçevede, akıllı şehir vizyonundaki küresel eğilimler ve yaklaşımlar referans alınarak eleştirel bir değerlendirme yapılmıştır.

Anahtar Kelimeler: Akıllı Kent, Akıllı Büyüme, Ulusal Akıllı Şehir Politikaları, Türkiye, BİT

to my own self

ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincere gratitude to my supervisor Assoc. Dr. Osman Balaban for offering intellectual guidance and constructive criticism during my thesis studies, by spending his valuable time with me. His insightful comments and suggestions enlightened my mind. He has been my mentor and supporter throughout this study. It would not have been possible to complete this thesis without his support and encouragement.

I would like to express my gratitude to all of my professors within the department from whom I have learned a lot. I owe special thanks to Prof. Dr. Serap Kayasü, city planner Işıl Nadire Yener from Presidency of Strategy and Budget, city planner Sadık Tipi in Ankara Metropolitan Municipality for their generous help in this research. I would also like to thank Hakan Güven, head of the Directorate General of Geographic Information Systems in the Ministry of Environment and Urbanization for taking his time and agreeing to meet with me. My gratitude extends further to all the people who helped in my research and provided an open data sharing arena for this thesis.

I would also like to thank my committee members, Prof. Dr. Serap Kayasü, Prof. Dr. Ela Babalık, Prof Dr. Çiğdem Varol Özden and Assist. Prof. Dr. M. Anıl Şenyel Kürkçüoğlu for their valuable feedback and inspiring comments.

I owe special thanks to my dear professors Assoc. Dr. Osman Tutal and Assoc. Dr. Adnan Aksu who have always supported me in my academic career and encouraged me in my studies.

I am deeply grateful to Mahir Onat Topal for his invaluable support, assistance and encouragement during the course of this work. I would like to express my thanks to my colleagues Sinem Görücü, Esma Aksoy Khurami and Arzu Aslaner with whom I

proceed together on this journey. My gratitude extends further to include my friends İpek Tavukçuoğlu, Hilal Pat and Adnan İlbay for their endless support.

Finally, my deepest thanks and gratitude go to my dearest family, whose endless support, love and encouragement are blessings for me, and they are my inspiration to persevere. My father Mustafa Can who has always encouraged me in my career; he has been my true inspiration as an architect. My passion for my profession, and my aspiration for city planning and architecture is a result of his inspiration. My mother Şengül Can have always been my guide in life; her devotion to her ideals and ethical way of life have been my light source, even in the darkest times.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

AMM (ABB): Ankara Metropolitan Municipality (*Ankara Büyükşehir Belediyesi*)

ASAT: Antalya Water and Wastewater Administration General Directorate (*Antalya Su ve Atıksu İdaresi Genel Müdürlüğü*)

ASEAN: Association of Southeast Asian Nations

ASKİ: Ankara Water and Sewage Administration (*Ankara Su ve Kanalizasyon İdaresi*)

ATAK: Adaptive Traffic Management Systems (*Adaptif Trafik Yönetim Sistemi*)

ATUS: Smart Public Transportation Systems (*Akıllı Toplu Taşıma Sistemleri*)

AUSDER: Smart Transportation Systems Association (*Akıllı Ulaşım Sistemleri Derneği*)

BEBKA: Bursa, Eskişehir, Bilecik Development Agency (*Bursa, Eskişehir, Bilecik Kalkınma Ajansı*)

Burulaş: Bursa Transportation - Public Transportation Management Tourism Industry and Trade Inc. (*Bursa Ulaşım– Toplu Taşım İşletmeciliği Turizmm Sanayi ve Ticaret A.Ş.*)

BUSKİ: Bursa Water and Sewage Administration (*Bursa Su ve Kanalizasyon İdaresi*)

°C: Celcius

COP: Conference of Parties

CT: Communication Technology

EDS: Electronic Detection System

EEA: European Environment Agency

ESPON: The European Observation Network for Territorial Development and Cohesion

EU: European Union

EC: European Commission

Eurostat: Statistical Office of European Union

GHG: Greenhouse Gas

GIS: Geographic Information Systems

ICT: Information and Communication Technologies

IT: Information Technologies

IEA: International Energy Agency

İMM (İBB): İstanbul Metropolitan Municipality (*İstanbul Büyükşehir Belediyesi*)

IoT: Internet of Things

IPCC: International Panel on Climate Change

İSKİ: İstanbul Water and Sewerage Administration (*İstanbul Su ve Kanalizayon İdaresi*)

İSTAÇ: İstanbul Environmental Protection and Waste Material Assessment Industry and Trade Inc. (*İstanbul Çevre Koruma ve Atık Maddeleri Değerlendirme Sanayi ve Ticaret A.Ş.*)

İSTTELKOM: İstanbul Electronic Communication and Infrastructure Services Industry and Trade Inc. (*İstanbul Elektronik Haberleşme ve Altyapı Hizmetleri Sanayi ve Ticaret A.Ş.*)

İSTKA: İstanbul Development Agency (*İstanbul Kalkınma Ajansı*)

İSBAK: IT and Smart City Technologies Inc. (*İstanbul Bilişim ve Akıllı Kent Teknolojileri A.Ş.*)

IT: Information Technology

İTÜ: İstanbul Technical University

METİS: Central Traffic Operation Systems (*Merkezi Trafik İşletim Sistemleri*)

MEU: Ministry of Environment and Urbanization

MTI: Ministry of Transport and Infrastructure

NGO: Non-governmental Organization

R&D: Research and Development

SCC: Smart City Council

SCST: Supreme Council for Science and Technology (*Bilim ve Teknoloji Yüksek Kurulu - BTYK*)

STS (AUS): Smart Transportation Systems (Akıllı Ulaşım Sistemleri)

TBV: Turkish Informatics Foundation (*TBV- Türkiye Bilişim Vakfı*)

TÜİK: Turkish Statistical Institute (*Türkiye İstatistik Kurumu*)

TÜBİTAK: The Scientific and Technological Research Council of Turkey (*Türkiye Bilimsel ve Teknolojik Araştırma Kurumu*)

TÜBİTAK BİLGEM YTE: The Scientific and Technological Research Council of Turkey, Informatics and Information Security Advanced Technologies Research Center, Software Technologies Research Institute (*Türkiye Bilimsel ve Teknolojik Araştırma Kurumu, Bilişim ve Bilgi Güvenliği İleri Teknolojiler Araştırma Merkezi, Yazılım Teknolojileri Araştırma Enstitüsü*)

UN: United Nations

UNFCCC: United Nations Framework Convention on Climate Change

UYM : Transport Management Center (*Ulaşım Yönetim Merkezi*)

WM: megawatt

CHAPTER 1

INTRODUCTION

1.1. Background

Smart City concept has been in the agenda of academic literature, and national and international policies for two decades. It takes its roots from several approaches such as sustainability, network society, creative class; all of which aim to explain and generate effective solutions for the problems and threats today's cities face. These approaches propose a new way of development for the future along their visions. The main focus of all of these themes lies in meeting the emerging needs of the city. In this regard, the technological leap that is occurring in the world, has been regarded as a strategic road map for the effective management of cities in order to achieve sustainable prosperity aims.

Cities are the core of both the problems that the world is facing and the solutions for them (Albino et al., 2015). The extensive systems that cities have, fabricate them as dynamic, living organisms where social, economic and environmental values are mainly generated. This means that every problem caused by cities could be solved in the cities. Like a living organism, the dynamic structure of cities is in constant change and this leads to new problems, opportunities and needs. In the second half of the 20th century, with industrialization, migration movement from rural to urban areas started to take place and caused population density to increase in these cities. As of 2008, more than half of the population is living in cities and partaking in the creation of this social-economic ecosystem (UN, 2008). The year 2008 has been a critical threshold for cities that marked rapid urbanization which have increased day by day from thereon (Figure 1.1 show population rise in urban and rural areas between 1960 and 2018). After a decade, now urban areas contain 54% of the world total population and

this ratio is expected to increase each year (Worldbank, 2017). The urban population is projected to become 66% of the total world population as near as 2050 (Figure 1.2 depicts the ratio in between urban and rural population). With more than half the population in them, cities have a significant influence on economy where most of the resources are consumed. Albino et al. (2015) characterize cities as a metabolism which consists of input of goods and the output of wastes. Becoming a growing market also comes with ecological burdens. Cities use 60-80% of energy worldwide and they are responsible for a significant part of total GHG emission (Worldbank, 2017). All of these have impact on the social environment of urban areas where accessibility to resources, unhealthy settlements and physical risks become daily problems.

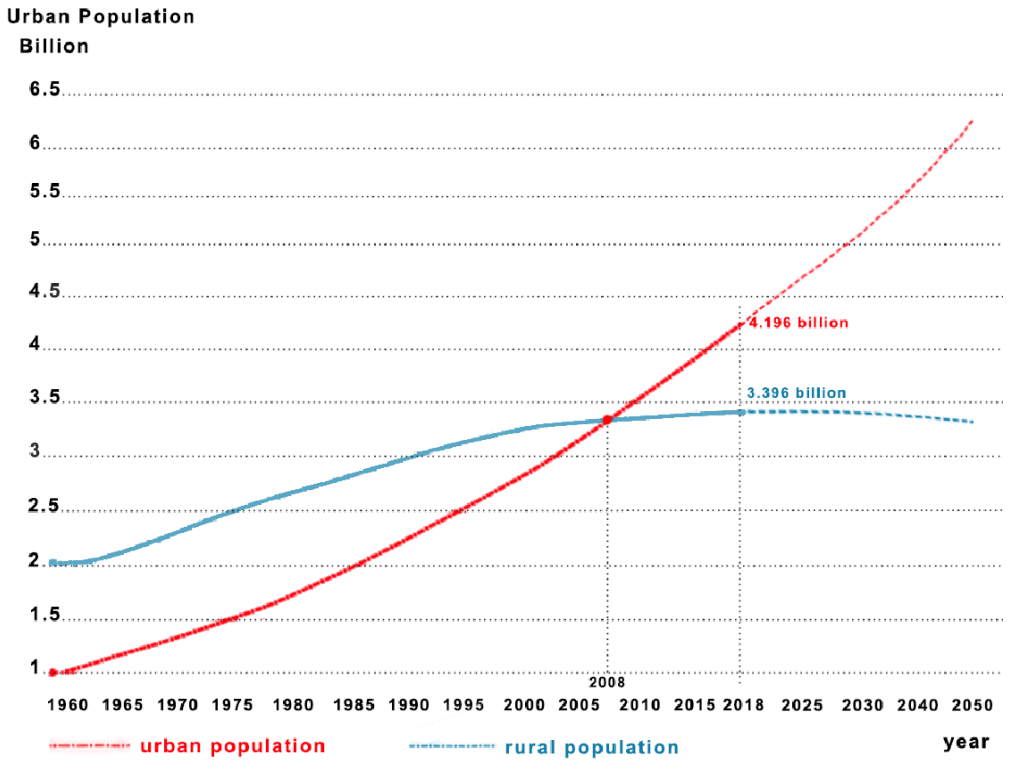


Figure 1.1. Urban and Rural Population Change in the World. (graph is created with the data obtained from Worldbank, 2018)

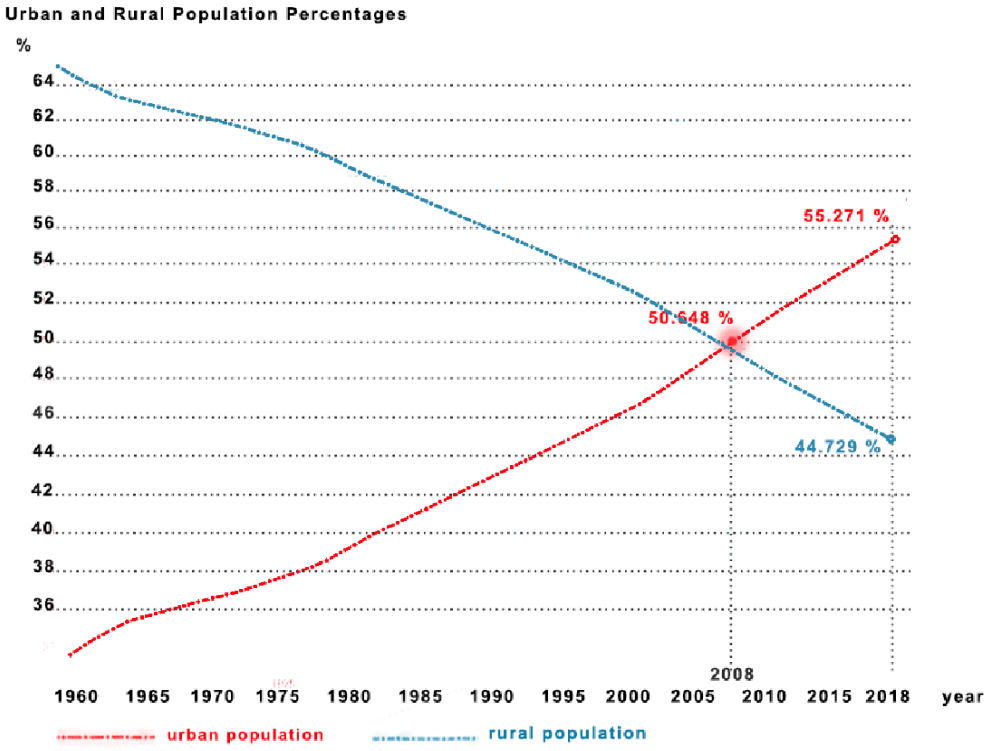


Figure 1.2. Urban and Rural Population Ratio in the World. (graph is created with the data obtained from Worldbank, 2018)

The increase in populations in cities and rapid urbanization rates, led both consumption of resources and production of waste to increase to a critical point. These anthropocentric activities cause irreversible environmental deterioration, unequal social structure, management and infrastructure problems that come with it. The impact of urbanization along with industrialization led to a major ecological crisis universally. Population, excessive consumption and energy usage have become the most pressuring issues on planet's resources (Figure 1.3, Figure 1.4). The consumption of limited resources and production of waste and emission of greenhouse gases are increasing year by year, leading our planet's state into a dangerous point (Figure 1.5).

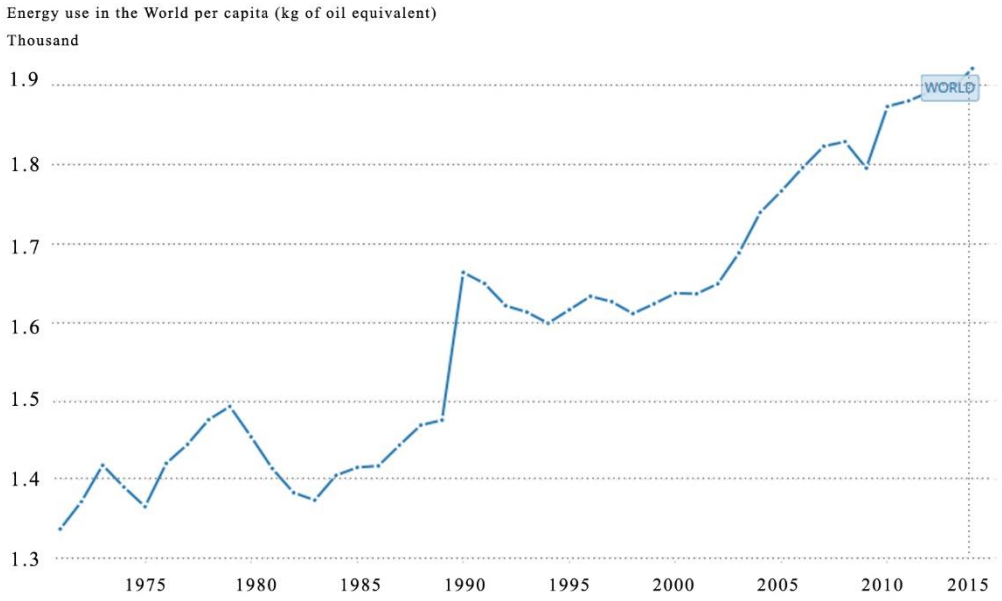


Figure 1.3. Total Energy Use in the World per capita between 1975-2015 (graph is created with the data obtained from Worldbank, 2018)

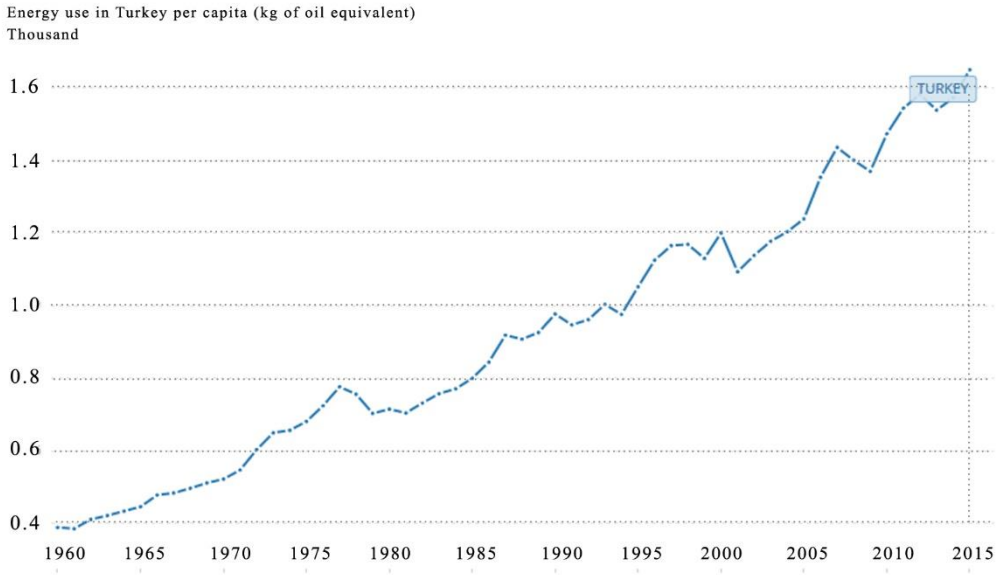


Figure 1.4. Total Energy Use in Turkey per capita between 1960-2015 (graph is created with the data obtained from Worldbank, 2018)

Global Footprint Network (2019), noted that July 29, 2019 became the Earth Overshoot Day[1] which is the earliest recorded in the history. This means that world biocapacity for the year 2019 is depleted in July, 29 and after this date every consumption is done by borrowing from next years' biocapacity. In other words, while borrowing from future, we are draining all the limited resources that or planet generates. In order to realize our daily life needs, we are using 1,5 times of the resources that earth generates annually and this number is expected to become two times by 2030, and exponentially grow if there would be no precautions (Balaban, 2019, Odero, 2013, Kudelas et al., 2018). Increased environmental footprint triggers ecosystem loss, global warming and climate change. These issues becoming more prominent each day with increased need in urban infrastructure, high demands of energy and resources and expending social services. It is believed that anthropocentric activities are the main reason of global warming since mid-20th century and high consumption of resources and high production of wastes and along with use of fossil fuels are the main generators that reinforce this process. The main initiator of this process in the increased amount of greenhouse gas emissions. Table 1.5 shows the GHG increase within the last fifty years and the sectors that play a part in this process are shown in Table 1.6. The prevention of this global process lies within renewable energy use, energy efficiency, sustainable infrastructure, sustainable management of resources and consumption.

[1] Earth Overshoot Day (EOD – also known as Ecological Dept Day – EDD) indicates the day in which the consumption of resources exceeds the resources generated that year by Earth. It is calculated by the division of annual world capacity by the ecological man-made (anthropocentric) footprint, and this number is multiplied by 365 (total calendar days) in order to find the exact date. The annual world capacity indicates the amount of resources generated by earth that year and it also means the annual capacity to absorb wastes. In this sense ecological footprint refers to the consumption of resources and absorption of wastes that are generated (Global Footprint Network 2019).

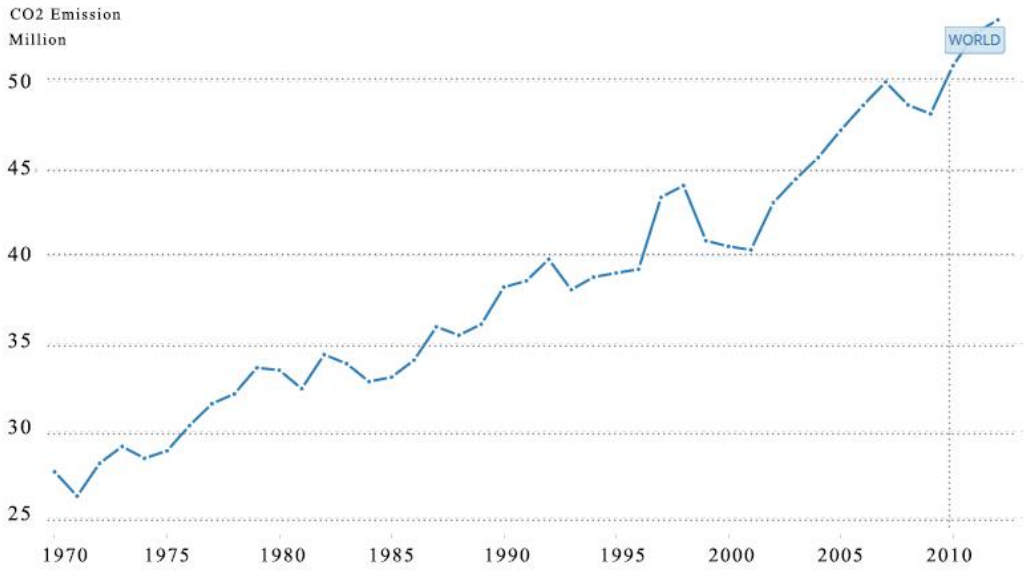


Figure 1.5. Total Greenhouse Gas Emission in the World (graph is created with the data obtained from Worldbank, 2018)

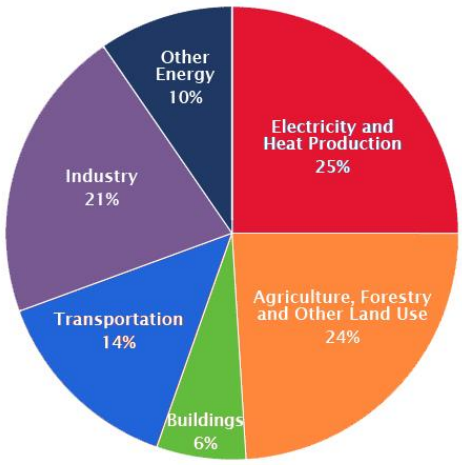


Figure 1.6. Global Greenhouse Gas Emissions by Economic Sector (IPCC, 2014).

In order to prevent ecological deterioration and limit global warming the concept of Paris Agreement has raised in 2015 at the COP21[2]. The Paris agreement aims restrain the global average temperature rise by 1,5°C above pre-industrial levels by decreasing the GHG emission (UNFCC, 2015). In 2017 human induced global warming already become 1°C and it is presumed to rise 0.2°C per each 10 year if this situation is not taken under control. With the Paris Agreement, in order achieve the aim of not surpassing 1.5°C temperature rise, each attended country had submitted Intended Nationally Determined Contribution (INDCs) to UNFCC, which stands for each countries' target and contribution to decrease the GHG emission (IPCC, 2018). To be able to achieve these targets the cities, their inputs and outputs play important role along with the opportunities the technological progress and innovation bear. International Energy Agency (2018) notes that use and demand for energy is one of the prominent factors for GHG emission and subsequently global warming. IEA (2018) states that 50% of CO2 emission can be eliminated with the right measures for energy efficiency. This is also supported by Ericsson Mobility Report (2019) which states; by only controlling the energy wastes that is occurred even it reaches the place of consumption, smart technologies and ICTs (sensors, meters etc.) have the potential of eliminating 15% of energy related GHG emission. The dynamic technological advancement and its impact on cities are expected to play a pivotal role within this process. In order to achieve the INDC targets, low carbon trajectory, climate actions and sustainability aims, smart city concept comes into prominence with its effective and efficient concept. The intelligent use of data collected by sensors would propose the possibility of efficient and effective management of urban assets and resources and, with the information gathered it could form a basis for smart decision-making for future.

As in universal course of events, in the Turkish context the demand for energy, consumption of resources and production of wastes are increasing rapidly (Figure 1.4).

[2] 21st Conference of Parties of the UNFCCC

This is stated as a result of economic growth and population increase (Ministry of Foreign Affairs, 2019). It is noted by IEA (2015) that Turkey has the fastest growth in electric energy demand among OECD members within a decade with an annual growth rate of 5, 5%. Furthermore, it is expected that Turkey's energy use will increase by 50% over the next decade (Ministry of Foreign Affairs, 2019). The Earth Overshoot Day for Turkey is determined June, 27, one month earlier than universally average date. This means date Turkey is consuming its resources and producing wastes 1,9 more than the its capacity to fulfill these environmental and resource needs (Global Footprint Network 2019).

Aforementioned events, rapid urbanization, high consumption demands and ecological crises formed a basis for the formation of the sustainability movement. To be able to create a sustainable future for the cities, it is seen that traditional planning approaches would not be enough. The emergence of the concept of smart city occurred in 1990s to offer a new planning approach through the use of advanced technological solutions in order to address problems which come with rapid urbanization. The aim of smart city approach is to act as facilitator to reinforce solutions for urban problems, create a connected city and introduce platforms where citizen participation is sustained. The advances in technology (broadband connections, ubiquitous sensor/monitors, big data and other ICT an IoT based networks) are seen as an opportunity to improve both the environment and the urban services by using information and communication technologies to this advantage.

There are three factors that gave rise to the emergence of smart cities in the planning paradigm. The first is the urban population, which has reached a size on a global level that makes urban problems more complex. The second is environmental problems with serious consequences, which necessitate critical measures. The last one is the opportunity provided by new technologies to make rational decisions by collecting data for urban problems and producing solutions based on these data (Hollands, 2015). Following these critical phenomenon, Kyoto Protocol entering the force in 2005 in

order to limit GHG emission to safeguard the environment, progression of internet-based infrastructure and diffusion of widespread internet usage and other digital technologies to everyday life accelerated and boosted up the emergence of smart city approach. Today this approach is largely unexplored. Even though it became one of the mostly discussed terminologies in the domain of urban planning, its' potentials and the treats that come with it, is yet to be discussed.

1.2. Problem Definition

Smart city concept bears a range of definitions in the literature, all of which try to form a consensus on the description of "smartness". The terminology is used widely by academicians, researchers, government officials, local governments and other stakeholders in different manners. The fragmented and superficial use of this concept as a labelling for the cities which adopt innovative technological instrumentation and automatization prevents the holistic understanding of the subject. In the academic world, the scattered descriptions and understanding of the concept initiates questions of what really counts as a smart city. In order to clarify the meaning and further explain this concept several characteristics, components and indicators are asserted to the subject. As an inter-disciplinary domain, smart city embraces wide range of themes which are directly specific to the location. Herewith, 'one size fits all' approach is not convenient for this concept. Instead, the subject is formed and conceptualized against the backdrop of a city, and it focuses directly to the needs, problems, and potentials of the employed study area.

The rise of smart city lies in the crisis of large population agglomeration in urban areas, the aftermath of large increase in population in cities and the advancements in the technology. Population ratios between urban and rural are the main initiator of most of the threats and problems todays cities face and it also plays a major role in smart cities, as the main object of smart approach is to generate a new planning and management systems in order to respond to the complex ecosystem that came with

high population. Even though innovative technologies determine the boundaries of smart initiatives, the real agenda of smart city focuses on a wider planning approach and use technology as a method. A comprehensive approach in this domain, is vital in order to further shed light on the true and holistic meaning of smart cities. Hence, the studies, strategies and applications has hitherto established, should be pieced together to form a common ground on the subject.

In the Turkish context, the concept has been on the agenda since the start of the 2000s. Technological progress and the continuous migration to urban areas starting from 1960s initiated the idea of benefiting from innovative systems in order to deal with the infrastructure and management problems, and to support easy access to urban services. In 1983, with the agglomeration in cities, the urban and rural population became equal, urbanization rate started to increase drastically and the gap between urban and rural population grew even more in the following years. (Figure 1.3 shows the urban and rural population change in Turkey).

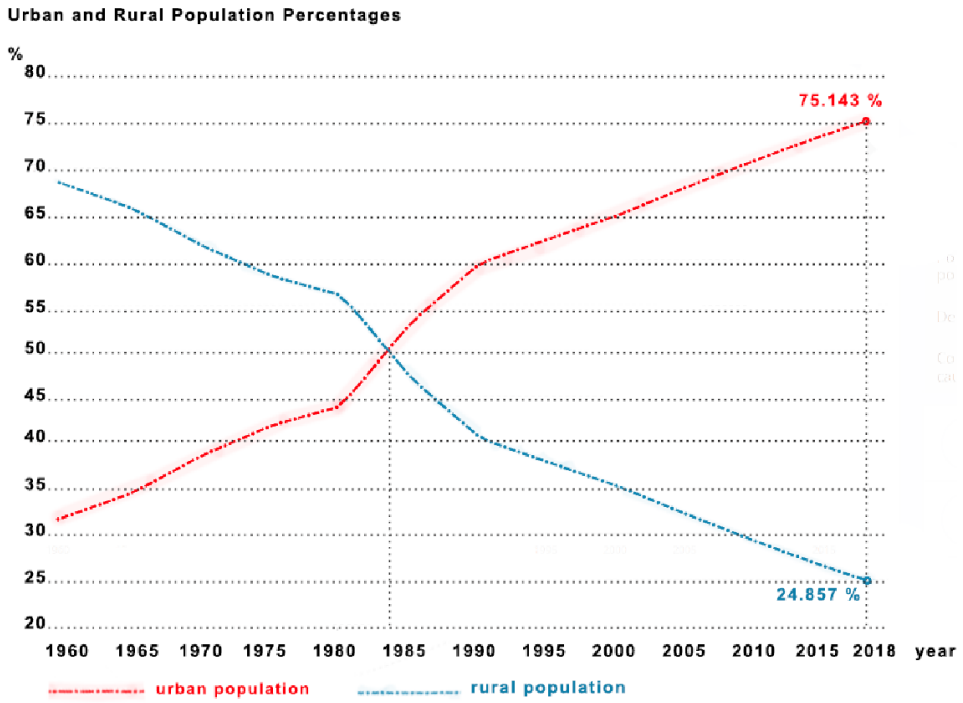


Figure 1.7. Urban and Rural Population Ratio in Turkey. (graph created with the data obtained from Worldbank, 2018.)

In order to adjust to the new complex ecosystem of cities, several national documents such as 2003-2023 National Science and Technology Policies Strategy Paper and 10th Development Plan introduced smart city concept to Turkish planning agenda and management systems. Rather than initiating an integrated and holistic smart city program, these documents focused on implementations of smart systems in the designated sectors. This fragmented perspective also claimed itself in the local level with the aim of branding itself with a smart city concept. The initial applications at the local level started with automation, digitalization and later on, the use of smart systems in the urban services. Recently, a major importance has been given to this subject on the national level with the preparation of 2019-2022 National Smart Cities Strategy and Action Plan, in order to create a common strategic ground both in national and local level and constitute a road map for smart cities. This uptrend in the smart city concept not only brings this concept into current agenda of urban planning discipline, but also sets up the inquiry on the status and perspectives of Turkey in the concept.

1.3. Scope and Purpose of the Research

The aim of this thesis is to assess the smart city concept and map out smart initiatives in the context of Turkey in order to reveal the standpoint of Turkish planning domain within the smart city agenda. Thus, a holistic exploration of "smartness" in national and local documents implementations is executed while drawing parallels along with correlations between Turkish context and dominant smart city movements in the world. The main research questions are defined with reference to the objectives of the study. These objectives formed the three main inquiries of this thesis and they can be stated as follows: that are the smart city initiatives in Turkey, how does the status and position of Turkey in the smart city concept progress and to what extent do they show parallels with the universal smart approaches. In order to answer these questions, the objectives of the study are formulated in the listed below;

- To explore the concept of smart city in depth and reveal diverse definitions, approaches and implementations of smart city concept.
- To examine the current state and position of Turkey in the domain of smart city by investigating initiatives regarding this topic both in national and local level that are generated by different stakeholders (government, metropolitan municipalities and non-governmental organizations).
- To map out smart city ecosystem in Turkey and discuss the standpoint of the Turkish case with regards to the policies and initiatives that are produced in Turkish planning agenda and make a comparison with the universally accepted features, approaches and components of smart city, and implementations of this vision in other countries.
- To make a holistic evaluation of the Turkish case and generate recommendations regarding the national and local strategies, implementations and roles of different actors to understand smart city concept better.

1.4. Research Agenda and Methodology

The research strategy and methodology are constituted with reference to the research questions and objectives, mentioned in Part 1.3. In order to find answers to them, generate in-depth understanding of the subject, analyze the smart city approaches that are obtained (from policy documents, reports, road-maps, other initiatives and implementations) thoroughly, follow a case-specific approach and reveal causal and chronological relationships between them, a qualitative research method is followed. In this respect, comprehensive data are obtained from several resources. Within the scope of the research primary literature and grey literature have been accepted as primary sources. First and foremost, academic publications are reviewed in order to investigate different definitions, explanations and approaches on smart city concept. Recent academic literature on the issue of "smart city" are reviewed both giving

reference to universal and national as well as local approaches in the Turkish case. Along with academic literature, reports on smart cities prepared by scientific institutions and international organizations (European commission, EIP-SCC[3], Smart City Council, Asean Smart City Network etc.) are examined and used in this research.

Subsequently published and unpublished government documents (grey literature) are examined in the Turkish context. In this regard, strategy and action plans, policy documents and unpublished reports, presentations and information notes are obtained from different government institutions. Face to face meetings are arranged with the governmental institutions that have conducted studies on smart cities and unstructured interviews were conducted with these institutions such as Ministry of Environment and Urbanism, Presidency of Strategy and Budget (old Ministry of Development), TÜBİTAK BİLGEM, Ministry of Industry and Technology and Ankara Metropolitan Municipality. Other institutions (metropolitan municipalities, NGOs) that were not been able to get in touch in person are contacted via email.

Furthermore, credible online sources are also used to address implementations, initiatives and shed light on other studies in Turkish case. 30 Metropolitan municipalities official websites are searched for the terms "smart city, smart development and smart systems" in order to map out all the initiatives conducted by these local governments. The studies of several NGOs are explored and the cooperation of different actors in the scene of smart city agenda is unveiled in this manner.

The use of qualitative methods in this study enabled the use of descriptive details and approaches to have an in-depth analysis for the theme of "smart city" and it provides the advantage of forming a holistic understanding on the subject with causal relationships and critical thinking.

[3] European Innovation Partnership on Smart Cities and Communities

1.5. Plan of the Thesis

This thesis consists of five chapters. The plan of the thesis is made of the introduction (chapter 1), the main body, which contains chapter 2, 3 and 4 and finally conclusion part (chapter 5). Outline of the thesis progresses parallel to the objectives of the study and aims to formulate detailed explanation for these objectives one by one.

The introduction chapter gives an insight on this study. It clarifies the intention/aim, research questions and objectives of the thesis. This part covers the overall scope of the study and defines the purpose of the study. The research agenda and methodology that is used in the thesis is located in this chapter.

Chapter 2 focuses on the concept of smart city in a general sense. This part is based on the literature review regarding the concept. Definition and background of the term "smart city" are reviewed with regards to the different interpretation of the subject. To clarify the meaning behind the terminology, this chapter refers to the definitions of academicians, private sector, institutions and national policy document. In order to have an in-depth explanation of the concept; components and characteristics of this approach, analogues terms to smart city, the tools and implementations it resides are addressed. At the end of the chapter, both the opportunities smart cities present and the threats it may create are discussed with a critical manner.

In the chapter 3 smart city initiatives and best practices around the world are examined. This chapter aims to present different trends and approaches in the context of smart cities. It gives an insight on how the case of each smart city differs from one another and there is no single template, method or plan to pursue smartness (Albino et. al, 2015). Instead this concept is adopted with reference to needs, potentials and problems of the city and each case differs from each other with their own characteristics and components. However, a number of upper level documents (policy documents, white papers etc.) that are created by governmental or non-governmental institutions or public agencies gather smart initiatives under the same roof. They aim to create a

common ground that would frame roadmaps for successful implementations of smart systems and create an experience sharing arena. The chapter starts the review from the places where smart city vision is widely accepted and initiatives that target sustainable environment, economic growth and better quality of life are implemented extensively. Priority is given to the cases and *écoles* in which Turkish planning system adopt in smart city context.

Chapter 4 presents the Turkish context, and it consists of five main parts which analyze the smart initiatives in different levels with different actors. This chapter aims to analyze all the smart city projects, documents (policies), implementations and initiatives both in national and local level. It sheds light on the development of smart city approach in Turkey and its standpoint. Starting from the first emergence of smart city concept in the Turkish policy documents to its implementations today, an inclusive analysis is made in order to map out the process. The chapter is structured starting from upper scale policies and it continues with lower scale implementations.

The first part of the chapter investigates all the national policy documents on smart cities chronologically; it gives the most importance to the recently developed "Smart Cities White Paper" and "2019-2022 National Smart Cities Strategy and Action Plan" with the cooperation of Tübitak Bilgem YTE and Ministry of Environment and Urbanization. The chapter analyzes the development process and the penetration of smart city concept into national policies until the contemporary strategy document that has just prepared. The focal point in the analysis of these documents lies in the basis of their approach to smart city concept and how they acknowledged it in their policies. The related policies and action plans are summarized with the implementations these documents propose and the smart city components they touch upon.

Part two consists of the national level research on smart city in Turkey which are conducted by non-governmental institutions, NGOs along with private sector cooperation. In this chapter, smart city evaluation reports, desk research and smart city

road maps that are prepared by the Public Technology Platform, Turkish Informatics Foundation, Istanbul Technology University and Vodafone are explored.

Subsequently, local initiatives are addressed in the third part of Chapter 4. The smart city implementations and initiations of metropolitan municipalities are taken into account as they have the closest and integrated relations with cities, urban services, citizens and their needs in a local level. Eight Metropolitan cities are selected which are specified to have best practices in smart city approach and its applications according to the recent Smart City White Paper by MEU (2018). These cities are mentioned to have a holistic approach regarding smart city concept. In this manner, the cities of İstanbul, Ankara, İzmir, Bursa, Antalya, Konya, Kayseri, Gaziantep, Kahramanmaraş are discussed according to their smartness and the smart city applications metropolitan municipalities in these cities planned and carried out.

Fourth part of chapter sheds light on the role of the private sector in the smart city concept giving reference to Turkish case. In this part, technology firms and their activities in different smart city initiatives and implementations are investigated, and how their role shape the smart city ecosystem is discussed.

Last part of the chapter, presents a holistic overview of the smart city concept in Turkish context. The findings that are investigated in Turkish case are summarized. Policies and implementations are correlated with the related smart city components in order to deduce the general smart city agenda in Turkey both in national and local level. A matrix which presents all the initiatives in the Turkish context and their relevance with universally and nationally determined smart city components can be found in this chapter.

The conclusion part provides a summary of the smart city concept and smart initiative in the Turkish case that have been discussed throughout the thesis. It generates a review of the current situation based on the investigation conducted in chapter 4. This part forms a comparative discussion in between universally recognized smart city components and the policies, initiatives and implementation that are realized in

Turkish case both in national and local level. The chapter intends to create a comprehensive and holistic investigation of the developments in the domain of smart city in the Turkish context by gathering all the findings together in chapter 4. Moreover, the standpoint of Turkey in the essential bases and principles of smart city approach are discussed. Suggestions and recommendations are presented as a final remark to pave the way for better understanding of the smart city concept regarding Turkish case and following to create a basis for more forward-thinking initiatives.

CHAPTER 2

SMART CITY CONCEPT

2.1. Definition of the Smart City Concept

The world is urbanizing at an increasing rate; making it difficult to manage urban areas. The increase in the share of the population living in urban areas, means increased resource consumption and environmental burdens. United Nations Population Fund affirms that 2008 had been the threshold year in which more than 50% people lived in urban areas, also estimates by 2050 this percentage would raise to 70% of the whole world population (UN,2008). The tremendous expanding rates of cities not only result in challenges concerning sustainability and environmental issues and overall quality of life, it also creates new management challenges for the city and its sources. The significant role of cities on economic, social and environmental issues arises from the metabolism of cities where input of goods and output of wastes rise several problems in economic, social and environmental domains (Albino et al., 2015). Correspondingly technological innovations that have been becoming a growing market at an increasing rate, aims to keep up with the environmental, institutional and societal needs emerging with the rapid urban growth. The integration of diverse technological developments with the cities, gave rise to the umbrella term 'smart city' in the last two decades. Even though the concept of smart city is closely linked with harnessing technology, it is not limited to the application of technology in cities (Albino et al., 2015). As the concept smart city has wide and uncertain boundaries, its' scope, dimensions and elements are not clear. The terms and its elements are conceptualized with different perspectives by diverse scholars and actors as well as similar terms have been used interchangeably. In the article 'Smart Cities: Definitions, Dimensions, Performance, and Initiatives', Albino et al.(2015) aimed to form a common ground by investigating a shared definition for "what constitutes a smart city,

what are its features" and how can the performance of a smart city is estimated according to different interpretations. A common definition would not only direct urban policy makers in the right tract to institute policies to make cities smarter but also will enable to measure and compare performances and smartness levels of cities.

Smart city as an umbrella term concerns combination of great range of topic and different variants of smart is used as digital, intelligent, ubiquitous, virtual city. O'Grandy and O'Hare (2012) notes that as the concept smart embrace different framings, "one-size-fits-all-definition" of it is not correct, instead a definition of smart could be made according to the studied case. The term 'smart' initialized in 1990s referring to the implementation of information technologies in the city. Shortly after, it was criticized by scholar, that the term is too "technically-oriented" and alternated into an "urban labelling phenomenon" (Hollands (2008) cited in Albino, 2015). To give further emphasis of the aspects that constitute "smart city" and for it to not only used as an empty labelling, different scholars came up with different visions on smartness. Harrison et al. (2010) used the terms "instrumented, interconnected and intelligent" to define smart, while Nam and Pardo (2011) gave emphasis on social aspect of the term and asserted the terms "people and community" along with technology. While Harrison et al. (2010) emphasized connectivity, networks, integration of technology he also defined collective intelligence of a city with four infrastructures; which are 1. Physical Infrastructure, 2. IT Infrastructure, 3. Social Infrastructure and Business Infrastructure. In the definition of smart city by several academicians, along with the emphasis on technological embeddedness; economic development, quality of life, sustainability and resource efficient ecosystem, happy and lifelong learning community, participation, entrepreneurship/human capital, maximization of services, preventive maintenance activities, monitoring and modelling for resilience were mentioned (Albino et al., 2015). These different aspects of smart city reveal the close connection of it with, different planning approaches such as, creative city, eco city, intelligent, digital, virtual and ubiquitous city. Caragliu et al. (2011) notes that these several terms focus on more specific and "less inclusive

levels of city". As an umbrella term 'smart' includes them. Digital city contributes to the domain by giving emphasis on information sharing, communication and collaboration with an aim of connected community, intelligent city adds on these specifications the factor of knowledge/learning. On the other hand, among all these features, smart include people component giving reference to quality of life, creativity, entrepreneurship and the role of people on economy, environment and community (social aspect). Wood (2013) explain the difference of these analogous terms as follows: "The label intelligent implies the ability to support learning, technological development, and innovation in cities; in this sense, every digital city is not necessarily intelligent, but every intelligent city has digital components, although the "people" component is still not included in a intelligent city, as it is in a smart city". Albino et. al (2015) justifies the confusion behind the meaning of smart city comes from the top-down action taking for creating a smart city. Furthermore, Nam and Pardo (2011) assert the importance of people in smart city could be sustained with a "bottom-up knowledge scheme" where the sense of community is achieved among citizens by different actors and institutions (elements of community) work in partnership to transform their environment. 'People' being the important factor that differentiates smart city from analogous terms, it sets apart two different kind of "domain". Albino et al. (2015) define these as "hard and soft domains". Hard domains are tangible assets such as buildings, energy grids, natural sources etc., whilst soft domain consist of intangible sources; social inclusion, education, innovation and culture.

Table 2.1. *Definitions of Smart City Concept*[4]

	Definition of Smart City Concept	Dimensions and Components
Hollands (2008)	".territories with a high capacity for learning and innovation, which is built in to the creativity of their population, their institutions of knowledge production, and their digital infrastructure for communication."	Infrastructure, life-long learning, knowledge
Lombardi et. al (2012)	The application of information and communications technology (ICT) with on the role of human capital/education, social and relational capital, and environmental issues is often indicated by the 1notion of smart city	Social Capital, ICT
Giffinger et. al (2007)	A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens	Economy, People, Governance, Mobility, Environment
Caragliu et. al (2009)	A city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance	Sustainability, ICT, quality of life, economy, environment, gorvernance
Lazzaroiu and Roscia (2012)	A community of average technology size, interconnected and sustainable, comfortable, attractive and secure	Safety, Environment, ICT

[4] The table presents a summary of different smart city explanations. It is generated through the use of following references; Holland (2008), Lombardi et al. (2012), Giffinger et. al (2007), Caragliu et. al (2009), Lazzaroiu & Roscia (2012), Kourtit and Nijkamp (2012), Komninos (2006), Thuzar (2011), Raari and Storper (2014), Hall (2000), Patridge (2003), Cocchia (2014), Anthopoulos (2015) and Albino (20159.

Kourtit and Nijkamp (2012)	Smart cities "are the result of knowledge-intensive and creative strategies aiming at enhancing the socio-economic, ecological, logistic and competitive performance of cities. Such smart cities are based on a promising mix of human capital (e.g. skilled labor force), infrastructural capital (e.g. high-tech communication facilities), social capital (e.g. intense and open network linkages) and entrepreneurial capital (e.g. creative and risk-taking business activities)."	Economic competitiveness, creative, human capital, entrepreneurship
Komninos (2006)	(smart) cities as "…territories with high capacity for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management"	Life-long learning, innovation, knowledge
Thuzar (2011)	"Smart cities of the future will need sustainable urban development policies where all residents, including the poor, can live well and the attraction of the towns and cities is preserved. […] Smart cities are […] cities that have a high quality of life; those that pursue sustainable economic development through investments in human and social capital, and traditional and modern communications infrastructure (transport and information communication technology); and manage natural resources through participatory policies. Smart cities should also be sustainable, converging economic, social, and environmental goals."	Inclusiveness, Sustainability, Economy, Society, Environment, Communication infrasturcuture

Rabari and Storper (2014)	…consists of the widespread implantation of sensors into urban and household environments, together with ubiquitous mobile broadband communication technologies that can transmit both deliberate communication and user data.	Digital skin (digital embeddedness),
Hall (2000)	A city that monitors and integrates conditions of all of its criticalinfrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens	Infrastructure, security, service
Patridge 2003	A city where the ICT strengthens the freedom of speech and the accessibility to public information and services.	Freedom, democracy, open data

Smart city includes several concepts and the wide range of these components should be defined particularly in order to form an integrated organic system. For this system several components are classified to help urban policy makers to form their agenda according to these focus points and how they will operate in relation to each other. As smart city gives importance to communication and network, it should be assumed these different components are interconnected and no system would operate in isolation. Kanter and Litow (2009) indicate the smart city system as an "organic whole", where each subsystem is infused by intelligence undividedly. Komninos (2002) portrays this "organic whole", composed of four dimensions. These are compiled as; 1. electronic and digital technology, 2. ICT (Information and Communication Technology), 3. Embedded infrastructure, 4. people interaction with ICT which will lead to "innovation, learning and knowledge". Like Komninos (2002),

Giffinger (2007) defines four components for smart cities. These four components; industry, education, participation and technical infrastructure give reference to the Komninos dimensions, as well as it gives importance to equal right of access and participation. Today this list has been expended and six components are mostly agreed upon to define smart city. These are listed as; 1. Smart economy; regarding industry, 2, Smart mobility; related to urban logistics and infrastructure, 3. Smart Environment; focusing on efficiency and sustainability, 4. Smart people; targeting education, 5. Smart Living; giving importance to quality of life, and security, 6. Smart Governance; focusing on participation through e-governance (Giffinger et al., 2007). Regarding these components Nam and Pardo (2012) reminds that the smartness of these components depends on the role of ICT and technology being a facilitator. Technology should not be the aim but a tool to help to form the urban areas and society. Shapiro (2006) states "Smarter cities start from the human capital side, rather than blindly believing that ICT can automatically create a smart city". The true nature of smart city could be achieved when a bottom up decision taking system is sustained, participation and inclusion is endorsed. Elements of smartness should stem from citizen and implementations should be citizen-centric. Giving reference to this, some scholar suggested that "quality of life" also should be one of the components of smart city. On the other hand, it is deduced that each component refers to "quality of life" within its scheme and it is a common goal.

The success of smart cities has always been a discussion topic since the term first has been used. As it contains and embraces several aspects and components, there is no one way to measure the performance of a smart city. Different methods and measurements have been developed which rely on rating of indicators that are defined according to the components of the smart city. The notion of evaluation a performance of a smart city not only will determine its success, it will also be a roadmap for the urban policy makers to where to focus time and resources. Most of the indicator that are defined by scholars, consider human satisfaction and overall quality of life. Lomberdi et al. (2012) defines 60 indicators under five clusters; smart economy, smart

people, smart governance, smart environment, smart living. Lomberdi composed these indicators according to the literature reviews of several EU projects and initiatives (Albino, 2015). These indicators and their measurement also sustained by embedded technologies such as data collection from sensors and embedded technologies within the cities. Different ranking systems compare and classify urban areas according to the different indicators. The result of measurements and comparisons could become guidelines to define future urban policies. Even though a shared definition would ease the assessment of smart cities, still the implementation of the approach could change the results drastically. Albino et al. (2015) asserts in some cases that without any importance given to components and indicators the terms are used as a labelling to attract investment to the cities. Masdar and Songdo being self-proclaimed smart cities that have top-down, "corporate pushed", approach would not be able to touch upon social aspects. Albino et al.(2015) notes that these initiatives take technology in a sense of a free-economic high-tech market and because of that they suffer criticizes as being estate initiates just to attract more economic gain. This is why smart city concept should not be approached only as adoption of ICTs, or embeddedness of technologies. Without the social, economic and environmental aspects as a whole, the results would be severely lacking the "multi-faceted" aspect of smart vision.

2.2. Historical Background of Smart City

In 1983 Brundlant Commission raised the topic of sustainable development and pursuing sustainable solutions for urban problems. Following this as Cocchia (2014) mentions;

1. Kyoto Protocol (1997, coming into force 2005),
2. 2.wide spread internet usage (2002),
3. IBM Smart Planet Concept (2008),
4. Covenant of Mayors (2008),
5. Europe 2020 Strategy (approved in 2010)

became 5 important events which evolved the smart city term.

2.3. Components and Characteristics of Smart City

To clarify the meaning of smart cities, the concept is explained by several components and characteristics. Below mostly accepted six smart city components are analyzed with reference to Giffinger's (2007) smart city model of component and indicators (Figure 2.1)' and Boyd Cohen's smart city wheel (Figure 2.2).

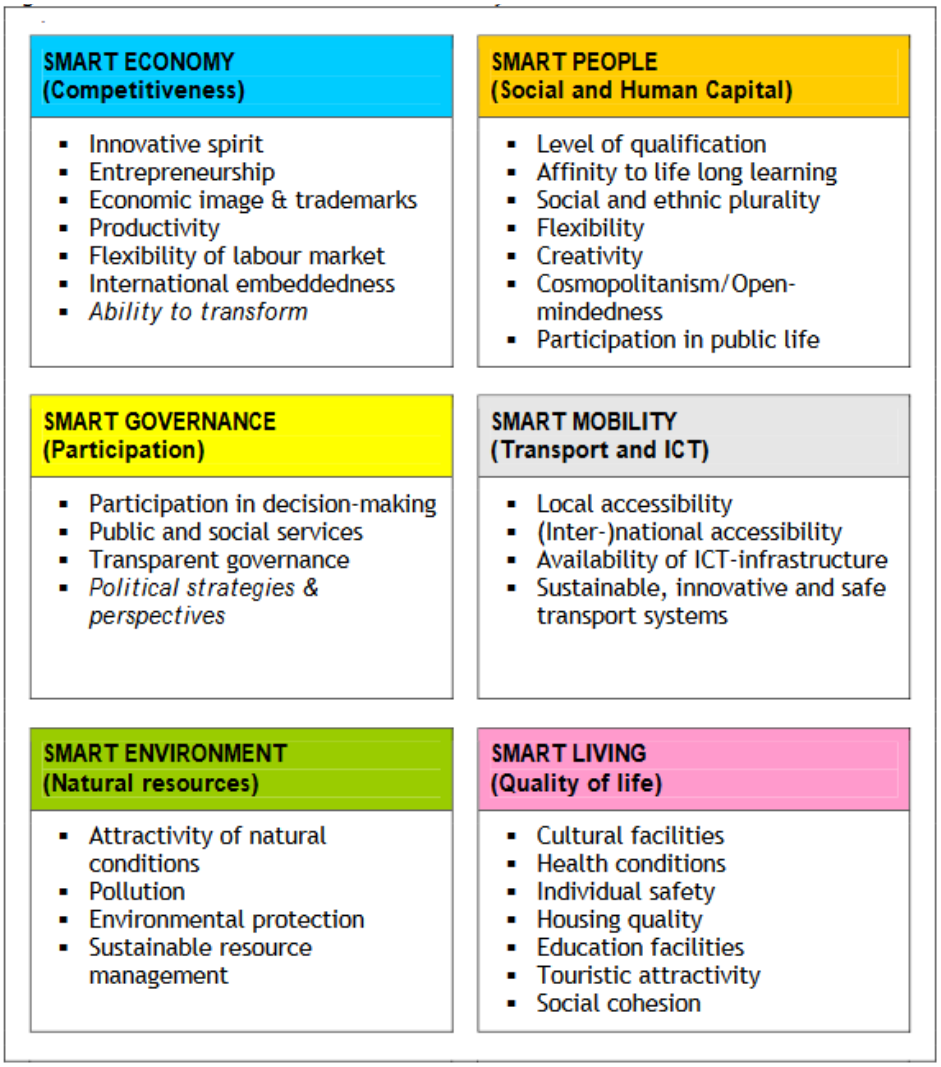


Figure 2.1. Characteristics and Factors of Smart Cities (Giffinger et. al, 2007)

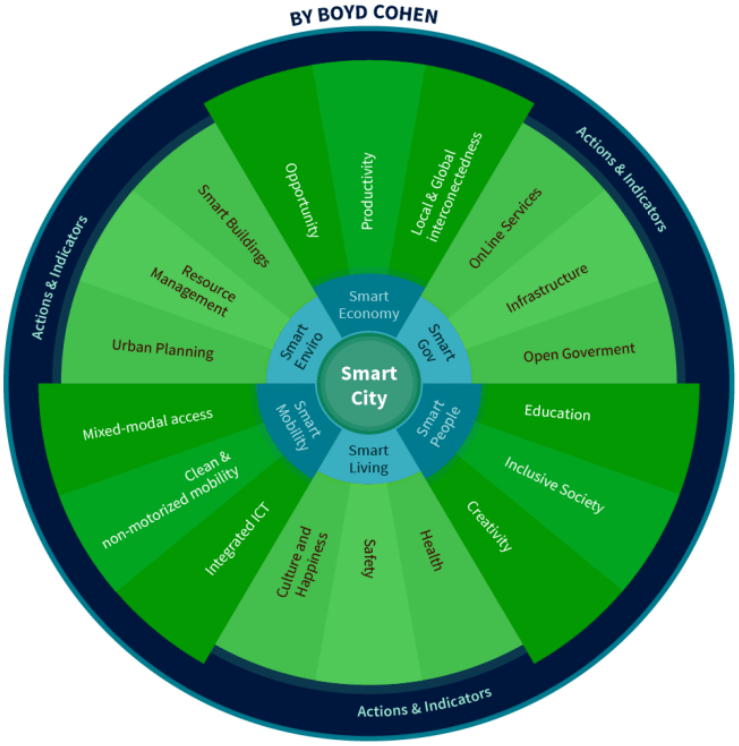


Figure 2.2. Boyd Cohen's Smart City Wheel (Cohen, 2012)

2.3.1. Smart Economy

Production and Service based on ICT reveals new typed of business models. The business model comes with smartness are linked to innovative spirit, entrepreneurialism, flexibility of the labor market, ability to transform and integration international market along with competitive infrastructure.

2.3.2. Smart Mobility

Smart mobility explains the support of ICT for intelligent transportation and logistics systems. Use of environmentally friendly, sustainable, safe and integrated transport

systems that uses real-life data increase the quality of services, reduce the costs and create sustainable solutions.

2.3.3. Smart Governance

Smart Governance refers to the integration of public, private and civil stakeholders in order to carry out effective, efficient and productive work in urban services and management. The communication and collaboration between stakeholders in the decision-making and planning stages with the use of ICT makes the governance smart. Smart governance strongly emphasizes participation of citizens and other stakeholders. The facilitating role of information and communication technologies in data collection and analysis reinforced by transparency and accountability.

2.3.4. Smart Environment

Smart environment understood in terms of attractiveness of natural conditions, lack of pollution and sustainable management of resources. This is the most recurring goal and I is strictly linked both to the most critical urban problems (traffic, pollution, waste) and to the most important hard technologies involved in smart city implementation such as energy production, mobility and logistics. To sustain sustainability of the environment, measurement activities are carried out for renewability with the help of information and communication technologies. This goal is easier to measure because it is linked to quantifiable results.

2.3.5. Smart Living

Smart Living means to have a better quality of life, giving emphasis on the dimensions of; culture, health, housing, social life and security. It is based on the activities and initiatives that are carried out to ensure and maintain this environment through information and communication technologies. Smart systems and innovative

technology could make daily life of citizens easier by given importance to user (people)-based approaches.

2.3.6. Smart People

Smart people component is linked to the level of qualification of human and social capital, flexibility, creativity, tolerance, cosmopolitanism and participation in public life.

2.4. Conceptual Variants of Smart City

Within the domain of urban planning paradigm there are various terms similar to smart city concept. These topics range from digital city, wired city, ubiquitous city to knowledge city, information city and so on. While some of these draws their perspective from technology, others give emphasis on sustainable environment and community objectives. As an umbrella term smart city contains these approaches and creates a holistic common ground. Most of the main ideas and objectives of these approaches fall into the components of smart city. However, they are more subject-specific and less inclusive approaches compared to smart city approach. In order to understand the fuzzy terms and clarify its meaning; smart city, these analogous approaches should be explained and the differences between them should be clarified. Following, several approaches and movements, their approaches and similarities with smart city are explored.

2.4.1. Digital City

In the 1990s, the transformation in the field of information and communication technologies not only reshaped people's daily life habits but also it had major impact on management approaches in different sector. The concept of digital city emerged in this era to integrate new technologies of the period to physical and social environment. It is based on number of planning principles such as integrating physical and virtual

space, providing information infrastructure for urban life, establishing public communication environments and development of network infrastructure to achieve connected communities. Digital city is an analogous term of smart city which is often used in similar manner in the literature. The main idea behind it is to reorganize both the physical and social environment of cities with technological infrastructure. The main difference between digital city and smart city lies in the factors; "people, education and learning (life-long learning)" which creates the social infrastructure through intellectual and social capital of a city (Albino et. al, 2015; Nam and Pardo, 2012).

In the definition of digital city; connectedness, use of communication technologies, information sharing and network connection are the featured concepts. Ishida (2002) defines digital city as follows:

> "a connected community that combines broadband communications infrastructure; a flexible, service-oriented computing infrastructure based on open industry standards and, innovative services to meet the needs of governments and their employees, citizens and businesses" (Ishida, 2002).

Digital city relies on ICT and IoT, which create a digital environment for information sharing (Nam and Pardo, 2012). The main objective of this concept is to form an information sharing platform through a collaborative environment. It gives emphasis on interoperability in order to ensure citizen accessibility to this experience from anywhere. These digital platforms enable data gathering, sharing and processing; thus, it offers efficiency and ease in management, new and accessible services for urban areas. In this approach digitalization of cities services is seen as a key factor to achieve sustainability, preservation of resources and safety.

2.4.2. Ubiquitous City

A ubiquitous city (U-city) is an extension of digital city concept in terms of ubiquitous accessibility and infrastructure. It makes the ubiquitous computing available to the urban elements and uses ubiquitous information technologies for efficiency. This approach aims to make the ubiquitous computing available to the urban elements such as people, building, infrastructure and open space. Its basis stems from the creation of an environment where any citizen can get any services anywhere and anytime through any devices. The ubiquitous city is quite different from the virtual city: while the virtual city reproduces urban elements by visualizing them within the virtual space, ubiquitous city is created by the use of digitalized urban elements (IoTs) (Lee et al., 2013).

2.4.3. Sustainable City and Green City

Sustainability focuses on meeting the needs of present without compromising the ability of future generations to meet their needs (OECD, 2015). The main aim of a sustainable city is to effectively manage the metabolism of a city which consists of the inputs and outputs. These inputs are resources that are being used in cities for daily activities and services. These are energy, food, water etc. Outputs of a city covers the GHGs emission, wastes and pollution. Sustainable city uses technology in order to reduce CO2 emissions and to produce efficient energy management

Green City follows the Green Growth which is a paradigm that promotes green economy. This stands for pursuing an economic development, while reducing GHG emissions, waste production and pollution, and efficiently using of natural resources (OECD, 2010). This would not only create a healthy living environment but also reinforce natural assets and maintain biodiversity.

2.4.4. Intelligent City

> "Intelligent cities are territories with high capability for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management" (Komninos, 2006).

Intelligent city carries the characteristics of both knowledge society and digital city. The use of information technologies and penetration of digital technologies in intelligent cities enables effective decision-making systems while altering the urban life and management with "incremental ways" (Komninos, 2011). The concept of intelligent city gives main importance to learning through innovation and technological development. It bears digital components in order to achieve the objectives it defines. The difference between an intelligent city with digital city is that even though intelligent city contains some digital elements, not every digital city can be accepted as intelligent. On the other hand, both in intelligent and digital city the people and community perspective are not included as in a smart city.

2.4.5. Learning City

The term "learning" in "learning cities" covers both individual and institutional learning (Albino et al. 2015). Individual learning gives emphasis on life-long learning and mainly based on reinforcing the social capital. It could mean acquiring "knowledge, skill or understanding" by the citizens (OECD, 1999). In this sense, learning does not finish with the school but it is a continues and accumulative process. The learning process benefits both the citizen and the society. With the knowledge they acquired individuals attain new employment opportunities while also providing advantages of human-capital and qualified workforce (OECD, 1999).

The smart city concept also covers the agenda of learning city. "It improves the competitiveness of urban contexts in the global knowledge economy. Learning cities are actively involved in building a skilled information economy workforce" (Cocchia, 2014).

2.4.6. Knowledge City

This is a city designed to encourage the nurturing of knowledge. The notion of knowledge city is interchangeable to a certain degree with similar evolving concepts like information or learning city. The concept of being clever, smart, skillful, creative, networked, connected, and competitive becomes a key ingredient of knowledge-based urban development and hence of a smart city (Dirk et al., 2010). The objective of a knowledge city is to reinforce a knowledge-based development. In order to achieve this aim, it takes actions in "creation, sharing, evaluation, renewal and update of knowledge" (Davies, 2015). This can be achieved through the continuous interaction which create knowledge-sharing culture within the city. City's design, IT networks and infrastructures support these interactions (Ergazakis, 2004). A knowledge city is similar to learning city but it does not necessarily use digital technologies in order to encourage knowledge society. On the other hand, the unique part of knowledge city is that it is heavily related to knowledge economy, and its distinction is stress on innovation. Rabar and Storper (2014) defines a knowledge city as "a city that was purposefully designed to encourage the nurturing of knowledge".

2.4.7. Creative City

Creativity is recognized as one of the important aspects of smart city, and thus people, education, learning and knowledge have central importance to smart city. "The expansive notion of smart city includes creating a climate suitable for an emerging creative class" (Albino et al., 2015). Unlike smart city, creative city not focuses on technological infrastructure but solemnly emphasizes human infrastructure. This

infrastructure covers creative occupations and workforce, knowledge networks, voluntary organizations, crime-free environments, entertainment economy which will reinforce social capital. Creative city is a mixture of education/training, culture/arts, business/commerce and social enterprise, cultural enterprise, and economic enterprise.

2.4.8. Other Variants of Smart City Concept

Wired City

Wired cities refer literally to the laying down of cable and connectivity not itself necessary smart" (Hollands, 2015). It gives at most importance to connectedness and mainly focuses of communication technologies and networks.

Virtual City

In a virtual city, the city becomes a hybrid concept which consists of a reality with its physical entities and real inhabitants and, a parallel virtual city of counterparts of real city and its features. "Virtual City concentrates on digital representations and manifestations of cities" (Schuler, 2002).

In a virtual city the experiences and services of an urban area is constituted in a virtual domain and its' functions are realized within this "cyberspace" domain. The virtual cities may also be based on its material space counterpart(Schuler, 2002). The virtualization of cities plays an important role of simulations in the domain of planning.

Information City

"Digital environments collecting official and unofficial information from local communities and delivering it to the public via web portals are called information cities" (Anthopoulos et al., 2010).

An information center organizes social interactions among people, businesses and government institutions via digital environment. The collected information from local communities are delivered into a web based public arena.

Well-being City

Well-being city aims to produce best quality of life for citizens, but also to create regional attractiveness both for people and for economy. The technology is only a tool to obtain these goals, but also culture, climate, history and people-centered planning are considered important success factors.

Techno-city

Techno-city states the use of technology to improve efficiency and effectiveness of its infrastructures and services. It focuses on use of technology in the dimensions of urban space quality, mobility, public transport, logistics.

2.5. Smart City Tools and Implementations

The smart cities are defined with their compatible structure with technological change. They seek comprehensive solutions for economic, ecological and social challenges that cities face through the advantages of information and communication technologies. These technologies range in several different tools and implementations.

In this part, the main smart city tools and implementations are investigated. The intended use and purposes behind these components, enable us to make in depth assumption about their use and importance in smart city approach. Broadband communication, cloud computing, big data, geographical information systems and living labs are the prominent smart city tools that are widely utilized. These ubiquitous systems enable effective and efficient operability and reinforce smart decision-making for future. Apart from the listed tools, all devices, systems that use ICT, IoT and big

data in urban services, management, data analyzation or ubiquitous decision making are considered part of smart city tools.

Smart cities are closely linked with ubiquitous information sharing and digital networks (Smart Cities Council, 2013). These two properties of smart city concept are realized through broadband communication, which indicate the fast information and data transmission. Broadband transmission systems enable multi-directional data conveyance within multiple users simultaneously. The speed of this real time transaction is based on these systems important ubiquitous property. Broadband communication constitutes the technological basis for ubiquitous smart systems, real time data accumulation and for the quick response mechanisms.

In order to manage and improve urban operations smart cities uses interconnected (network) technologies to establish communication, transfer analyze data. In contemporary cities these technologies are used in several urban component; infrastructure, energy, economy, transportation, environment, disaster coordination etc. In order to achieve an easily ubiquitous accessible data sharing and operation structure IOT and Cloud-computing gains importance. Cloud-based technologies establishes efficiency, real-time accessibility by this way they increase the quality and effectiveness of urban services. Briefly cloud computing stands for storing and transferring information and data through internet instead of just using a computer's storage (memory). It forms information flowing network and establishes interconnectedness between different services, sensors and other smart systems.

Big Data refers to very large and complex dataset that are difficult to process with conventional information and communication technologies. As a result of the increased use of electronic devices and networks and the digitalization of production processes, a large amount of data is produced. The term big data does not only

emphasize the immense volume increase in data. Doug Laney (2001) asserts that, Big Data is formulated through "3V"s, which are "volume, variety" and "velocity".

Technological, economic, social and cultural developments have led to an increase in the global data set. Cities produce differentiated and largescale data due to demographic density and technological infrastructure (Rabari and Storper, 2014). The use of big-data in order to retrieve information for the process of decision-making, carries huge advantages for the future of cities.

Geographic Information System is the collection of methods to collect and analyze various geographical data and form data-sets in order to solve the problems our cities face in the fields of planning, ecology, socio-ecology and so on. GIS helps to take rational decisions by making location-based analyzes for decision makers. The importance of spatial data emerges with the use of GIS.

The concept of Living Labs is composed by William Mitchell (2013) in the aim of citizens to take active role in the design and planning of urban areas. Both an innovation space and also a product of innovation, living labs are a important tool in smart city approach.

2.6. Opportunities and Treats of Smart City Concept

The advancements in technology; manifested itself within cities in order to open a new horizon to urban development and respond to the problems that come with rapid urbanization. Even though smart city term emerged to define "urban technological evolution", it does not only dwell upon digitization of cities (Anthopoulos, 2017). The term had been widely used for application of intelligent devices or tools in general; but in a greater sense it deals with the very structure of urban areas; which are based on economic, social and environmental aspects. Viitanen and Kingston (2014) address

the democratic and environmental issues within smart city concept and argue how well the implementation of smart city refers to these components.

The aim of technology in smart city approach is to act as facilitator to address and reinforce solution for urban problems, create a connected city and introduce platforms where citizen participation is sustained. As the term was closely linked to technological advancements, it beared the treat of becoming a "digital marketplace", pushing aside two major components; sustainability and quality of life (Viitanen and Kingston, 2013). The top down implementation of smart city concept not only created a hegemony of technological firms, but it also rendered the users(citizens) as involuntary consumers. Even though it gives emphasis on urban resilience, engaged citizenship, participation and accessibility of services with the use technology, it is adverted by Viitanen and Kingston (2013) the superficial approach to 'smart city' raises issues of inequality and urban risks rather than resolve them. In the essence, smart city embraces several urban planning approaches such as eco-city, creative city, intelligent city etc. Inherently the raised issues such as "decarbonizing the world's economy", "societal integration", "lifelong learning" are anticipated to be approached through socio-technical innovations (Joss, 2011). Today it is argued the advertisement of technology as a product has been prioritized over the primary aims of smart city. The so-called smart cities have shifted their vision from being democratic and sustainable places into "creating market places for technology products and services" (Viitanen and Kinston, 2013). In a formation like this, the role of citizen is shaped as the sole consumer of the systems. Chua (1998) marks, as a result "a culture of consumerism came up", which do not form any environmental or social beneficial value.

The use of technology was assumed to eliminate any human made errors. In the smart city approach, technologically oriented development aims to have error-free, reliable and resilient management. But the selective implementation, leads to unfavorable results. Smart city projects such as New Songdo in Korea, Masdar in Abu Dhabi

advertises an easier urban life with the help of advanced technologies, but they do not promise that everyone can access these opportunities. The market value of technology brings forward inequality within the society by promoting a privileged societal order. Viitanen and Kinston (2013) grounds the reason behind this inequality to the role of private firms and commercial interests that come with advanced ICTs:

> "Urban infrastructure can exacerbate inequality due to resource allocation, investment and maintenance being partial to perceived sources of 'value creation' and 'competitive articulation' in urban economies" (Graham, 2004; cited in Viitanen and Kinston, 2013).

The main problem of inequality in smart cities arises from the fact that service is sustained for specific commercial interests while the accessibility and people component stay in the background. Even the environmental aspect of smart cities favors wealthier citizens. "Exerting the power of the state and capital over the interest of individuals and communities", under the label of smart city and sustainability may result in social and spatial inequalities (Viitanen and Kingston, 2013). The incentives on energy bills, and carbon policies benefit a certain group rather than being inclusive. In a research done by Joseph Rowntree Foundation (2013), it is found out that richer household uses three times more energy than poorer households. As it was mentioned before not only technology market would target the consumer with higher rate, but the incentives for energy efficient systems could also result in an increase in demand in these areas, increasing the gap between the wealthy and the poor.

Cities are the major consumers of energy and resources. Madlener and Sunak (2011) notes that urban areas have share of two thirds of total energy consumption in the world and %70 share of C02 emission. As the cities getting crowded each day, new solutions have started to be sought in order to have a sustainable future. In this respect new approaches such as "ecocities and low carbon cities" emerged in the literature (Gossop, 2011, Loss, 2011). The way to smart city also dwells upon these approaches

regarding its ecological components. Marvin (1994) assets that application of ICTs may also reinforce environmental problems, instead of contributing to the development of a sustainable city. It is justified by Ropke et al. (2010) that integration of ICTs to urban life will lead to increase in the demand for electricity. Ropke(2010) also noted that it is estimated that this rise in demand will double itself within two decades. "On an aggregated level, positive and negative impacts tend to cancel each other out. ICT-induced higher energy saving in several areas are nearly compensated by ICT-induced additional energy consumption in other areas" (Hilty et al., 2008). If the citizens were equipped with a technology which is more accessible and more energy-saving, they tend to increase their demand unconsciously. Eventually this cancels all the gains from energy-saving technological applications. This "rebound effect" foresees that energy saving with ICTs is not guaranteed (Viitanen and Kingston, 2014).

On the participation aspect of smart cities Viitanen and Kingston (2014) refer to their doubts on the inclusion and an effective e-democracy system. There are two major issues about Internet democracy, one the accessibility and the other is the management of Big Data. Not everyone can afford or have the basic knowledge to reach these services. If the policy makers do not give importance to the 'learning' community component of smart city, the inclusion will not be achieved. Besides, control of data plays an important role. Corporate and governed based control on communication systems and internet, have the opportunity to manipulate people and control their role in participation. Viitanen and Kinsgton(2014) note their concern as: "The controlling mechanism include Internet protocols, Ip addresses, domain names, deep jacket inspections by Internet service providers, and private decisions of search engines. A question arises about the extent to which smart city operating systems and data are visible to the public." Infrastructure based control not only affect the participation process but also influences citizen behavior and reinforces "culture of consumerism". Assuredly as the demand for the integrated ICTs gets higher, the market for products and services will also expend, resulting increase in the gap and inequalities within the society and more controlled environment and market place.

.

CHAPTER 3

SMART CITY INITIATIVES AND BEST PRACTICES AROUND THE WORLD

3.1. Smart City Documents, Guides and Organizations

3.1.1. European Commission and Smart Cities

The smart city concept entered the European Commission's agenda under the topic of EU Regional and Urban Development. The objectives lie behind the implementation of smart city approaches explained through the concepts of management and efficiency in the urban areas with the use of technological advancements. EC's description is as follow; "… a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business" (EU, 2018). In addition to this description, EC notes that a smart city does on only consist of the use of ICT, but it is an integration of these technologies in order to achieve effective management of urban services and create sustainable and efficient implementations. The main focus of smart cities are formed around the sustainable aims that covers resource efficiency and less emission, and much more accessible, inclusive and interactive urban services that embodies, smart transportation systems, ubiquitous and responsive services, safer public spaces and so on. With these aims European Commission initiated the program of EIP-SCC, which will be discussed in the next part. Within the smart cities agenda EC's activities are mostly based on the energy and sustainability themes.

The 2014 "Mapping Smart Cities in the EU" document published by EU provides a framework for its approach to smart cities. In this document EU adopt 6 smart city components (economy, governance, mobility, environment, people and living) and asserts three core factors of these components, which are "technology, human and instructions" (Manville et al., 2014). These core factors specify the enabling nature of

smart cities that cover several characteristics of the concept. Technology factors covers the innovative systems which makes the use of smart technologies possible, they cover; physical infrastructure, digital technologies and other technological advancements that emerge each day. Human factor focuses on social capital and its capability level whereas institutional factors embrace decision-making branches such as governance, polies, regulations and directives. These three factors determine the ability of a smart-city and its limits.

3.1.2. European Innovation Partnership on Smart Cities and Communities (EIP-SCC)

EIP-SCC established in 2012 by European Commission for the Europe Strategy 2020 with the aim of reinforcing both the development and use of smart urban technologies. The community aims to provide a platform ("marketspace") where a multi-stakeholder smart ecosystem could take place with the cooperation of public and private sectors along with participation of citizens. This platform both aims to create an information exchange platform where actors can learn from different smart city practices and experiences and to form partnerships in order to develop integrated smart city solutions. As in the European Commission smart city agenda, EIP-SCC give emphasis on energy and aims to tackle the increasing energy problems created by growing demand in mobility with the opportunities ICT provides.

In its strategic framework, the objectives of this initiation could be gathered under 4 main themes;

1. Facilitating partnership creation among a variety of actors and provide a knowledge sharing-platform where best practices would be replicated,

2. Enhancing market potentials by stimulating investments and engaging dialogue between different actors,

3. Boosting competitiveness of EU market in the global level,

4. Improving citizen quality of life in by making cities smarter and better places to live (EIP-SCC, 2017).

Being a network and creating a platform of dialogue in the context of smart cities EIP-SCC, operates on six action clusters, which are;

"1. Business models, finance and procurement,

2. Citizen focus,

3. Integrated infrastructure and processes (including open data),

4. Policy and regulations and integrated planning,

5. Sustainable districts and built environment6. Sustainable urban mobility." [European Innovation Partnership on Smart Cities and Communities (EIP-SCC)]. (2017).

Rather than forming a certain roadmap, EIP-SCC forms an integrated platform which aims to create a knowledge sharing ecosystem and to bring together stakeholder in order to realize smart city implementations. This system emerged with a focus on collaboration. The advantage of this system is that it acts as a mediator, prevents piecemeal projects that are realized by an individual actor and precludes the repeated implementation of already failed projects by experience-sharing.

3.1.3. Smart Cities Readiness Guide – Smart Cities Council

Smart Cities Council envisions using the transformative power of smart cities with the use of digital technologies and their reflections on a smart planning system in order to achieve sustainable cities that reinforce quality of life for their citizens. It promotes cities with regards to their three crucial features; livability, workability and sustainability.[5]

[5] The concept of livability refers to the aim of providing healthy living conditions for the citizens in which digital infrastructure enables easy and ubiquitous to urban services.

The council provides guidance for the cities to create their own road-map to achieve smartness. Smart Cities Readiness Guide prepared by Smart Cities Council (from here on SCC) in 2013, aims to present several roadmaps and educated decisions to transform cities with the use of technology. The audience of this paper is intended to be actors of public sector and decision makers. In this document a holistic approach for the smart city concept is presented. SCC defines smart cities as follows;

> "A smart city uses ICT to enhance its livability, workability and sustainability… There are three parts to that job: collecting, communicating and crunching. First a smart city collects information about itself through sensors, other devices and existing systems; next it communicates that data using wired or wireless networks. Third, it crunches analyzes that data to understand what's happening now and what's likely to happen next" (SCC, 2013).

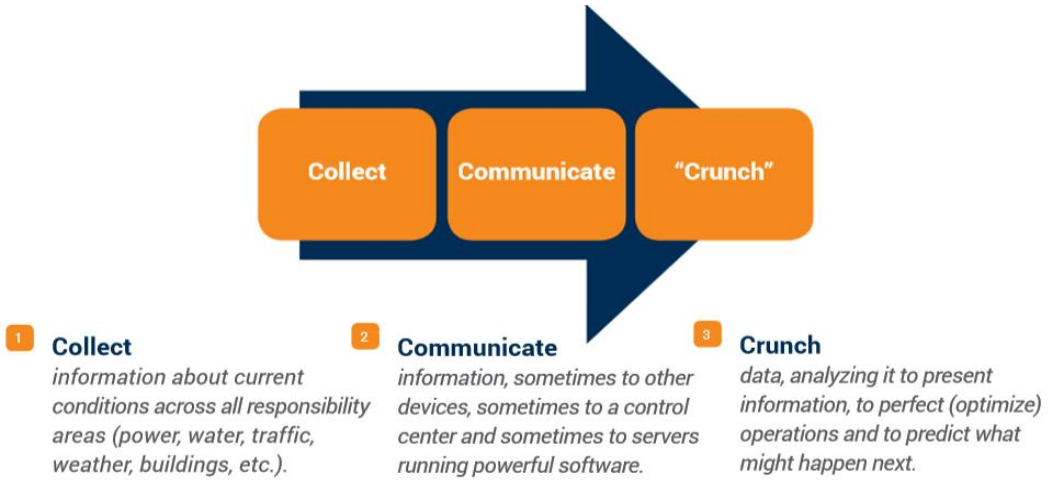


Figure 3.1. Three steps of the smart systems; Data Collection, Communication and Data Analysis (crunch) (SCC, 2013)

Workability focuses on an infrastructure that is based on connectivity in order to increase the competitive capacity of the city.
Sustainability defines the affording the urban services, without compromising the future needs.

In this manner, the ICT technology is aimed to be used in cities in order to collect and analyze data through IoT, make inferences and using these as a basis for future decision-making. As the concept of smart city recently gained popularity, it is important to acknowledge the reasons behind the rising momentum of this trend. Growing urbanization, growing stress both in economy and environment, inadequate infrastructure, globally growing economic competition, growing expectations and demand of citizens, increasing environmental challenges, rapidly growing technological innovations and technology becoming more accessible by rapidly declining costs are identified as the forces behind the emergence of smart cities (SCC, 2013).

In order to define the work areas of smart cities, SCC (2013) not only focuses on 6 main components of smart cities. Instead it proposes an in-depth understanding of the concept with the collaboration of smart city functions ("responsibilities") and transformative technologies ("enabler"). The relation in between these two important parts of smart cities is summarized in the figure below (Figure 3.2). The service areas of smart city are defined within the sectors and services of "built environment, energy, telecommunication, transportation, health and human services, water and wastewater management, public safety and payment systems" (SCC, 2013). In order to realize the objectives in these sectors and services, "enablers" are used and they determine cities technological capabilities.

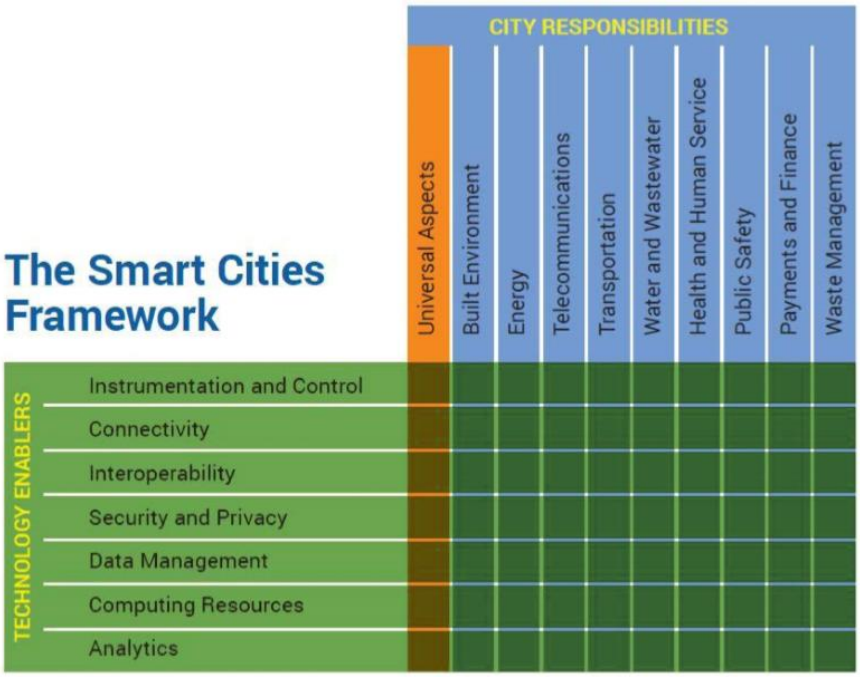


Figure 3.2. Responsibilities of Cities (sectors and services) versus Technological Capabilities of a Smart City (SCC, 2013)

While aiming to raise awareness in the subject and to guide public decision makers into forming a successful smart city road-map, Smart Cities Readiness Guide created by SCC sheds light on the benefits smart cities bear and the barriers their implementation may encounter. These benefits and barriers concerning smart cities are represented in Table 3.1. Among them, siloed and piecemeal implementations of smart cities raise concerns about the traditionally divided city functions in the public sector where each department only focuses in its own subject-matter without collaboration. Not having a holistic approach in the smart city context not only increases the costs of with un-integrated implementations, it diminishes the efficiency and range of these applications. It prevents experience and information (data) sharing in-between different departments and created unnecessary coordination difficulties that is caused by isolated implementations.

Table 3.1. *Benefits of Smart City Approach and the Barriers faced in this Agenda (the table is prepared with reference to SCC, 2013)*

Benefits	Barriers
Enhanced Livability	Siloed and Piecemeal Implementations
Enhanced Sustainability	Lack of Financing
Enhanced Workability	Lack of ICT-know-how
Cost and resource saving with effective management systems	Lack of integrated services
Coordinated and holistic	Lack of citizen engagement
Participation of citizens (both contribute and access real-time urban services)	Lack of smart city vision

3.1.4. Asean Smart City Network

The Asean Smart City Network has been recently established in 2019 with the aim of supporting sustainable development through adopting smart city vision. As EIP-SCC, Asean Smart City Network also functions as a catalyst which contributes the cooperation among stakeholders with an inclusive approach. Along with a multi-stakeholder ecosystem, smart city network intents to improve citizens' quality of life by including them as actors in smart city development approach. Collaborative platform

The six study areas of Asean Smart City network are introduced as; "civic society, health and well-being, safety and security, quality environment, built infrastructure, industry and innovation (Ministry of Foreign Affairs Singapore, 2018). Three objectives of this network are listed as;

"1. Facilitate cooperation on smart cities development,

2. Catalyse bankable projects with the private sector,

3. Secure funding and support from ASEAN's external partners for smart city implementations" ([Asean Smart Cities Network Concept Note], 2018).

In this manner main purpose of this network is to form a collaborative platform which would facilitate development, coverage and implementation of smart initiatives. Furthermore, within the six study areas, the platform gives emphasis on local and cultural context. The needs and potentials of each city are specific to itself that is why the platform promotes the projects that refer directly to the specific case of each place.

3.2. Smart City Approaches and Practices

When we look at the prominent cities in the world about smart cities, we can see that many cities define smart city initiatives as a means to improve citizens' quality of life with all its dimensions. Among these dimensions; environment, energy, transportation and economy stand out one step ahead of the other components of smart city.

Smart cities are implemented as a response for the rapidly urbanizing world that lead to problems of scarce resources and inadequate urban services. With the help of communicative technologies, smart cities aim to create a more efficient urban environment both to improve quality of life and to provide sustainability. The concept of smart cities, which respond to urban problems, has gained popularity in the last 20 years. Today nearly 300 cities have been described as smart by various sources; but because the concept of "smart" does not have sharp boundaries and no standardization of what is considered smart, it is controversial how many of these cities are actually smart (Anthopoulous, 2017, 21). Among all the smart city implementations, Europe, America and Asia have the most smart cities and smart initiatives in the world (Nam and Pardo, 2011; ICF, 2011) (cumulative list of smart cities defined by Intelligent Community forum could be found in the Appendix A).

When the smart city projects around the world examined, it has been seen that most of them are based on existing cities. These brownfield projects are realized through integration of smart implementations to the city in order to improve the quality of the

exiting city, in other words upgrading it. But in other instances, smart cities from scratch (Greenfield projects) are developed (Angelidou, 2014). While brownfield approach is mostly embraced in Europe, Greenfield smart city projects usually pursued in Asia and Middle East. These two strategies bear both advantages and disadvantages in their own domain. Even though in Greenfield city projects there are no limitations or constraints that comes with a built environment, this approach is highly criticized as it may create an uneven social structure where only high-income groups could afford to live in these cities built from scratch (Angelidou, 2014, Balaban, 2019). Moreover, as new cities, greenfield projects carry the risk of not being able to attract residents which would lead to huge economic burdens. The prominent examples of the smart cities built from scratch are; Masdar City in United Arab Emirates, Songdo in South Korea, Cyberjava in Malaysia, PlantIT Valley in Portugal and Lavasa in India.

In order to have a more comprehensive understanding, smart city approaches from Europe, North America, Asia, Africa and Middle East are presented below. In the Turkish agenda, the practices from Europe and followed by Asia are embraced and for the preparation of 2019-2022 National Smart Cities Strategy and Action Plan, examples of Copenhagen and Amsterdam are considered as best practices (MEU, 2018b).

3.2.1. Europe

Smart city initiatives are available in all of the 28 European Union countries according to European Commission's objectives. The best six smart city practices are Amsterdam, Barcelona, Kopenhag, Helsinki, Manchester and Wien (EC, 2018). As the EU's environmental sustainability goals are directed to the aim of reducing GHG emission. In this regard smart environment and smart mobility are two of the main implementation areas among the six accepted components (smart government, economy, government, people, living, transportation). Open data, empowerment of

citizens, creating a cooperative ecosystem among private and public stakeholders and implementation of IoT in order to obtain ubiquitous data and take decision according to the inputs obtained from this data are other important aspects of Europe's smart city approach (Caragliu et al., 2011; Giffinger et al. 2014).

The case of Copenhagen is thought to be the one of the best practices in smart city domain. The "triple helix of innovation model" of Copenhagen creates a collaborative environment, in which the smart initiatives are created with the equal input of each of the three organizations that takes park in the model (Figure3.3). According to the model that is created by Henry Etzkowitz, the interaction between organizations (public authorities, research institutions, private companies and organization) of the model generate a different point of view about the subject-matter, thus a multi-faceted, holistic approach is obtained.

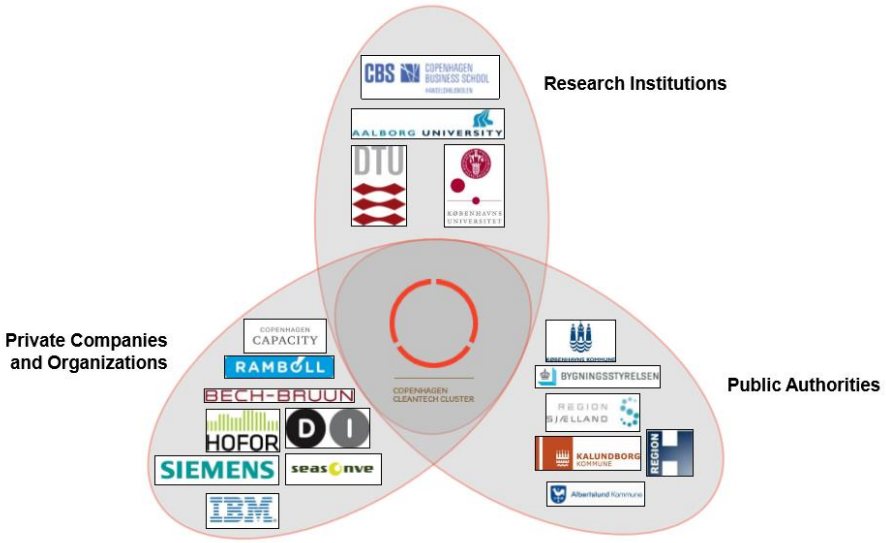


Figure 3.3. Members of Triple Helix Model of Copenhag ([Copenhagen Smart City], 2014)

Copenhag's smart city vision includes; quality of life (safe, diverse, leisure, convenience), growth (knowledge, innovation, employment, investment) and sustainability (carbon neutral, clean air and water). With reference to the aims in these themes, the prominent smart city initiatives of Copenhagen are; smart network platforms that utilize from IoTs, living labs, open data, smart grid and smart transportation ([*Copenhagen Smart City*], 2014).

3.2.2. North America

The smart approaches in North America mainly take its root from the use of Big Data, IoT and cloud computing. Many cities in United States and Canada supports sharing economy and ecosystem in a broad perspective and entrepreneurship, and focus on environmental solutions that reduces the impact of climate change by the implementation of innovative transportation and energy saving systems. Especially in the case of United States it is seen that a piece-meal approach is dominant in the smart city context where most of the implementations are single actions based on solemnly on use of technological advancements for automation of urban services (Technology and Innovation Task Force, 2018).

3.2.3. Asia

The case of Asia bears importance as 24 of the 31 mega cities that have more than 10 million population are located in this region. And it is thought to have the fastest growing cities in the world by 2010 (Worldbank, 2018). Both in the smart city market place and the smart city initiatives the cities in Asia carry great potential. Singapore, Seoul, Osaka, Hong Kong are the best practices from Asia with their forefront emerging economies, smart community structure and high technology utilization rates.

One of the best practices Singapore formed a vision of "Smart Nation: The Way Forwards" in 2014 (Smart Nation and Digital Government Office, 2019). This vision

aims to create more empowered citizens through the use of innovative technologies and establish productive business opportunities with the digital economy. The study areas of this vision is defined as follows; healthcare, urban living, integrated public services, integrated city planning, urban mobility, safety and security. In this respect by harnessing ICT, networks and data, Singapore aims to create stronger communities with high quality of life. For the roadmap of Smart Nations various stakeholder (entrepreneurs, technology builders) are involved in the vision along with citizens in the established living labs. In order to realize these aims in smart people and smart living, several digital platforms are established which promote the process Big Data, open access to data (Open Data) and interoperability of different communication technologies. The city also gives importance to integrated data for interoperability of different ICT systems, in order to facilitate "the optimal use of resources across different systems." (Lee et al., 2016). The prominent initiatives of the city which give reference smart systems are extends to; "Analytical, Open Data for urban transport, Open Data Platform of Singapore, Smart Nation Sensor Platform (SNSP), main business development environment (codex)" along with the pilot projects of smart counters, smart grids and smart health services (HealthHub) (Smart Nation and Digital Government Office, 2019).

3.2.4. Africa

Although Africa is considered to be at the very beginning of smart city development, in order to tackle the problems that comes with high urbanization rater, new technologies such as 5G networks which provides ICT infrastructure are realized in Casablanca, Johannesburg and Cape Town (Nam and Pardo, 2011). These technological infrastructures not only ensure connectivity but it will also create a basis for future smart city initiatives.

3.2.5. Gulf Region

Unlike the previous examples, Gulf Region smart city approach is based on mostly planning smart cities from scratch. In 2025 Gulf Region projected to have 9 ongoing smart city projects, seven of which will Greenfield projects without any restrictions that comes with an already built city. These cities are considered as thematic cities as they apply extensive technological systems within their program. This bears concerns whether;

- These smart city projects from scratch would be able attract residents,
- Greenfield smart projects deepen the economic gap between the society because of the high initial costs of technological systems and would it lead to a segregation within the citizens as low-income groups would not be able to afford to live in these cities,
- Even though these cities are labelled as sustainable and smart, is it a really smart approach to focus on a highly technology-oriented approach neglecting other components of smart city.

These smart city implementation in Gulf Region both unique in their case and radically different from the examples around the world. Viitanen and Kingston (2013, 806) criticize the fact that even though Masdar City - a greenfield project in Abu Dhabi is best known for its implementations of green technology and label of eco-city, the environmental performance of the city still debatable "while the still itself is bereft of the social dimension of sustainability.

CHAPTER 4

SMART CITY APPROACHES AND PROJECTS IN TURKEY

4.1. National Policy Documents on Smart Cities

National policy documents are among the important policy documents for smart city approach, as they create a holistic framework in the context of the country and determine methods in order to reach goals related to the smart city approach and its applications. For a successful smart city vision, the national documents could act as a guide and a roadmap for local governments, that way the relation between upper scale policies and lower scale implementations are ensured. In the case of Turkey, the strategies and action plans regarding smart city vision in city planning domain are prepared by several national institutions. The subject based documents that only focus on the use of smart development strategy in single sector or dimension are produced by the related institutions; these are, Ministry of Energy and Natural Resources, Ministry of Transport and Infrastructure, Ministry of Transport, Maritime and Communication. The strategy and action plan documents that embrace smart vision as a whole are composed by State Planning Organization, Municipality of Environment and Urbanization (here on MEU), Ministry of Development and The Scientific and Technological Research Council of Turkey (here on Tübitak). These strategy studies are carried out by the collaboration of different departments under the supervision of Department of Information Technologies and General Directorate of Geographic Information Systems located in these institutions. In Table 4.1 the national strategy documents that refer to smart city vision and its dimensions such as mobility, environment and smart technologies are chronologically presented. With the chronological representation, the process of smart city approach in Turkey is examined. The pioneer national documents of the smart city process are each further discussed.

Table 4.1. *Chronologically ordered National Policy Documents on Smart Cities in Turkey*

National Policy Documents on Smart Cities		
Document	Year of Approval	Institute
2003-2023 National Science and Technology Policies Strategy Paper – Vision 2023	2004	Tübitak
2006-2010 Information Society Strategy	2006	State Planning Organization
2006-2010 Information Society Strategy, Action Plan	2006	State Planning Organization
Integrated Urban Development Strategy and Action Plan - Kentges	2010	MEU
Turkey Climate Change Strategy (2010-2023)	2011	MEU
Energy Efficiency Strategy Document (2012-2023)	2012	Ministry of Energy and Natural Resources
10th Development Plan (2014-2018)	2013	Ministry of Development
Renewal of Information Society Project - Information and Communication Technologies Supported Innovative Solutions Axis Current Status Report	April 2013	Ministry of Development
Renewal of Information Society Project - Information and Communication Technologies Supported Innovative Solutions Axis Global Trends and Country Reviews Report	May 2013	Ministry of Development
2015-2018 Information Society Strategy and Action Plan	2014	Ministry of Development – Information Society Department
2016-2019 National e-Government Strategy and Action Plan	2016	Ministry of Transport, Maritime and Communication – General Directorate of Communication

National Energy Efficiency Action Plan 2017-2023	2017	Ministry of Energy and Natural Resources
2017-2020 National Broadband Strategy and Action Plan	2017	Ministry of Transport, Maritime and Communication – General Directorate of Communication
National Smart Transport Systems Strategy Document and 2018-2020 Action Plan	2018	Ministry of Transport and Infrastructure
Smart Cities White Paper	2018	MEU
2019-2022 National Smart Cities Strategy and Action Plan	ongoing	MEU, Tübitak Bilgem YTE

4.1.1. 2003-2023 National Science and Technology Policies Strategy Paper – Vision 2023[6]

The first policy on "Smart Cities" in Turkey, appear in National Science and Technology Policies (2003-2023) strategy document. The strategies in this document establish a base for a smart city approach and their components. Most of the policies concentrate on the foundation of infrastructure and technologies. Even though the document does not put stress on the smart city approach, it gives direct insights on the smart city component: smart transportation. Under the aim of "improving the quality of life", the policy "gaining the ability to develop modern and safe transportation" introduces smart road systems, smart vehicles and innovative security systems. Hereunder, smart transportation becomes the first and the most emphasized component and implementation area of smartness in the context of Turkey. Other strategies and clarification on this document are given below.

[6] *Ulusal Bilim ve Teknoloji Politikaları – 2003-2023 Strateji Belgesi*

In 2000, the Supreme Council for Science and Technology (SCST)[7] assigned the Scientific and Technological Research Council of Turkey (TÜBİTAK) to determine Turkey's science and technology policy with an attempt to keep up with the recent technological developments. The aim of the strategy is to approach technology not only as a state policy but also internalize it as a social project (Tübitak, 2003). This document gives importance to the idea that it is necessary to build on a vision shared by all relevant sectors in order to implement the policies, which are developed, and to achieve the favorable objectives. The cooperation network within sectors of universities and research institutions, industry and other producer sectors and public institutions is considered together as a "triple helix structure". As it was first theorized by Etzkowitz and Leydesdorff (1995) the interaction between these three agencies plays an important role in the process of knowledge creation in an innovative system. While 2003-2023 National Science and Technology Policies Strategy Papers acknowledge each institutions individual and reciprocal role, it does not include civil society as a part of this collaborative system. Instead, the strategies mainly focus on research and development activities that rise from this cooperation. The technology and its integration are dominantly discussed in this paper without referring the role of the citizens.

The framework of the strategies in this paper formed around four main objectives. Under the chapter "Prioritized Technological Activities", four aims are defined as; "ensuring competitiveness in industrial production", "improving the quality of life", "sustainable development", "reinforcing technological infrastructure for transition to information society" (Tübitak, 2003, 12-17). The goal of ensuring competitiveness in industrial production mainly focuses on the use of unmanned systems, intelligent

[7] The duties of the Supreme Council for Science and Technology (SCST) are to assist the government in the determination of long-term science and technology policies, to set objectives, identify priority fields, prepare plans and programs, prepare necessary legislations and to ensure cooperation and coordination between sectors and public institutions (TÜBİTAK, 2016).

machines and automation in general. With the use of these innovative systems, it is aimed to be a part of the competitive global industry.

The emerging theme, quality of life, is reviewed especially in health and transportation sectors. Some strategies also defined in housing under the approach of healthy city. The smart use of technology is addressed in both of these areas but it remained limited to several aspects of urban life. Promoting and realizing remote health services, remote real-time patient monitoring and real-time interventions, gaining the ability to establish a healthy and contemporary urbanization infrastructure, taking measures against natural disasters, reducing the energy requirements of buildings and providing renewable resources, using smart vehicles and smart road systems to increase security in traffic are the main strategies to sustain quality of life through the use of technology. The first policy on smart cities in Turkey is for the smart transport component, included in the National Science and Technology Policies Strategy Paper. Under the objective of "improving the quality of life", the policy of "gaining the ability to develop contemporary and safe transportation systems" refers to actions of "to develop smart vehicles and smart road systems for urban transportation" and "to establish fire and security systems for transportation and tourism structures" (Tübitak, 2003, 15).

Sustainable development part highlights some of the common themes that are discussed under the quality of life part. The use of renewable energy modes, the control of power systems and energy use along with the emphasis on pollution theme are referred in this part. It is aimed to use ubiquitous technologies to monitor air quality, climate change and water and soil pollution. Developing and disseminating technologies for recovery of solid wastes and removal of hazardous wastes are encouraged.

Transition to information society is discussed as a roadmap that should establish broadband systems, security of information and ensure high service quality in information management and transmission through information and communication technologies. To create a base for future innovations, the focus of this aim mostly

consisted of infrastructure investments. The technologies that will be used to achieve these goals are named "strategic technologies" and grouped under eight main headings[8]. Starting with ICT, road maps have been determined for each of the technology and it is aimed to gain competence in these specific areas. As the strategy paper focuses on specific technology areas, problem and solution-oriented approach has been pursued rather than a holistic framework. Among eight technology fields, National Science and Technology Policies Strategy Paper asserts importance to three main paradigms; "political, public administration and social awareness" to internalize these strategies (Tübitak, 2003, 31). Continuity of strategies independent from political will, coordinated programs in public administrations, social perception and support are defined as the critical issues for the success of the process.

The envisaged strategies and technology areas in the policy document are referenced with European research areas in technology (Tübitak, 2003). This indicates that from the start of smart city vision, the stance that Turkey forged for technology and the use of innovative smart systems mainly based on European approach. Even though smart and smart system phrases are used throughout the document, it does not refer to up to date holistic meaning of "smartness" in the domain of urban planning. Still, this document could be accepted as the penetration of smart city vision into the Turkish agenda. The dissemination of technology and new attitudes toward the use of innovative and smart technologies in different sectors, paves the way for opportunities they bear. On the other hand, fragmented approach that is portrayed in this document, established a partial relationship between urban planning discipline and smart systems only through transportation and health services.

[8] Each of the eight "strategic technology" is defined for specific objectives developed upon the categories of; industry, quality of life, sustainability and information society. These technologies are ICT, biotechnology, nanotechnology, mechatronics, manufacturing technologies, material technologies, energy and environment technologies and design technologies.

4.1.2. 2006-2010 Information Society Strategy and Action Plan

The Information Society Strategy was prepared by the State Planning Organization for the period between 2006-2010. The aim was to accelerate public services and transactions by sharing data between the institutions in the electronic environment and thus provide speed, efficiency and transparency in the processes related to these services. Later in 2014 the Information Society Strategy and Action plan was renewed and this time prepared by the Ministry of Development for the years 2015-2018. In the renewed strategy, the smart city approach is discussed in detail both at global and local scales. Even though the first Information Society Strategy did not cover smart aspects of the use of technology, it initiated the process of utilizing ICT and creating information society to prepare the background for a smart city vision.

The main objective of this strategy document was to form an integrated system with the use of information and communication technologies. This would not only decrease the operation durations in public administrations, but also provide more effective, fast, easily accessible and efficient services for the citizens. The document also refers to reducing the digital divide within this process and aims to ensure the benefit of citizens from the opportunities of information society. To create easily accessible and widespread information and communication technologies, the document gave emphasis on the growth of this technology sector and creating a competitive environment that will provide widespread, sufficient communication services with affordable prices for all.

In order to achieve the aforementioned strategies, the Action Plan of 2006 Information Society Document gave priority to a seven-step roadmap; 1.Social transformation, 2.Influence of ICT in business world and market, 3.Citizen-oriented service transformation, 4.Modernization in public administration, 5.Creating globally competitive information technology industry, 6.Competitive, widespread and inexpensive communication infrastructure and services, 7.Improving R&D and innovation. The document does not deeply analyze how to achieve a smart city;

instead it is concentrated on the dissemination of some of the smart city tools, infrastructure investments, and it gives emphasis on creating a citizen-oriented digital transformation in several urban services. It aims to decrease the digital divide by increasing the use of ICT in different sectors, administrations and in daily lives by citizens.

4.1.3. Integrated Urban Development Strategy and Action Plan 2010-2023 – Kentges[9]

KENTGES is a roadmap for central and local administrations on urbanization and zoning issues which was prepared by Urbanization Council[10]. The meetings of Urbanization Council and General Assembly activities started in 2007. Approximately 500 experts from 151 different central and local institutions and organizations contributed to the Urbanization Council and KENTGES activities. KENTGES-Integrated Urban Development Strategy and Action plan published as a final document for these meetings and activities in the pursuit of a sustainable and integrated development. This document aims to develop a single coordinating and supervisory reference for urbanization and settlement issues as a central activity, and for the local areas, it aims to be a guide for executive local governments and their services. The 72% actions in this document are related to central administrations and the other 28% refers to the actions of local governments (MEU, 2010). It determines the activities and procedures to be carried out at the national and local level in the fields of transportation, infrastructure, risk management and mitigation, housing, climate change, quality of life, social policies and participation (MEU, 2017).

The document of KENTGES which assesses the current situation of the urbanization, settlement areas, spatial planning system and aims to develop solutions for the problem, does not directly refer to the vision of smart city. However, the issues and

[9] *Bütünleşik Kentsel Gelişme Stratejisi ve Eylem Planı*
[10] *Kentleşme Şurası*

the approaches of the document have parallels with the vision. “Rational decision taking” and “rational management” themes are addressed in several topics of climate change, energy efficiency, urban transportation and the use of resources. The concept of rational decision making in this document embrace some of the most important dimension (smart mobility, smart environment, smart living) of a smart city. The document aims, strategies and actions have the same ground with the objectives of smart development especially considering sustainability. However, this points out a smart/rational decision-making approach; the document does not particularly focus on the use of technology in order to achieve its goals.

4.1.4. 10th Development Plan 2014-2018

The first holistic high-level policy in the field of smart cities is set out in the 10th Development Plan published in 2013. In this document smart city strategies are specified in several different policies in order to address the issues that stem from the population increase in cities. Problems encountered in the provision of urban infrastructures such as energy, natural resources, transportation, health, education and security are mentioned along with policies and actions that require smart solutions. The following paragraph examines the strategies, related policies and actions that refer to smart city understanding in this document.

“Increasing the production and export capacity in the areas of smart buildings, smart building materials, smart public transportation vehicles and signaling systems” in Transformation of Manufacturing Industry section (Article 656), “expanding the use of smart applications, particularly in areas such as health, transportation, building, energy, water management and risk management” and “developing and reinforcing cooperation, coordination and data sharing among relevant institutions, including non-government organizations and increasing the role of local governments, private sector and NGOs”, “giving priority to innovative sectors and creative industries and applications that support high technology and environment-friendly production in

urban transformation projects" in Livable Places, Sustainable Environment section (Article 731, Article 900, Article 964), "increasing the use of Electronic Traffic Control Systems in an integrated way with smart transportation systems with the aim of reducing the deaths caused by traffic accidents by 50%" in Logistics and Transportation section (Article 841), "effective use of information technologies and intelligent transportation systems in traffic management and public transportation services" in Urban Infrastructure section (Article, 987) are the strategies asserted within the smart city vision in the 10th Development Plan (Ministry of Development, 2013, 90-131).

The development plan also determined prioritized transformation fields and related smart actions. Within the scope of Energy Efficiency Improvement Program (program 1.14) article 5 Increasing Energy Efficiency in Transportation gives emphasis on the policy of reinforcing the use of electric and hybrid vehicles along with establishing smart bicycle networks and pedestrianized networks in suitable settlements. Two smart city related actions are composed in order to realize this strategy. Those are; 1. Preparing and implementing energy efficient and climate sensitive urban transport strategies, 2. Promoting the use of intelligent signaling systems for the real-time traffic management (Ministry of Development, 2013, 176). In the program of Strengthening Local Institutional Capacity (program 1.23), the policies of "improving capacity, governance and participation in local" and "enhancing the technological infrastructure, speed and quality of services of institutions at the local level" is defined along with the action 24. supporting feasibility studies of metropolitan municipalities for smart city application (Ministry of Development, 2013, 194-195). Furthermore, smart building systems are included under the program of "Urban Transformation Program, Developing Competitiveness and Social Cohesion".

Being the first development plan to directly mention smart visions and initiatives, this development constructs the first high-level framework for smart city approach. The smartness discussed mainly in the fields of transportation, industry and energy sectors without addressing all the six components of a smart city. Nevertheless, it formed the

basis for a participatory, cooperative environment with the policy that gives emphasis on the inclusion of several actors (Article 900), but did not further defined the roles and regulations related with this environment.

4.1.5. Renewal of Information Society Project and 2015-2018 Information Society Strategy and Action Plan

With the aim of revision of Turkey's Information Society Strategy and renewal of the current dynamics, Ministry of Development (here on DPT) cooperated with the consulting firm Mckinsey&Company, in order to compose 2015-2018 Information Society Strategy and Action Plan. The document directly addresses application of smart systems and submits action plans to diffuse these applications in everyday lives of citizens and management of local governments. The smart city axes this strategy document emphasizes are; information technologies sector, broadband infrastructure and sectoral competition, qualifies human resources and employment, social transformation, information security, protection of personal information and secure internet, innovative solutions supported by IOT, internet entrepreneurship, user(human)-centered public services and efficiency (DPT, 2013).

The "innovative solutions supported by information and communication technologies" axis of the report directly mentions and adapts the smart city approach. Under this axis lies the targets; 1. reinforcing the field of intelligent solutions supported by information and communication technologies, 2. providing state support for the commercialization of domestic solutions and services, 3. Implementing smart irrigation practices that will ensure efficient use of water resources in agriculture throughout the country; 4. Creation of autonomous management systems and use of autonomous vehicles. The target "implementation and dissemination of smart city solution" aims to initiate a smart city common ground with action. Some of the actions that shed lights on a smart city road map are given below.

1. Defining a smart city strategy,
2. Setting standards for smart city implementations,
3. Adapting a smart city certification model,
4. Promoting and commercializing smart city technologies starting from urban transformation areas.

These aims behind these actions are range from creating a reinforcing the brand value of cities to disseminating smart systems and applications. Even though this document presents some insights about the topic of smart city, an integrated smart city approach which renders a holistic approach in every aspect of the city is not composed. Instead the aims and actions are mostly focused on the economy and infrastructure parts of the approach and penetration of innovative technologies into everyday life. In this direction, another action plan depicts the establishment of living labs in order to create coordinated environment for future smart city applications.

4.1.6. National Smart Transportation Systems Strategy Document and 2018-2020 Action Plan

Rapid developments in information and communications technologies have led to the emergence of new trends and expectations in the society's understanding and style of transportation. Overall increasing urbanization and population growth results in a demand for mobility. The increased density in transport modes create problems ranging from traffic congestion, traffic accidents, longer commuting, insufficient parking areas, loss of land and public space, pollution (high emission of GHG, noise pollution etc.), high energy consumption and management problems. It also impacts the comfort and safety of the users. When the increase in transportation demand is not met with the public transportation potentials, dependency to automobiles and private cars increase. According to TÜİK (2017)'s data, even though the population rate is %12 between the years of 2010 and 2017, the rate of increase in the number of private cars is %59 in between these years. The increase in automobile ownership indicates

the rise in the use of private cars compared to the public transport, as well as the dependency to road transportation. This shows the progressive problem that lies in transportation in the Turkish case. Smart Transportation Systems play an important role in meeting these emerging planning problems, needs, trends and expectations. Recent advances in technologies, rapid of urbanization, demand for public transport and the increase in numbers of vehicles and drivers develop and directly affect STS (*AUS- Akıllı Ulaşım Sistemleri*) and lead to the emergence of new smart implementations in the transport sector.

Ministry of Transport and Infrastructure (from here on MTI) (2018) defines STS as a collection of smart systems, including monitoring, measurement, analysis and control through multi-faceted data exchange between user-vehicle-infrastructure and management center. The purpose of STS is to reduce travel time, increase traffic safety, optimum use of existing road capacities, meet the needs of increased mobility, contributing to the national economy by providing energy efficiency and reducing environmental damage.

The National Smart Transportation Systems Strategy Paper and 2018-2020 Action Plan is developed to both to tackle the problems of transportation sector and meet the needs and demand of mobility by utilizing innovative technologies. This is one of the subject specific national approaches to the use of technology in the defined study area. It does not refer to "smart city approach" and "smartness" as a whole; instead, it analyses the opportunities that innovative technologies bring into the sector of transportation and how to achieve a successful outcome from this arising movement. Within the scope of the document five stakeholders are determined. These consist of public institutions, local governments, universities, private sector and NGOs (AUSDER). Within this framework, for the preparation of the strategy document face to face interview were conducted with the aim of identifying the current situation and the needs for the provided services, obtaining information about the activities carried out by institutions/organizations on STS and creating a participative environment by receiving opinions and suggestions on strategy and action plan document (MTI, 2018).

In additional, to have an in-depth overall context of the current situation regarding the use of smart systems and standards in STS, a survey is conducted with stakeholders. This survey reveals the sectors in which STS have most influence and effect on. Industry, energy, construction, IT, software, communications, automotive, education and health sectors are identified to have direct relation with the application and use of smart systems in transportation (MTI, 2018).A common ground is aimed to be achieved with the participation of stakeholders in organized workshops (local government workshop, strategic perspective workshop, strategy document and action plan workshop). In the preparation of this document, a participative environment is sustained to address strengths and threats that transportation sector has with regard to different actors. On the other hand, the citizen participation is not considered.

Another factor affecting the preparation of this document is the global trends on this subject. The ecoles of USA, Germany, Japan, Korea and the Netherlands are examined and their stand to the use of smart systems in the transportation sector, objectives, targets and strategies are taken as examples.

In reference to all these studies, the vision of Smart Transport Systems in Turkey is determined as; "People-oriented transportation technologies with the use of advanced information technologies" (MTI, 2018). The mission of the strategy document prepared to achieve this mission is to create an "efficient, effective, innovative, dynamic, environmentalist and sustainable" intelligent transportation network that integrates all the modes of transportation by taking advantage of current technology. It is foreseen that the smart transportation network will create a sustainable economic model that will create added value by utilizing domestic and national resources. Five main strategic objectives stand out referring to the vision and mission of the document. These are; 1. Development of STS Infrastructure, 2. Ensuring data sharing and security, 3. Providing sustainable smart (and innovative mobility), 4. Ensuring road and driving safety, 5. Building a livable environment and aware society.

In the domain of transportation local initiatives, solutions and measures specific to the space gains importance under an upper national document. The implementations smart systems and effects of smartness are further analyzed in part; 4.3 Smart City Initiatives of Local Governments in Turkey.

4.1.7. Smart Cities White Paper

The white paper on smart cities is an informative document that forms the proposal base of 2019-2022 National Smart Cities Strategy and Action Plan. It was issued by the Ministry of Environment and Urbanization in 2019. In the preparation of the document, İstanbul Metropolitan Municipality (form here on İMM) and subsidiary of İMM, İSBAK A.Ş.[11] have contributed with their experiences in smart city vision (The pioneer role of İstanbul and implementations of İMM and İSBAK in smart city ecosystem is Turkey is explained in episode 4.3.1). The white paper document reveals a framework for smart city vision of Turkey. It is composed of five main parts that contain challenges cities face with, the definition of smart city, rising global trends and new technologies in smart cities, smart city initiative in Turkey and, best-practices from world. MEU (2019, 10) defines smart cities as "more livable and sustainable cities that produce solutions to add value to the quality of life through foreseeing future problems and needs, based on data and expertise". It utilizes new technologies and innovative approaches and realizes them through stakeholder cooperation (MEU, 2019, 9). The need for a smart city is based upon the challenges the contemporary cities face and their effects. These challenges that need smart interventions are defined as population growth, global climate change, long life expectancy, reduction of resources, pollution, increased energy requirement, technical labor demand, increased

[11] Istanbul Information and Smart City Technologies Inc. was established in 1986 by İMM in order to realize project design and give services in applications of projects in the areas of traffic and system engineering. With the establishment of R&D department in 1995, the İSBAK institution expanded its fields of activity and started its projects in Smart Transportation systems. ISBAK is the first licensed R&D center in Turkey, which started operating in the field of "Smart Transportation Systems" in its own constitution. Research, development and production work is operated in the fields of smart systems (İSBAK, 2018).

communication needs, rural issues and outdated infrastructure in the white paper (MEU, 2019a, 8). These challenges bear the threats ranging from; housing and employment problems to backlogged energy needs and environmental problems. It also bears the opportunities such as entrepreneurship, high technology solutions for sectors and sustainable solutions. In order to meet the needs of the cities and even to create opportunities for urban development, the concept of smart systems comes to the fore. With the smart systems, the goal is to invest in technology to improve environmental conditions by promoting economic growth and social development in cities (MEU, 2019a). The difference within the use of smart systems and smart city vision lies in the social, environmental and economic aims and achievements. This is why the focus of smart city approach primarily consist of humans and citizens.

The emergence of smart city concept in Turkey is based open the challenges that cities face with constant growth. This constant growth results in reaching the capacity limits of resources and it leads management problems in key components of city planning such as environment, transportation and health. The smart city approach is embraced to eliminate these problems and transform them into opportunities for urban development. The establishment of the Department of Smart Cities and Geographic Technologies within the General Directorate of Geographic Information Systems of MEU has initiated the institutional structure and policy ownership of this approach in Turkey. It is accepted as an umbrella term that covers the concepts of sustainable city, connected city, competitive city, brand city, digital city and livable city. It is explained as a concept that gathers the strong aspects of each of these approaches.

In order to further explain the concept of smart city the white paper introduces 17 smart city components to create a roadmap for each one of these study areas. Five of these components (smart people, smart economy, smart mobility, smart governance, smart environment) overlap with Giffenger (2007)'s components that is highly accepted, only excluding smart living component. The other components are "open data, big data, smart energy, smart buildings, smart health, disaster and emergency management, smart security, information security, information technologies,

communication technologies, smart space organization, GIS and smart infrastructure. The definitions and contents of these smart city components defined by MEU are giving below.

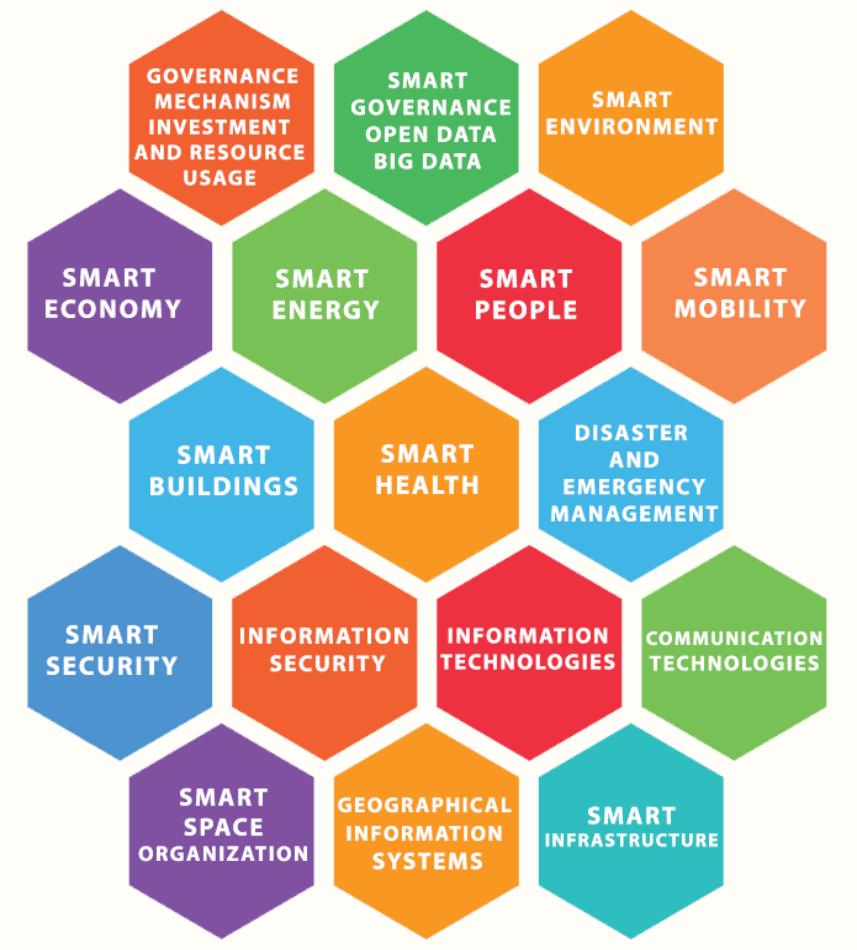


Figure 4.1. Components of Smart Cities by MEU. (the figure is prepared with reference to the Smart City White Paper Document, 2019a)

Table 4.2. *Definition of the Smart City Components of Ministry of Urbanization and Environment (MEU, 2019a, MEU, 2019b).*

Components of Smart Cities	Contents and Description of the Component
Governance Mechanism, Investment and Resource Usage	Management of policies together and interactively within the framework of a common understanding, providing inter-institutional and intra-institutional cooperation. It also covers training, guidance services and legislations.
Smart Governance, Open Data, Big Data	Supporting fast and efficient decision-making (in the public administration processes such as analysis, planning, implementation and policy making) with the principles of transparency, participation and accountability.
Smart Environment	Ensuring the sustainability of the environment and nature, preserving the city's natural assets through the management of waste, air, water, soil and climate change. Applying environmental management policies based on green city planning approaches.
Smart Economy	This component tackles economic input, output and other economic activities within the context of smart industries. Competitiveness, brand value and sharing economy[12] are the important features of this component. It also gives emphasis on efficient consumption of resources, measures for increasing consumption and quality of life.
Smart Energy	Energy management through networks based on innovative approaches which are intended to ensure high efficiency in terms of energy and resources, and increasingly supported by

[12] The sharing economy is an economic model based on a shopping arrangement. A good or service that is rarely needed by the owner is offered to other users in need when it is not used by the owner, by a specialized marketer, and the marketer receives a share from the user's paid usage fee.

	renewable energy sources. Also smart energy components aims for cost and energy saving.
Smart People	Reinforcing citizens to have high awareness, participation and creativity; to incorporate information technologies into their lives, and to internalize lifelong learning. Social infrastructure, cultural cohesion and interactions are the fundamentals in order to support high level of human and social capital as a focal point of the city life.
Smart Mobility	The use of IT-supported and integrated transport systems. It compasses sustainable, secure and interconnected transport systems involving tramways, buses, trains, subways, cars, bicycles, pedestrians and the use of one or more modes of transport.
Smart Buildings	The use of technological approach and rational decision-making aiming to improve the quality of life by ensuring the basic needs such as; housing quality, building security measures, building ergonomics and thermal comfort, and energy systems.
Smart Health	Applications and services that aim to increase the quality of life, improve health services, develop an awareness of individuals about their health, and provide intelligent analysis of health data.
Disaster and Emergency Management	A set of implementations and intelligent systems that cover; reduction of damages by precautions, provision of preparedness for disasters and emergencies, interventions during an event, analysis of disaster and emergency data, and applications in returning to normal life.
Smart Security	Protecting citizens against crime with the application of smart technologies and providing crisis management systems in the cities.

Information Security	Risk management process and preservation of information, in line with the confidentiality, integrity and accessibility. Integrated protection and handling of technology, systems and infrastructures (network, software, devices, data, etc.)
Information Technologies	IT technical support for many smart city components. It plays a role in the production, collection, processing, operating and sharing of information and data.
Communication Technologies	Apart from IT, CT covers the infrastructure, technology, standards and equipment related to the transmission of information.
Smart Space Organization	The ability of cities to withstand natural disasters such as earthquakes, floods, landslides that can cause loss of lives, property, social, cultural and economic livability and sustainability.
Geographical Information Systems	GIS refers to the necessary hardware, software, human resources, standards and methods that are used to produce, supply, store, process, manage, analyze, share, present and keep up to date all kinds of geographical data. It is emphasized by MEU (2018); "all kinds of smart city application can be built on a strong GIS infrastructure".
Smart Infrastructure	These are the systems that transmit, analyze, measure and monitor the data that is collected with the sensors used in smart environment, smart transportation, and communication technology components. They aim to respond intelligently to user demands and environmental changes for improved performance and user experience.

In the context of Turkey, smart city is implemented by a multi-stakeholder ecosystem that is disconnected, with a multi-tiered governance model. This consequently resulted in a distributed stakeholder structure and legislation. The establishment of the Department of Smart Cities and Geographic Technologies aimed to unite this scattered structure. In order to create an integrated base for National Smart Cities Strategy and Action plan, this document analyzes the best practices of smart city approach in Turkey. In this regard, the implementations and plans of eight metropolitan municipalities that bear prominent smart city applications are referred to along with best practices in the world. İstanbul, Ankara, Bursa, Antalya, Konya, Gaziantep, Kayseri and Kahramanmaraş are mentioned as the cities that have the highest smart city potentials. The smart city trend and implementation of smart systems and services gained momentum especially after the 2000s. The implementations and approaches of these eight pioneer cities are discussed in episode 4.3 Smart City Initiatives of Local Governments in Turkey.

4.1.8. 2019-2022 National Smart Cities Strategy and Action Plan

In order to achieve a holistic smart city approach, it is important that all public institutions, local administrations, universities, private sector and non-governmental organizations act within a common set of actions in order to plan and guide smart city activities on a national scale. To create this integrated smart city ecosystem, a high-level document, which will provide guidance and establish specific standards and legislation for different actors is needed. Thus, the standards, which are created to facilitate the preparation of Smart City Projects and to provide a common structure, covering basic project information and governance information, can be laid down. In the context of Turkey, smart city paradigm has been handled in a multi-stakeholder ecosystem and multi-layered governance model within scattered legislations. There has been a need for a common national strategic domain supported by legislations. According to this agenda, "2019-2022 National Smart Cities Strategy and Action Plan" was started to be prepared on April 10, 2018 by MEU, along with the

cooperation with TÜBİTAK BİLGEM YTE. In the preparation of the strategy, confidentiality agreement was signed between these two government institutions. Therefore, the confidential approach of the project contradicts with the open data aspect of smart city domain.

This document aims to create a common national strategic view in smart city approach with a broad ecosystem. This shared strategic view is planned to ensure the sustainability and continuity of smart city governance mechanism and the stakeholder organization as well as the coordination of smart city initiatives and implementations. The preparation of this document consists of five stages which forms the basis for the aim of creating a common ground for smart city initiatives. These stages are listed respectively as;

1. Current situation analysis and identification needs,
2. Preparation of 2022 National Smart Cities Strategy and Action Plan,
3. Capacity building of smart city ecosystem,
4. Establishment of National Smart Cities Monitoring and Evaluation Model and System,
5. Establishment of National Smart Cities Maturity Assessment Model ([*Akıllı Şehirler*], 2018).

In the stage of "current situation analysis", stakeholder interviews, several workshops, 15 focus group meetings (regarding to each smart city component) were conducted and local governments survey is realized with the participation of 327 local governments ([*Akıllı Şehirler*], 2018). Furthermore, a smart city capacity building workshop is conducted with local governments, central governments and suppliers for the current situation analysis. Within the context of smart city maturity model, the themes of smart city and vision are discussed in the project consultant academics workshop. In the 2019-2022 National Smart Cities Strategy and Action Plan project; central government institutions, local governments, private sector, non-governmental

organizations and universities have been involved in the analysis studies; top policy documents and related legislation were reviewed, international literature was searched, workshops and focus group meetings were held covering all stakeholders, and surveys with broad participation were administered to local governments. (MEU, 2019b). All these activities resulted in the preparation of the strategy and action plan with Turkey's own conditions in line with the participation of different actors/stakeholders. Requirements and best practices and other country practices, international developments, technological innovations and trends are taken into consideration in the process. As it was mentioned in Smart City White Paper, 17 smart city components have been defined on a wide scale for the different needs of cities. The explanation of smart city is shaped according to the needs sought in the study as there is not a single common definition of smart city. As a broader explanation, this document defines smart city as follow:

> "Smart city is a more livable and sustainable city that is created with the cooperation of stakeholders; which uses new technologies and innovative approaches, justified on the basis of data and expertise, and which produces solutions that add value of life by foreseeing future problems and needs" (MEU, 2019c).

Along with this definition, in order to provide further explanation of the aims of smart city in general, are as follows;

> "…to make the current and future expectations and problems of the city a trigger force in all the spaces and systems of the city, to conduct physical, social and digital planning together, identify, foresee and meet the challenges in the city with a systematic, sustainable manner, to provide integrated service in the city within organizational borders" (MEU, 2019c).

This definition is supported by strategic overviews, vision, strategic objectives and targets. It is mentioned in this strategy document that, this document dwells on people-oriented approach, and thus the vision is determined as "Livable and Sustainable cities that add value to life" (MEU, 2019c). This vision adopted along with two strategic overviews; "efficient and sustainable smart city governance" and "competent and productive smart city ecosystem" (MEU, 2019c). The smart city here is explained as a dynamic approach. It deals with the innovative use of technology and data, together with organizational change, and addresses the guiding issues that will create effective, powerful and sustainable city visions for the future of cities. In other words, it turns a new page for the traditional planning and governance of the cities. Additionally, with the creation of necessary smart city capabilities, it is intended to create a driving force in economic growth and employment.

The aims of national smart city strategy are assembled in 4 strategic objectives that are supported by 9 targets (Table 4.3). These objectives and targets are aimed to be realized by 40 actions (critical determined actions are listed in Appendix B). Four of these are defined as priority actions. These actions give emphasis on the smart city road maps that are specific to the cities. Following the road maps, specific to each city, in order to ensure the continuity and coordination a smart city index is aimed to be created using smart city maturity assessment model. It is emphasized to create an encouraging and facilitating environment for smart city investment by providing a holistic and planned investment environment for the efficient and effective use of resources. Within this process smart city projects with high public value, their implementations and popularization are encouraged.

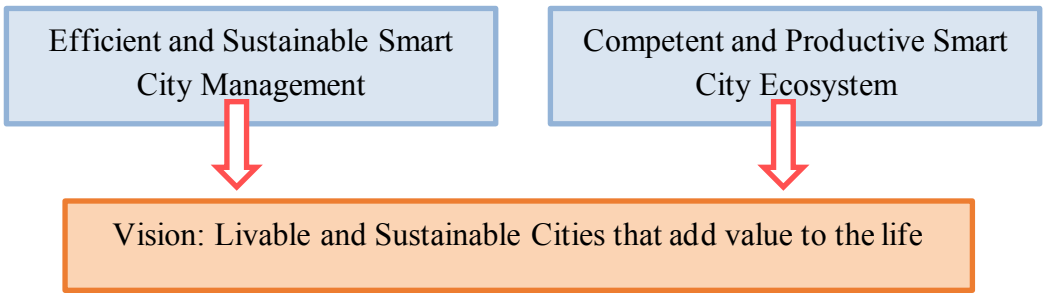


Figure 4.2. Strategic Overviews and Vision of the Document (MEU, 2019c)

Table 4.3. *Strategic Overview, Vision, Strategic Objectives and Targets of the Document (the table is prepared with reference to 2019-2022 National Smart Cities Strategy and Action Plan; MEU, 2019c).*

Strategic Objectives	Targets
1. Create an effective smart city ecosystem	Smart city ecosystem governance mechanism will be established. Holistic financial management regarding smart cities will be achieved
2. Increase smart city conversion capacity	Smart City conversion capacity of technology manufacturers, solution providers and service providers will be increased. The smart city transformation capacity of the city dwellers will be increased.
3. Create a guiding and facilitating environment in the smart city transformation	Smart city architecture will be created. An environment of cooperation and interaction between smart city technology manufacturers, solution providers and service providers will be created.
4. Provide smart city transformation in urban services	Stakeholder participation in smart city solutions will be increased. Use of urban services provided by smart city solutions will be expanded. The maturity of the service integrity of smart city components will be increased.

Department of Smart Cities and Geographic Technologies within the General Directorate of Geographic Information Systems of MEU aims to monitor and assess the state and progress of Smart cities in Turkey with regard to the strategic and action plan. It is aimed to determine the competencies of cities in terms of smartness with the implementation of the smart city maturity assessment model that is applied by TÜBİTAK BİLGEM YTE. The Smart City Maturity Assessment Model developed specifically for the country which creates a common language and a systematic structure in order to guarantee the development of the maturity of all cities together. It evaluates the Smart City Capabilities of a city and determines the Smart City maturity level and offers suggestions for improving the maturity level. The model aims local government Smart City ecosystem stakeholders to contribute effective, efficient and sustainable transformation of Smart cities. Through to the realization of the National Smart City Strategy and Action Plan, a maturity index is aimed to be achieved. By this index the maturity level of different cities will be compared. As a pilot study, the maturity level of Selçuklu district of Konya and Beyoğlu District of İstanbul are analyzed. The smart city maturity analyses in the primary areas; smart environment, GIS and smart transportation of both of these districts are presented below.

Smart City Maturity Analysis of Selçuklu District of Konya

Smart City Maturity Analysis of Beyoğlu District of İstanbul

Figure 4.3. Smart City Maturity Analysis of Selçuklu district of Konya (left hand side) and Beyoğlu district of İstanbul (right hand side) in Smart Environment, GIS and Smart Transportation work areas (the figure is created based on the smart city maturity analyses conducted by Tübitak Bilgem YTE, the data is retrieved from MEU, 2019b, Akıllı Şehirler Bilgi Notu).

4.2. National Research on Smart Cities and Studies of NGOs

A smart city ecosystem is built upon collaboration and participation of different actors. It involves multiple stakeholders, in order to create a multi-faceted approach for the implementation of smart cities. These stakeholders range from public and private sector, knowledge institutions, NGOs, citizens and civil society. Flaconer and Mitcell (2012) states that public sector (national and local governments) mostly view the cities according to their economic potentials along with the urban services that are provided for citizens. Thus, the policy initiatives are developed with an objective based on economy and service component of cities. On the other hand, NGOs and institutions approach cities in terms of social, environmental and economic aspects (Flaconer & Mitcell, 2012). They give at most importance to society, social inclusion, needs of people and create an unbiased neutral territory for all the stakeholders. It is essential to reinforce engagement among these actors and form a common ground for the needs and potentials of different stakeholders.

Non-governmental Organizations (NGOs) carry a critical importance for the smart city development. They create a "neutral space", where different stakeholders come together and identify their needs and potentials ([*Are NGOs key factors for cities?*], 2017). This also triggers a bottom-up participative ecosystem providing cooperation among stakeholders and establishing a relational network of actors. In order to create a successful smart city model, the specialized expertise of institutions and facilitator role of NGOs are crucial.

When the Turkish context is analyzed, it is seen that the cooperation among different actors is not strong and most of the smart city projects are realized only by public sector. Still there are active NGOs and institution, which have significant studies in

the domain of smart cities. In this regard, it has appeared that Turkish Informatics Foundation (from now on TBV)[13] is the pioneer non-governmental organizations that generate extensive studies in smart city concept. Following this, there are several cooperative studies among NGOs such as TBV and Public Technology Platform, with private sector actors of Deloitte, Vodafone and Intel. Additionally, İstanbul Technical University and Novusens are the institutes that actively collaborate with these NGOs in the context of smart city. There are several researches and studies on smart cities in Turkey that are conducted by different instructions, which are not included in this chapter as the academic studies in the area are presented in the literature review part and only the studies that are prepared by NGOs, institutions or multiple stakeholder, seeking to compose a road map or an evaluation report for national and local governments for the Turkish context, is discussed in this section.

Table 4.4. *National Researches on Smart Cities and Studies of NGOs*

National Researches on Smart Cities and Studies of NGOs		
Document	Year	Institute
Turkey Smart Cities Evaluation Report	2016	İTU, TBV et al.
Smart Cities Desk Research	2016	Public Technology Platform
Smart City Road Map	2016	TBV, Deloitte, Vodafone

[13] TBV- Türkiye Bilişim Vakfı

4.2.1. Turkey Smart Cities Evaluation Report

Turkey Smart Cities Evaluation Report is established by the collaboration in between Smart City Institute of Nouvens İnnovation and Entrepreneurship Institute, Turkish Informatics Foundation, İstanbul Technical University Faculty of Computer Engineering with the sponsorship of Intel and Mastercard. The study is performed between years 2015 and 2016, with the participation of 105 governmental institutions (metropolitan municipalities, metropolitan district municipalities, water management departments and other local public institutions) to the prepared surveys. The aim of the study is to evaluate the smart city initiatives in Turkey and evaluate the success rate of these initiatives.

The arguments that are raised in this evaluation report and the basic findings are listed below;

- Financial competence is the most important challenge in smart city applications. Approximately 60% of the participants in this survey, stated that municipal resources were used in this regard.
- The lack of inter-institutional cooperation has emerged to be the most important obstacle to smart city applications. Moreover, cooperation is a key factor for the success of smart cities. In particular, NGOs, universities and other municipalities should be involved in the cooperation ecosystem.
- Knowledge and experience in smart cities, expertise in information and communication technologies have been identified as a critical success factor for implementation of smart cities. Competent human resources are crucial in planning and implementation of this approach.

- Citizen involvement is important for smart city success. Among the aims of smart city applications, "facilitating the life of the citizens and improving living standards" took part the first place.
- Existing smart city applications do not benefit from cloud computing or big data analytics. However, mobile applications are quite common especially in local level smart city implementations.
- Two out of three municipalities participating in the study plan to design smart applications in the field of transportation. After the transportation, in are energy and water fields systems there exists most smart projects. (TBV et. al, 2016).

As most of the data obtained in this document is based on local level implementations, the results of the surveys are discussed in Chapter 4 Part 3 "Smart City Initiative of Local Governments in Turkey".

4.2.2. Smart Cities Desk Research

The rapid increase in the urban population in Turkey, raised the problems in areas such as transportation, energy, water management, health, environment and security. Smart City Desk Research conducted by Public Technology Platform emphasizes that innovative ICT-supported solution have great potentials in improving public services, quality of life and solving the problems caused by population increase in urban areas. The intention of this document is to explore this domain and its potentials.

The document defines seven problem areas in cities. These problem areas consist of energy, transportation, buildings, technology, health services, infrastructure and government. In order to provide solutions for these problem areas, smart system implementation suggestions are developed. These solutions range from smart grids, public lightning, green energy, waste management, water management, food and

agriculture, urban logistics, mobility informatics to building services and managements, and quality of housing (Public Technology Platform, 2016). The paper acts as a guide and gives main insights about smart city implementations focusing mainly on smart environment, and smart transportation.

4.2.3. Smart City Road Map

Being one the most comprehensive guide document in the Turkish context, "Smart City Road Map" aims to provide a resource on smart cities for municipalities to benefit from. The document composed by cooperation of TBV, Deloitte and Vodafone. In this road map smart cities defined as the cities which use information and communication technologies with a holistic approach in order to create more livable, sustainable and more efficient environments. They provide technology-based solution to adopt citizen-oriented, participative and transparent governance without violating the confidentiality of personal data or other ethical rules. In this respect the study aims to;

- Provide a complete definition of the smart city concept with its key components,
- Address current developments of smart cities in the main sectors
- Produce a brief overview of the current situation of Turkey
- Share critical recommendations for a successful smart city transformation journey
- Create a road map that would pave the path for smart city developments with different maturity levels.

The document asserts that 20% energy-saving and 35-45% decrease in waiting time in the traffic junctions is possible with the implementation of smart city

projects in Turkey and it claims that holistic application of smart cities would contribute 20-30 billion TL per year to the gross domestic product of the country. According to the document, the success of a smart city depends on a clear vision, public and private collaborations, integrated organizations, effective smart city platform, citizen participation, supportive technologies (and infrastructure), risk mitigation, social inclusiveness, dissemination of practices, supporting legal environment (TBV et. al, 2016b). In conclusion, the document provides a 12 steps roadmap to achieve a successful smart city (Table 4.5).

Table 4.5. *Smart City Road Map – Steps (TBV et.al., 2016b)*

Smart City Road Map - Steps	
1	Determination of city-specific vision, goals and strategies
2	Identification of priorities
3	Determination of sub-objectives
4	Defining projects
5	Determination of financing model
6	Value chain analysis
7	Determination of stakeholders' map
8	Examination of legal aspects
9	Analysis of good practices
10	Technology platform model
11	Project management office and roadmap
12	Communication plan

4.3. Smart City Initiatives of Local Governments in Turkey

Local governments have an important role within the smart city process as they are directly responsible and involved in urban planning, distribution of services, urban problems and their solutions. According to the organizational structure, local governments have the closest relationship with cities, citizens and their needs. Municipalities are the main actors of a smart city as they are the most practical institutions responsible for increasing quality of life, maintaining sustainability and managing urban services in cities (Varol, 2017). The role local governments play in a city is based on the local potentials, treats and opportunities that the city bears. As the closest institutions they have the knowledge and first-hand experience of the space and with the know-how they would be more successful in fast decision making and taking action. They have the potential to directly address citizens and other actors and the power to include them in decision making process. Municipalities have the authority to assemble different actors and to create a participatory ecosystem. This chapter investigates how the national policies of Turkey regarding smart city context and new technologies translate into local policies and implementations along with the role and responsibility of local governments in smart city approaches. Hitherto smart local projects, implementations and their affects and potentials within urban planning are investigated, and risks and obstacles that municipalities face in the process of smart vision are discussed.

Smart City studies in Turkey have recently started to develop in policy level and various studies have been carried out at the implementation level in metropolitan cities where urban problems are getting intense. In general, these implementations develop around the concepts of transportation, urban services and most recently energy consumption and water management systems (TBV, 2016). Most of these focused implementations are limited to certain services and thus it is seen that relations and

cooperation between departments and institutions are not organized strongly in development and effective use of technological infrastructure. According to the organizational charts of several metropolitan municipalities, smart city projects and initiation are generally carried out separately by the 'Department of Information Technologies', 'Electronic and Communication Directorate', 'Directorate of Geographic Information Systems' and 'Directorate of Software and Management' in the subjects that belong to their domain. Departments of geographic information systems (GIS) are active actors at the national level policies of smart cities but their involvement is not sufficient in the local level. In 2004 "establishing geographic information systems" have been added to the responsibilities and duties of the metropolitan municipalities (Metropolitan Municipality Law No. 5216, Article 7/h). Hence information technologies introduced to the supervision and decision-making process of cities. Although most of the central and local governments have GIS-based solution for smart cities to a degree, targets and strategies have not been identified. Accordingly, the implementations of municipalities are restricted to fragmented solutions and services, which only refer to some components of the smart city approach. This not only prevents a holistic attempt but also marks the question of whether use of ICT technologies is enough for creating a smart city.

İstanbul Metropolitan Municipality is the first local government to have an active Directorate of Smart City which is established in 2015 to achieve an integrated governance of smart city implementations. To carry out smart city projects and programs in a more effective, efficient and coordinated manner, the Directorate of Smart City has taken part under the Department of Information Technologies. The other branches of Department of Information Technologies consist of Directorate of Data Processing, Directorate of GIS and Directorate of Electronic systems and they cooperate together with Directorate of Smart City to form integrated smart city

approach[14]. Recently in 2019 Bursa Metropolitan Municipality formed a Smart Urbanism Unit under Directorate of R&D to assemble all the smart city indicatives of Bursa M.M under the same roof.

Within the scope of 'Renewal of Information Society Project - Information and Communication Technologies Supported Innovative Solutions Axis - Current Status Report' by Ministry Development (2013) a comprehensive survey of 'smart city implementations of municipalities' is performed. In this survey, the state of smart city initiatives within local level and the challenges that rose during their processes has been documented[15]. Transportation, Urban Services, Energy and Water Management are the main study areas in which municipalities constitute their smart implementations on.

Within these areas, most of the local governments have projects on citizen participation, IoT based tracking services and integrated payment systems in public transportation modes (Figure 4.4). On the other hand, the smart implementations in the domains of energy use and water management have been realized by limited number of municipalities. In this document, it is noted that municipalities remarked their priority in smart city application as participation of citizens, emergency response and disaster services, smart street lighting systems, water and air quality monitoring respectively. Among the smart city components, most implementations give reference to smart governance, smart environment/energy, and smart mobility and, other themes such as smart people, smart living and smart economy are mostly neglected.

[14] https://www.ibb.istanbul/CorporateUnit/Detail/89
[15] 40 Municipality took part in the survey.

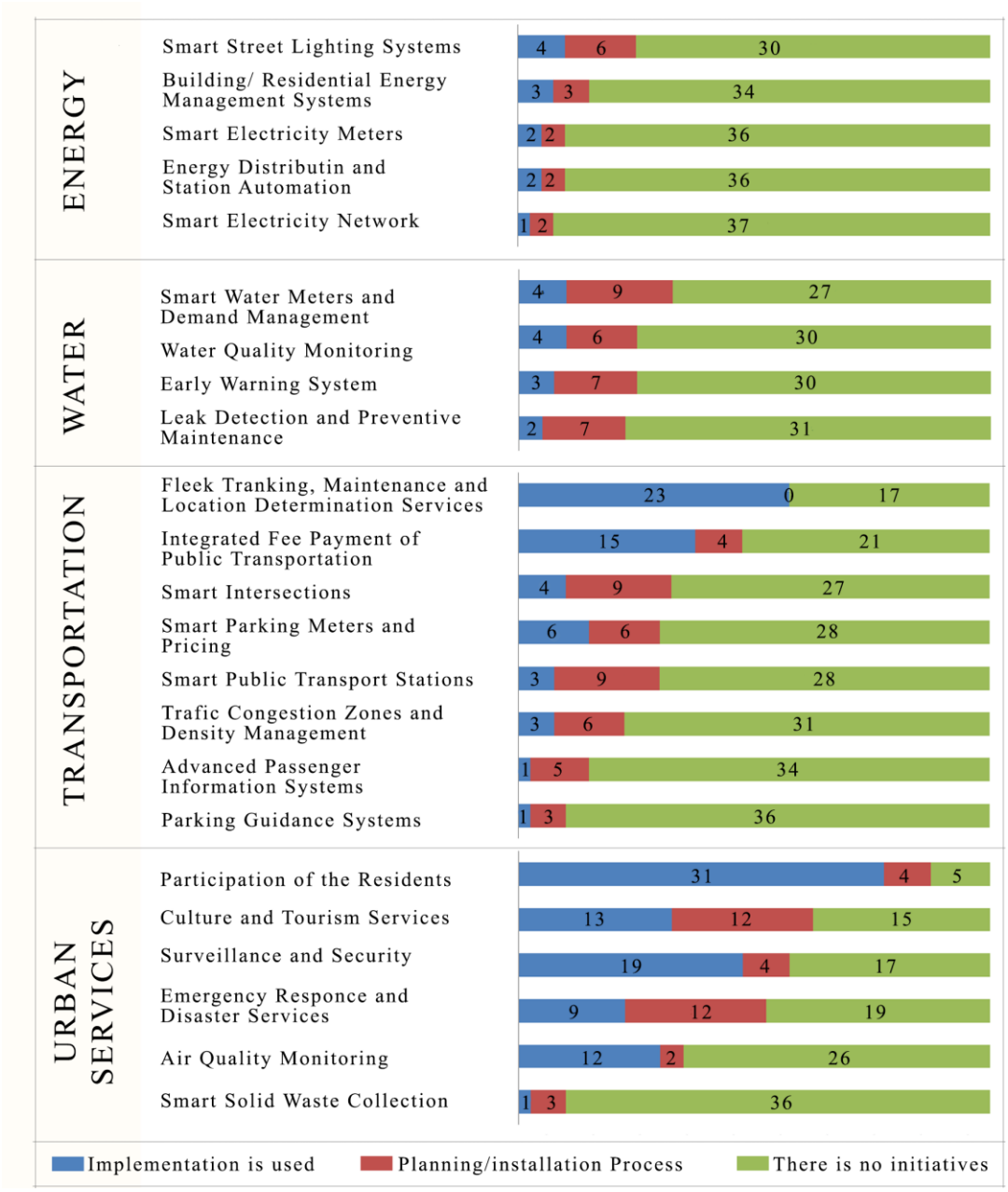


Figure 4.4. Smart City Initiatives in Municipalities (prepared by using the data from the survey of smart city implementations by municipalities) (Republic of Turkey Ministry of Development, 2013)

There are several different reasons and aims of municipalities to use and adapt to innovative technologies within different practice areas in the city. These objectives form the basis of smart city approaches. As a fuzzy term, smart city contains several different visions and approaches related with sustainability, creative class and human capital, use of technology etc. The common aspect of smart cities is that they propose solution for social, economic and environmental sustainability challenges and problems in the city through smart technologies. The differences in the implementations and objectives show the differences in smart city approaches. To apprehend the understanding of smart city in the Turkish context, reasons and aims behind the use of smart technologies should be examined. Figure 4.5 shows the common objectives of metropolitan municipalities in the use of smart technologies. Even though some of the objectives change according to local input; facilitating the citizen lives, increasing the brand value of the city and gaining knowledge and experience during this process are noted as the main goals of smart initiatives.

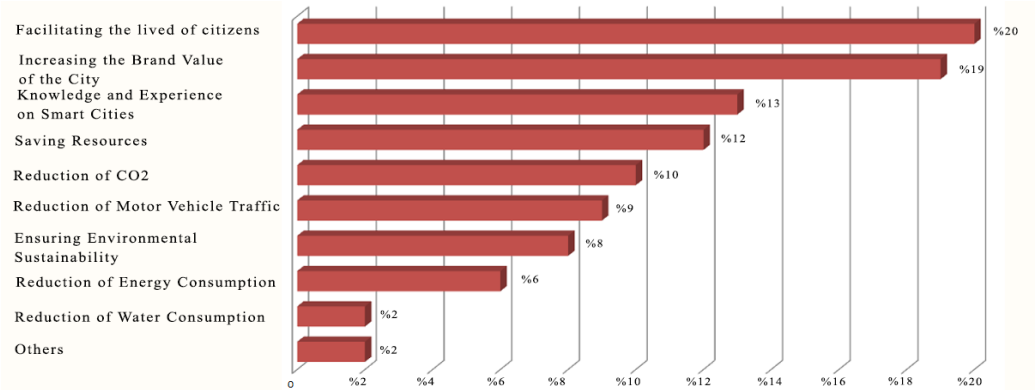


Figure 4.5. The Objectives of Smart City Projects of Metropolitan Municipalities (Prepared by using the data of Turkey Smart City Evaluation Report, 2016)

The goals that local governments designate in the case of smart city approaches are not objectives that could be achieved alone. Instead, as in most smart implementations, they need an integrated formation with the cooperation of different stakeholder.

Unfortunately, the data and experience sharing is not developed in Turkish case and the cooperation ecology does not actively occur. According to Lombardi (2011)'s smart cities evaluation framework; 'Four Helices Model', the reciprocal and multiple relation between government, industry (private sector), university (institutions) and civil society, defines the performance of smart environment. "The interplay between these actors and forces determines the success of a city in moving on a smart development path" (Lombardi, 2011).

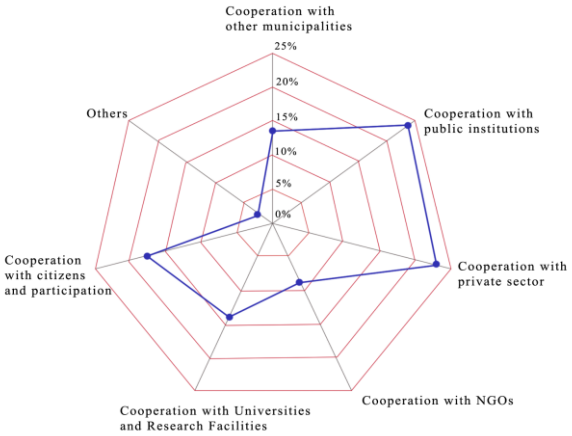


Figure 4.6. Collaboration Structure of Smart City Applications (Turkey Smart City Evaluation Report, 2016)

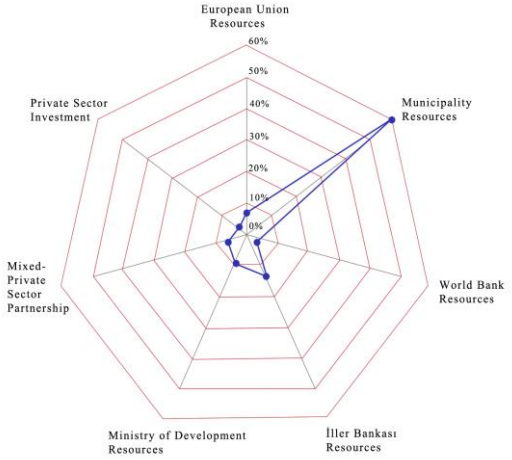


Figure 4.7. Financial Structure used in Smart City Implementations (Turkey Smart City Evaluation Report, 2016)

In the Turkish case while government and industry forces are active participants of the smart development process, cooperation with NGOs, participation of citizens and experience sharing in between different public institutions and within the departments of institutions are not sufficient enough (Figure 4.6).

The transformation from conventional systems to new innovative management modes in the city is not easy. Without an integrated vision and strategies, or a roadmap, a fragmented approach is inevitable and sustainability of these implementations is uncertain. A city-specific review shows that the vision of smart city lacks a holistic approach at local level in Turkey. The lack of united smart city approach and legislations, lead local government to have important problems in finance, integration of implementation and compliance with standards (Ministry of Development, 2013). These obstacles reveal the need for standards and guidelines, integrated strategies that will ensure interoperability between cities. As a result of high initial investment costs, financial problems are the primary barriers municipalities face with (Ministry of Development, 2013, TBV et. al, 2016). Most of the financial obligations of smart city initiatives are covered by limited municipality resources (Figure 4.7). Other resources include European Union Funds, mixed and private sector investments, ministry of development and other institutional resources. There is a lack of active collaboration with other financial sources as most of the investments are provided by the local governments. Other challenges that local governments face in the domain of smart cities, include, cooperation between institutions, insufficient technological infrastructure, lack of expertise in the field of IoT, lack of citizen involvement and adaptation, insufficient knowledge and experience, lack of standards and regulations, political factors and unpredictable implementation risks (TBV et. al, 2016).

Many of the metropolitan municipalities in Turkey have been carrying out smart city approaches in a wide range of implementations. Most of the implementations of metropolitan municipalities are technology-oriented and only consist of digitalization of the urban services and lack integrity. According to the previously reviewed national documents about smart cities; cities that are exemplified as best practices and that

contain pilot smart city projects have been examined in detail. To have a better understanding of the smart development process in local level, eight metropolitan municipalities and their smart city initiatives are selected that are mentioned in Smart City White Paper (2018) as best holistic practices. The different smart city approaches, initiatives and smart characteristics their projects have, viewed one by one.

4.3.1. İstanbul Metropolitan Municipality

İstanbul is the pioneer city to begin the process of implementing smart city solutions in Turkey. As it hosts approximately 20% of the whole population of Turkey, the city bear the concerns of rapid urbanization, high population and the use of resources. To create a holistic smart city roadmap İstanbul Metropolitan Municipality initiated Directorate of Smart City under the Department of Information Technologies in 2015. The cooperation among İ.M.M, İ.M.M subsidiary company İSBAK and İSTTELKOM initiated the Smart City Project agenda. A five step process is planned as a result of this cooperation. These steps to achieving a smart city agenda consisted of; literature review and investigation of best practices in the world, analysis of current situation, determination of vision and strategy, detailed infrastructure design and designating the priorities of the project, resource requirements, governance principles and performance indicators. This agenda paved the way for Smart City Vision of İstanbul; "to be the smartest city in the world that makes the most contribution to the quality of life by 2029), along with short (2019), medium (2023) and long (2029) term strategic objectives and smart city road map (İ.M.M, 2018). Eight topics of İstanbul Smart City initiatives specified as "mobility, environment, energy, governance, economy, life, human and safety" (İSBAK, 2017). In addition, each focus area is evaluated within the framework of three activators (Information and Communication Technologies, Organization and Human Resources and Finance), which will be the facilitators for the strategies and related initiatives (Ministry of Environment and Urbanization, 2019a). This roadmap is concluded with three focus points; 1. decision making with stakeholders and citizens, 2. using technology with innovative methods, 3.focusing on

efficiency. These constituted the main outcomes that are hoped to be obtained during implementation of smart technologies and Smart City initiatives process.

Table 4.6. *Smart City Projects initiated by İstanbul Metropolitan Municipality*

İstanbul Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
Smart meters	Demand management of electricity usage by adopting a pricing method according to the usage hours	BEDAŞ, AYEDAŞ	Smart Energy (Environment)
İSKİ Scada (Supervisory Control and Data Acquisition)	Management of drinking water distribution with the sensors placed in dams and water distribution systems, measuring data (pressure, flow, water quality) and controlling valves by a central system	İSKİ	Smart Environment, Smart Water + Sanitation
Traffic Control Center and Fully Adaptive Traffic	Collecting information on traffic flow with IoTs, operating this information for intersection management. Providing information via mobile and internet applications to the citizens.	İMM	Smart Mobility
İSPARK – Smart Parking Management	Determination of parking fees according to the density by smart parking fee system. Operating from one integrated source which aims to transfer long-term parking to less dense areas with smart pricing.	İMM	Smart Energy (Environment), Smart Mobility
Electonic Detection System (EDS)	Detection of speed, red lights and lane violations with Iot based cameras.	İMM	Smart Mobility
Başakşehir Living Lab	Develop and support information technologies, design-based innovation and entrepreneurship ecosystem by bringing developers and end users together.	İSTKA, İBB	Smart Economy (Entrepreneurship and Innovation)

Smart Public Transport and Smart Stations	Real-time measurement of the location, speed, and occupancy rates of the buses with sensors. Regulation of the most suitable route to the destination.	İMM	Smart Mobility, Smart Living
Smart (İstanbul) Card	Integrated payment on different modes of transport	İSBAK	Smart Mobility, Smart Living
Smart Container	The use of smart containers which separates solid wastes by automation and reward methods.	İSBAK	Smart Environment, İBB Directorate of Waste Management
Air Quality Monitoring Center	Measuring air quality in the city with the sensors placed in strategic points.	İMM	Smart Environment
İSBike	Bicycle sharing program (140 stations)	İMM	Smart Mobility
Environmental Control Center	Monitoring, controlling and management of waste logistics according to the simultaneous information received from sensors	İSTAŞ	Smart Environment
UYM (Transport Management Center)	Big data collected by traffic monitoring and measurement systems are processed and used for traffic management and driver information. Processed data and its inferences are used for mobile applications, call centers, İMM web radio, variable message systems – VMS and variable traffic signs.	İMM	Smart Mobility
Büyük Çekmece Lake Floating Solar Power Plant	This r&d project is estimated to supply annual electricity needs of 202 household and prevent emission 164 tons of CO2 per year. It is established on an area of 2900 m2 with 240 kw power.	İSKİ, İstanbul Energy Co.	Smart Energy (Environment)

Domestic Waste Incineration[16] and Power Generation Facility (ongoing)	This facility aims to eliminate 15% of the waste produced in İstanbul by incineration method. Another objective of this system if to prevent the emission of 11 million tons of GHG annually that are produced by landfills and produce energy that meet the electricity needs of 1.5 million people households.	İSTAÇ	Smart Environment
Zemin İstanbul	R&D innovation center based on the topics of 'environment, energy, transport and social innovation'. It aims to attract entrepreneurs that develop innovative products and services that address the needs of the residents of İstanbuI. Its mission is to reinforce the innovative ecosystem by bringing together different actors (users, entrepreneurs, investors, manufacturers). Zemin İstanbul consists of incubation center, experience center and education, activity, animation studio units.	İMM, İSTKA	Smart Living, Smart Economy
Mobile Apps	There are 30 subject-specific mobile applications created by İMM. Mainly featured subjects consist of transportation, urban services, city guide and tourism. These applications are created by the related directorates under İstanbul Metropolitan Municipality. [17]	İMM	Smart Living, Smart Mobility, Smart Governance

[16] Incineration is a waste treatment technology. During the process of combustion of organic materials, energy is recovered. Not only it eliminates waste material, but also as a co-benefit it contributes to primary energy savings and decreases GHG emissions.

[17] Mobile Applications are listed as following; İBB Cep Trafik, İBB Beyaz Masa, İBB Yol Gösteren, İBB Şehir Tiyatroları İBB Kültür, İspark, Miniatürk, İBB İstanbul, iTaksi, İstanbul Şehir Haritası, Yürü&Keşfet, İBB Trafik Radyosu, İBB Simultane, İstanbul Eczanesi, Mobil İSKİ, İSEM (Directorate of People with Disabilities), İBB İmarSor, İsbike, İBB Trafik Bilgi Yarışması, Sesli Kütüphane, İBB Karekod, Tech İstanbul, Gözüm Kulağım İstanbul, TUDES, İBB AR, İstanbul Bülteni, Tourist, İstanbul Kart, Mobiett, Metro İstanbul

4.3.2. Ankara Metropolitan Municipality

In 2011 Ankara Metropolitan Municipality started developing smart city initiatives based on technology in order to increase the quality, continuity and efficiency of services offered to its citizens. Accordingly, mobile applications and digital payments offered via the Internet, smart transportation and information systems carried out throughout Ankara. In 2013, the paper ticket application was terminated in public transportation vehicles operating under the municipality and the card system was introduced. This project was supported by smart stops, mobile application, in-vehicle passenger information and camera systems. The mobile applications developed by AMM provide the information regarding stops, routes and time of the public transport vehicles (EGO, 2018a).

With the SCADA system used by ASKİ, data related to 60 pumping stations, 108 water tanks and 13 measuring points are monitored instantly in electronic environment and ubiquitous responses are made to water losses and leakages (ASKİ, 2019). Recently for the purpose of efficiency ASKİ initiated the smart counter project. In addition, reports on fullnes rates in the dams and the activities carried out are made available to the public via the ASKİ web site daily.

Automation systems are widely used in smart city applications in Ankara. However, most of the systems have been dealt with in a fragmented manner and inter-institutional coordination has not been achieved (Varol, 2017).

Table 4.7. *Smart City Projects initiated by Ankara Metropolitan Municipality*

Ankara Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
Integrated Solid Waste Management Systems[18] in Mamak and Sincan Districts	The project aims to establish an integrated solid waste management system within the transfer, recover and disposal of mixed garbage. It enables the collection, transfer and disposal of 5500 tons of mixes waste per day. The amount of energy recovered from disposed wastes compensates the 5% daily energy need of the city. It is the first implementation in Turkey.	AMM, ITC Invest Trading & Consulting AG.	Smart Environment
Smart Water Management Systems (SCADA) and Smart Water Meters	The use of smart water meters and remote reading and monitoring systems enables to momentary data reading of water consumption, index information, and control of water leakage and meter temperature The system is expected to assure efficiency, decrease excessive water consumption, prevent high bills and support immediate response mechanism in case of leakage or any other emergency. Aski Mobile application provide several online services along with consumption and index information.	ASKİ	Smart Environment
Electric Energy Tracking System (ETS)	Energy management system implemented in public facilities in order to monitor energy quality, active-reactive power, instantaneous voltage-current values and power failures. It is envisaged to have 75% electric energy saving in these facilities.	A.M.M	Smart Environment

[18] Integrated Solid Waste Management Systems represent the integrated management of transfer stations, mechanical separation plants, biomethanation (the process of converting organic materials to biogas) plants, power generating plants and incineration systems. It provides innovative technologies on recycling, disposal and rehabilitation of solid wastes and landfills (Republic of Turkey Ministry of Environment and Urbanization, 2019)

Smart Transportation Systems (and counting sensors)	Traffic data generation systems, information systems, central junction management and monitoring systems enable a holistic traffic management concept in Ankara. The traffic density data is obtained daily, weekly and monthly through counting sensors in main boulevards. These data are processed and shared with citizens through mobile apps to prevent traffic congestion.	A.M.M	Smart Transportation
Meteorological Data Tracking System	Real time data tracking and utilizing this data for decision making processes.	A.M.M	Smart Environment
Zero Waste Program	Since 2018 municipality, all of the waste materials are recycled within the municipalities institutions	A.M.M	Smart Environment
Smart Public Transportation Systems	Use of integrated Ankarakart (electronic card system), electronic information boards including information of route, waiting time, speed and code of the vehicle.	Directorate of EGO, A.M.M	Smart Transport
Information and Access Technology Education Center	Education and internet access centers that include audio library, braille library and technology education in order to close the digital divide between individuals, and create an inclusive life-long learning environment.	A.M.M	Smart People
Free Wifi Services	41 Wifi hotspots exist in 28 different locations including 9 parks and 19 districts.	A.M.M	Smart Society
Mobile Apps	There are 11 subject-specific mobile applications created by AMM. Mainly featured subjects consist of transportation, urban services, city guide and tourism. These applications are created by the related directorates under Ankara Metropolitan Municipality.[19]	A.M.M	Smart Government

[19] Ankara Metropolitan Municipality App (ABB Ankara), EGO Cepte, Mavi Masa, BİP, Ankara Asist, AMM City Guide (ABB Kent Rehberi), AMM Excavation (ABB Hafriyat), ASKİ, Ankara AR (Agumented Reality), AMM Traffic (Ankara Trafik), AMM Cemetary Information Systems.

4.3.3. Bursa Metropolitan Municipality

Bursa Metropolitan Municipality initiated smart city actions in order to provide an advantage in 'cost, time and quality' for the city. In order to achieve an integrated strategy, municipality founded Smart Urbanism Unit under the R&D directorate. Smart Urbanism Unit[20] of Bursa Metropolitan Municipality identified five smart city categories (Smart Transportation, Smart Governance, Smart Environment, Smart Society, and Smart Healthcare) and initiated projects referencing these components (Bursa Metropolitan Municipality, 2019). In a web-based platform these projects and implementations are shared with the citizens and in the direction of creating a participatory governance ecosystem, citizens are involved in the process with 'convey your idea, surveys and city cameras' services provided in this platform[21]. It can be noticed that most of the smart city implementations concentrate on integration of administrative works in electronic environment, thus aiming to increase efficiency and strengthen the cooperation in between different departments within the municipality. For the creation of smart society several education programs themed around technology, intelligent services for disadvantaged groups in society are initiated by the municipality. Under the environment category, municipality promoted the use of renewable energy resources and formed a SCADA center under BUSKİ to achieve ubiquitous control, observation and real time decision making regarding these facilities. Even though the organization chart and the vision is clearly identified, it could be seen that the smart city projects in Bursa mainly based on digitalizing different services and they lack a broader understanding of the subject. Fragmental projects and implementations show inadequacy of a holistic approach and well-planned strategies.

[20] *Akıllı Şehircilik Birimi*
[21] http://akillisehir.bursa.bel.tr/

Table 4.8. *Smart City Projects initiated by Bursa Metropolitan Municipality*

Bursa Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
Smart City Platform (ongoing)	It is aimed to manage and integrate the smart city implementations and applications under the titles of Transportation, Health, Society, Management and Environment within a single software platform.	Bursa Metropolitan Municipality	Smart Governance
Bursa Mobile Education Project (BUMEP)	The project aims to raise awareness in information and communication technologies, and promote life-long learning. On the other hand, as the project's target group only consists of female users, it raises concerns about the inclusiveness of the project.	BMM	Smart Society
Sludge Incineration and Power Generation	In this facility, 2.5 MW electric power is generated per hour from waste value of sludge. 1MW of the electricity generated is used for the energy need of the facility and the rest is used by wastewater treatment plant. As an environmentally friendly process the ash produced by the combustion is used in asphalt production or concrete plants as raw material (BUSKİ, 2017).	BUSKİ	Smart Environment, Smart Energy
Tracking Chips (Sevgi Çipi)	This tracking device allows citizens with Alzheimer's and mental illnesses to easily be connected with their relatives. As a pilot project 117 tracking chips has been distributed and is being used since 2017.	Bursa Metropolitan Municipality Social Services Department	Smart Healthcare, Smart Security
Monitoring Sea Sweepers	With the use of GPS Technology and IoTs, sea sweepers are monitored and their routes are determined accordingly. Intensely polluted areas are detected and mapped out and to carry out an effective cleaning, these areas given priority.	BMM	Smart Environment

Smart Intersection Green Wave Control Strategy	Regulation of the traffic and controlling the traffic flow according to the momentary density versus capacity of the roads.	BMM	Smart Mobility
Monitoring and Online Management Systems	These online implementations are carried out through to ensure efficiency in the operational processes within the citizens and municipality or municipalities department with each other. They also aim to facilitate the control of procedures. These implementations consist of Excavation Tracking System, Online Monitoring system of Signboard Advertisement (IRODES), Infrastructure License Control Program (ARUDEP), Medical Waste Management System.	BMM (related departments)	Smart Governance
Public Transport Information Systems	It aims to provide information about times, vehicle times and characteristic.	BMM	Smart Transportation
Mobile Apps	The applications of BMM mainly focus on tourism, transportation and urban services. Along with municipality's integrated applications, there are four applications on tourism and three applications on transportation.[22] The cooperation of municipality and BEBKA (development agency) led to the 3D city and tourism applications with is believed to reinforce the touristic potential. Different transport applications are specialized in public transport and transportation guide, navigation and density maps and mobile card.[23]	BMM, BEBKA, Burulaş	Smart Mobility, Smart Economy

[22] These applications are described as; "…not only facilitates access to municipal services, but also contributes to the development of Bursa's tourism potential" by the municipality.

[23] Mobile applications of BMM: Bursa Metropolitan Municipality App (Bursa Büyükşehir Belediyesi-Bursa Cepte), Bursa 3D City Guide (Bursa 3D Kent Rehberi), Bursa 3 Dimentional Mobile Tourism Map (Bursa 3 Boyutlu Mobil Turizm Atlası), Enjoy Bursa, Burulaş Transport (Burulaş Ulaşım), Burulaş. Traffic (Burulaş Trafik), Burulaş Public Transport Guide (Burulaş TUR – Burulaş Toplu Taşıma Ulaşım Rehberi)

4.3.4. Antalya Metropolitan Municipality

The city of Antalya has a major potential in agriculture, industry and in particular tourism sectors. In order to support the potential of these sectors and increase their benefit within the economy, Antalya Metropolitan Municipality initiated smart city programs in 2015. The sub-vision of smart city project was described as "prioritizing technological and environmental awareness, aiming to improving the quality of life with the effective use of technology in urban services for all citizens to benefit from them, making Antalya a brand city with sustainable, participatory and innovative urban development" by Antalya Metropolitan Municipality (2018). In cooperation with Türk Telekom (integrated telecommunication and technology services provider) in 2015 and later with Türksat A.Ş. in 2017, pilot studies of many smart city implementations were realized. These implementations mostly revolve around automation of several urban services. The main smart city projects that are initiated by Antalya Metropolitan Municipality are; electronic control system in traffic, city information screens/kiosks especially for tourism, panic button and remote health applications, free internet services at designated points in several districts, child and elderly tracking devices/programs and voice navigation applications. An integrated Smart City Management Platform was also established to monitor, control, and manage smart services from a center and to collect data.

The biggest smart project of Antalya is based on an urban transformation area in Kepez Santral Neighborhood. Municipality takes the urban transformation project as a chance to set up a smart area that would be built based on ICT solutions in the themes of energy, environment and transportation. The project has been awarded a grant by European Union Horizon 2020 program and the implementation of the project has been started in 2019 (Antalya Metropolitan Municipality, 2019). As a pilot project, the 'new Kepez Smart City' would be the first in Turkish context to be built as a smart city from scratch. As it was discussed in the previous chapters, "greenfield cities" or "cities from scratch" has their own opportunities and treats. According to Angelidou (2014) entirely new cities such as "Masdar City in Abu Dhabi-UAE, Cyberjaya in

Malaysia, Songdo International Business District in South Korea, PlantIT Valley in Portugal contain the risks of budgetary issues, failure to attract residents, segregation or non-formation of social cohesion. Yet a well-planned new smart city could also benefit from lack of physical constraints and it has to opportunity to have an integrated design in every aspect (such as development of infrastructure, housing, incorporation of technology) of the planned city. The whole idea of a 'smart city from scratch' is to plan an ideal city to use best practices that embody technology and innovation for the solutions and the needs of urban areas, thus the capacity to explore new innovative domains are also vast in these implementations rather than enforcing smart solutions in an existing city.

Table 4.9. *Smart City Projects initiated by Antalya Metropolitan Municipality*

Antalya Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
Kepez Santral Neighborhood Urban Transformation Area- Smart City Projects	Antalya Metropolitan Municipality plans to implement 42 different smart city solutions in this area such as; use of solar power in energy production, heating and storage of energy, smart transportation systems (use of electric transportation models), Smart City Automation System (AKOS), and big data management within AKOS, use of IoT solutions in energy, transportation, housing, single center integration and management of these systems. The urban transformation area would be a pilot project for the implementation of a "planned smart city"(smart city from scratch).	Antalya Metropolitan Municipality, MAtchUp Smart City Project (EU Horizon 2020 grant)	Smart Energy (Environment), Smart Mobility

Smart City Management Platform and Automation Systems	It provides central monitoring and management of several applications within the city which are intelligent lighting and irrigation, city information screens and kiosk, free Wi-fi points, traffic cameras, electronic inspection systems (EDS), chronic patient monitoring and panic button. This platform operates as a central component of smart urbanism in Antalya.	Antalya Metropolitan Municipality	Smart Governance
Solid Waste Integrated Assessment, Recycling and Disposal Plants	The project aims to establish an integrated solid waste management system within the transfer, recover and disposal of mixed garbage. In this plant, a thousand tons of mixed waste is aimed to be mechanically separated. This separation system is integrated with biomethanization (the process of converting organic materials to biogas), compost and medical waste sterilization plants.	Antalya Metropolitan Municipality	Smart Environment
Mobile Apps	Antalya Smart City mobile application brings together different services such as; transport, city guide, culture and art events, city services, e-municipality under the same roof integrated with city information systems. 'Antalya Card' (Antalya Kart) application in the field of transportation and 'ASAT MOBİL' in the field of water use and wastewater management provides information and facilitates electronic payment transactions.	Antalya Metropolitan Municipality, ASAT	Smart Governance, Smart Transport, Smart Environment

4.3.5. Konya Metropolitan Municipality

Konya is the Turkey's largest city in terms of area and seventh largest in terms of population (TUİK, 2018). Konya Metropolitan Municipality is one of the first municipalities to adapt smart city solutions in order to support efficiency and effectiveness of urban services and improve urban life that is getting more complex with increasing population. The projects and implementations within the scope of Konya smart city vision are carried out by Information Technology Department of Konya Metropolitan Municipality and this department formed a booklet containing all of the smart city initiatives in Konya[24]. Recently, to assure a holistic view in the practices of smart city and produce strategies and projects that will improve quality of life of people living in Konya, Smart City Management Branch Directorate has been established under the municipality.

Konya has been the pioneer in several smart city initiatives in Turkey, especially in the areas of transportation and e-municipality. Fleet management and passenger information is provided with Smart Public Transportation System (ATUS) and dynamic traffic management, incident detection and traffic information is provided with Central Traffic Operation System (METİS). To preserve the historic city center Konya gave importance to use of bicycle, bicycle sharing programs and the use of tram without catheters (without the use of poles and wires). Konya has 500 bicycles in its bicycle sharing program and with its 515 km bicycle road, it is the city where bicycles are mostly used in Turkey (Konya Metropolitan Municipality, 2018, Bilici and Babahanoğlu, 2018).

Konya Metropolitan Municipality is the first municipality to provide its services in e-government platform in Turkey. The first digitalization movement of administrative services occurred with the provision of online services such as e-license, e-design, e-pati and e-musicality. The coordination information center system of the municipality collects all the information about the projects, services and other amenities of

[24] http://www.konya.bel.tr/akillisehir/

municipality in a single center, and presents these to citizen through online services and mobile applications.

For a more environmentally friendly approach the environmental management information system center, is used as a ubiquitous problem identification and decision-making system of the urban and regional environmental problems, providing real time access to data. Smart environment-based implementations of Konya include electric generation from methane gas in solid waste plant and use of smart solutions in public buildings and LEED certificated environmentally friendly solutions in large scaled building complexes (stadiums, congress centers, science center).

Table 4.10. *Smart City Projects initiated by Konya Metropolitan Municipality*

Konya Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
Electricity Production from Methane Gas in Solid Waste Plant	The facility initiated in 2011 with a capacity of 5.6 MWs. The electricity produced within the facility meets the daily electricity needs of 26 thousand household operating in full capacity and the emissions of GHG is eliminated majorly.	Konya Metropolitan Municipality	Smart Environment, Smart Energy
Environmental Management Information System Center	The system provides real-time information and solutions regarding urban and environmental problems. It covers air quality monitoring, waste tracking, noise tracking, fuel control and vehicle tracking modules. The instant monitoring of pollution levels give the opportunity to create pollution maps and taking action accordingly.	Konya Metropolitan Municipality	Smart Environment

Smart Public Transport System (ATUS)	It is an integrated transportation information system, which monitors and provides real time information on public transportation, their routes, schedule, and status of the vehicles. It is believed to be used actively by the citizens with a 450.000 number of users per day (Konya M.M, 2018)	Konya Metropolitan Municipality	Smart Transportation
Electronic Inspection System (EDS)	EDS has been established in certain critical points in the city in order to prevent risks in traffics. 54% of the traffic accidents with injuries and 63% of the fatal traffic accidents is estimated to be prevented by central traffic operating system (Konya M.M, 2019).	Konya Metropolitan Municipality	Smart Transportation, Smart Security
Central Traffic Operating System	System enables real time detection and management of all the factors affecting transportation. Dynamic Intersection Management system is used in 77 intersection points to control and regulate the traffic in these areas according to momentary density data.	Traffic Control Center (TKM)	Smart Transportation
Smart Bicycle Program	Since 2008, 500 bicycles in 40 stations are provided for bicycle sharing program. The momentary information of number of rentable bicycles and free parking spaces are provided by mobile and online services.	Konya Metropolitan Municipality	Smart Transportation, Smart Environment
Konya Science Center	Science center has been established in 2014 with the aim of arousing scientific curiosity by creating interactive environments. It is believed to reinforce new innovative ideas.	Konya M.M	Smart Society
E-Pattern (E-Desen)	Identification of the most suitable agriculture products in the region with soil and climate analysis. Raising awareness through the information provided to the citizen through several online services.	Konya M.M, Mevlana Development Agency, Selçuk University	Smart Society, Smart Economy
Mobile Apps	Municipality has one main mobile application, named 'Konya' which performs as a city guide. The main themes of this application are developed around transport and accessibility to several urban facilities. Apart from city services, municipality provides another application as an online book format. [25]	Konya Metropolitan Municipality	Smart Transport, Smart People

[25] Name of the mobile application: Mevlana & Mesnevi

4.3.6. Kayseri Metropolitan Municipality

Smart cities implementations in Kayseri are as follows: “Smart City Kayseri” Mobile Application, Traffic Control Center, Bike Path and Stop, Sustainable Energy Action Plan.

Table 4.11. *Smart City Projects initiated by Kayseri Metropolitan Municipality*

Kayseri Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
Traffic Control Center (TKM)	Collecting information on traffic flow with IoTs, operating this information for intersection management. Providing information via mobile and internet applications to the citizens.	Kayseri Metropolitan Municipality	Smart Transportation
Smart Junctions and Smart Transport	The system enables real time management of junction points and controls priority in case of emergency. It aims to provide information about arrival times, vehicle times and characteristic.	Kayseri Metropolitan Municipality	Smart Transportation
Smart Irrigation	Smart irrigation system monitors the time, day and how much irrigation is done in specific area.	Kayseri Metropolitan Municipality	Smart Environment
SCADA (Central Audit, Info.Collection System)	Management of drinking water distribution with the sensors placed in dams and water distribution systems, measuring data (pressure, flow, water quality) and controlling valves by a central system	Kayseri Metropolitan Municipality	Smart Environment

Mobile Apps	Kayseri Metropolitan Municipality has an integrated smart city application, which eliminates the barriers to access municipality's services and forges these urban services to be easily accessible. Several urban services are provided in this application supported by the city information system. Besides this integrated smart city application, there are two subject specific applications that are developed by the municipality in the areas of public transport and sport facilities (integrated with personal health data).	Kayseri Metropolitan Municipality	Smart Governence, Smart Living, Smart Environment

4.3.7. Gaziantep Metropolitan Municipality

Smart Park and Garden Irrigation, Smart Grid and Renewable Energy Systems are the prominent smart city implementations in Gaziantep.

Table 4.12. *Smart City Projects initiated by Gaziantep Metropolitan Municipality*

Gaziantep Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
TEDES - Traffic Electronic Inspection	Collecting information on traffic flow with IoTs, operating this information for intersection management. Providing information via mobile and internet applications to the citizens.	Gaziantep Metropolitan Municipality	Smart Transportation
Water SCADA Systems	Management of drinking water distribution with the sensors placed in dams and water distribution systems, measuring data (pressure, flow, water quality) and controlling valves by a central system	GMM	Smart Environment

Smart Grid and Renewable Energy Systems	900 electrical meters are located within the city. Real time energy consumption could be monitored. This enables the use of electricity as efficient as possible. The system had reduced the 4% leakage ratio to 0.5%.	GASKİ, GMM	Smart Environment
Smart Irrigation Systems in Urban	Smart irrigation system monitors the time, day and how much irrigation is done in specific area.	GMM	Smart Environment
Traffic Signaling and Smart Public	Regulation and management of the most suitable route to the destination. Provides real time information to citizens.	GMM	Smart Mobilty

4.3.8. Kahramanmaraş Metropolitan Municipality

Smart city initiatives in Kahramanmaraş consist of: City Information System, Kahramanmaraş Mobile Application, Cemetery Information System, GIS SUDABİS Infrastructure Information System, Intelligent Elderly Care and Coordination Center (Spiritual Son Button), Traffic Management Systems, Smart Solar Poles.

Table 4.13. *Smart City Projects initiated by Kahramanmaraş Metropolitan Municipality*

Kahramanmaraş Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
Traffic management systems, center, smart station screen	Collecting information on traffic flow with IoTs, operating this information within an integrated center. Providing information via internet applications to the citizens as well as smart station screens.	Kahramanmaraş Metropolitan Municipality	Smart Transportation

Smart Counter Sysems	The use of smart water meters and remote reading and monitoring systems enables to momentary data reading of water consumption, index information, and control of water leakage and meter temperature The system is expected to assure efficiency, decrease excessive water consumption, prevent high bills and support immediate response mechanism in case of leakage or any other emergency	KMM	Smart Environment
GIS SUDABİS Infrastructure Information System	With KASKİ Geographical Information Systems, drinking water, wastewater and rainwater lines belonging to the city are matched with underground lines, address and subscriber data and displayed on the map. In this way, the length material and diameter information of the pipes, the subscribers are shown on the map by providing the geographical location of the feed is provided.	KMM, KASKİ	Smart Environment
Intelligent Elderly care and coordination center	Along with the intelligent automation system installed in the homes of elderly people living alone, sensors, fire, gas poisoning, smoke, water overflow and so on. In case of emergency, the automation system detects the emergency situation and transfers the data to the call center instantly. The personnel working in the call center informs the relevant units such as ambulance, emergency service, police and fire department.	KMM	Smart Health
Smart Solar Poles	It was established in 19 points. These poles produce their own energy from daylight and offer free internet service to the citizens as well as lighting and telephone charging service.	KMM	Smart Environment

4.3.9. Attempts and Initiatives in Other Cities

İzmir Metropolitan Municipality

Even though, İzmir local government is not listed as a pioneer in smart city implementations, the municipality gives importance to smart infrastructure investments. The smart city programs of İzmir Metropolitan Municipality are mainly hinge on the infrastructure investments. Two major smart projects of İzmir; İzmirNet - Broadband city project and smart traffic systems are closely linked with integration of urban services and to achieve this integration ICT infrastructure establishment has been taken as the first step. İzmirNet project aimed to form a strong infrastructure for e-municipality, e-healthcare, e-education, e- government and other smart initiatives. Even though İzmir has the major infrastructure capacity for smart projects and implementation, these initiatives stayed limited with IoT devices and mostly projects in the transport area has been realized. Along with integrated smart traffic system and safety, İzmir focused on the environmental aspect that is created by smart and sustainable transportation solutions. The use of electrical bus fleet within ESHOT (Izmir Belediyesi Electric, Water, Gas, Bus, Tram Company) started in 2017 and within 1-year time 1823 tons of CO2 emission has been prevented (ESHOT, 2018).

Although İzmir managed to create a broadband network system within the city, fragmented projects and implementation led to the insufficient utilization of this opportunity. The lack of strategies and related action plans, prevented a holistic approach. In 2018, İzmir Metropolitan Municipality founded "İzmir Smart City Platform" with several stakeholders and has taken 'Smart City Strategic Plan' into its agenda in planning activities. This step not only reinforced several smart city projects and a holistic approach, it also paved the way to a more inclusive and participatory smart city approach (İzmir Büyükşehir Belediyesi, 2018). The platform with multi-stakeholders such as İzmir Development Agency, IT Association, universities (İzmir Institute of Technology) and representatives of professional organizations, has the opportunity to create a bottom-up process that could directly affect the smart-

governance and smart-people components of the strategic plan. This multi-stakeholder process could also make it easier for the citizens to adapt new, innovative practices and projects.

Table 4.14. *Smart City Projects initiated by İzmir Metropolitan Municipality*

İzmir Metropolitan Municipality – Smart City Projects			
Name of the Project	Explanation	Actors	Smart City Characteristics
İzmirNet – Broadband City Project	The İzmirNet project, is an infrastructure investment on ICT and broadband for the purpose of integration and monitoring of all the urban services of the municipality in an electronic environment. Within the scope of the project, investing 235 thousand meters of fiber cable network laying, municipality's İzmirNet project have been among the largest networks in Turkey. It is considered that this infrastructure investment will be of great importance in the transition and adaptation process to smart cities and will facilitate access to urban services (İzmir Metropolitan Municipality, 2017).	İzmir Metropolitan Municipality	Smart Infrastructure, Smart Governance
Smart Traffic System (ATS – *Akıllı Trafik Sistemi)*	The objective of the smart traffic system is to increase the use of road capacities, ensure a safer vehicle and pedestrian traffic at high efficiency. Other benefits of the system are; reducing travel time, eliminating accumulation and waiting times at intersections. System includes, real time management of junction points and priority in case of emergency, public transport vehicle monitoring and passenger count and smart parking lot systems.	İzmir Metropolitan Municipality	Smart Transportation

Sensors and Smart Devices (IoTs)	Sensors, cameras and other smart devices are actively used within different urban services and activities. The integration of these different IoT devices are sustained with İzmirNet broadband project. The Iot devices and systems used within the city include; adaptive traffic control systems, meteorology measurement sensors (in 30 strategic points), traffic –density-measurement sensors (209 units within the city), traffic monitoring cameras (110 units), variable message systems (DMS, 48 units), parking lot information displays (60 units) and gabarite measurement system (16 units). All the data that is acquired from these IoT devices are integrated with geographical information systems (İzmir M. M, 2017)	İzmir Metropolitan Municipality	Smart Governance, Smart Transportation
Mobile Apps	Subject specific five mobile applications created by İzmir Metropolitan Municipality focuses on the themes of transportation, public transport, city guide and urban facilities. The use and accessibility of health facilities and nature parks are also aimed to be increased through the specific applications for these facilities.[26]	İzmir Metropolitan Municipality, Eshot General Directorate[27]	Smart Mobility, Smart Healthcare (Smart Living)

Kocaeli Metropolitan Municipality

Furthermore, Kocaeli and Sakarya Municipalities focus on smart initiatives within disaster and emergency management with refence to the local. With the protocol signed in August 2018, Kocaeli Metropolitan Municipality, Disaster and Emergency Management Presidency (AFAD) and Gebze Technical University in cooperation the "Kocaeli Smart City Disaster Loss Mitigation Project" is initiated and to establish an early warning system for all industrial establishments in the city is realized (Kocaeli Büyükşehir Belediyesi, 2019). With this application, a smart city solution that consists of automatic warning of gas, water, electricity and other explosive mechanisms in

[26] Mobile Applications of İzmir Metropolitan Municipality: İzmir Metropolitan Municipality mobile application (İzmir Büyükşehir Belediyesi), Eshot Mobil, İzmir Trasportation Center (İZUM – İzmir Ulaşım Merkezi), İzmir Wildlife Park (İzmir Doğal Yaşam Parkı), Eşrefpaşa Hospital application.
[27] Eshot is the name of the bus operating company of İzmir Metropolitan Municipality. The abbreviation stands for 'Electric, water, coalgas and public transport'.

factories will be provided by giving early warning signal before earthquake. With the disaster risk mitigation purpose, this intelligent solution, which will be developed for the first time in Turkey.

Sakarya Metropolitan Municipality

The Disaster Coordination Center (AKOM), which was commissioned by Sakarya Metropolitan Municipality in 2016, is currently working on strengthening the urban structure for possible natural disasters. AKOM, which is built with technological equipment to provide uninterrupted energy and communication opportunities in case of a disaster, conducts a study to reduce disaster risks management in the city through planning, intervention and organization processes (Sakarya Büyükşehir Belediyesi, 2019).

Eskişehir Metropolitan Municipality

Eskişehir Tepebaşı Municipality has received a financial grant from the European Commission for -REMOURBAN-Smart City Project which will be carried out between 2015-2020. REMOURBAN is a 5-year (2015-2020) project funded by the European Commission's Horizon 2020 Research and Innovation program. It is a new model for accelerating smart urban transformation (Kentli Dergisi, 2019). The main objective of REMOURBAN Project is to identify innovative solutions and designs by combining energy, transportation and information and communication technologies applications in a single point, to apply and spread urban transformation model in districts and cities, to improve the quality of life of the city people, to ensure social acceptance and environmental sustainability, the adoption of innovative business models for renovation. Within the REMOURB Project, Tepebasi / Eskisehir (Turkey), Valladolid (Spain) and Nottingham (England) identified as practitioners cities and Seraing(Belgium) and Miskolc (Hungary) designated as a spectator cities which will

offer innovative solutions in transportation, energy and information industry, provide strategic support and develop their partnerships with the practitioner cities. The project combines urban transformation and smart city concept. The aims of Eskişehir Tepebaşı Municipality, which emerged from the combination of these two concepts, are listed below;

1. Smart City Monitoring Portal will be created. What the energy consumed in buildings is used for; how much of it comes from renewable sources.

2. Building shells and joinery systems will be renewed to increase the energy efficiency of the buildings

3. 4 electric buses to be used in public services and 7 hybrids to be used in domestic services will be put into operation.

4. Building and environmental lighting will be replaced with LED luminaires.

5. Solar solar panels and boilers burning organic waste will be installed for heating and hot water needs.

6. 6.2 kilometers of smart bike road will be organized; 50 electric bicycles will be offered to the public.

7. Charging stations that receive energy from the sun will be established at different points of the city.

8. Instead of natural gas, water-source heat pump systems that take their energy from the sun will be installed.

9. Direct participation of the people of Eskişehir will be supported. (REMO Urban, 2015).

As a pilot project a living lab is established in Tepebaşı district in order to include citizens in this smart transformation project with an inclusive manner. The objective of Tepebaşı "Future Living" Lab (TFLL) is to analyze and verify innovative

technologies that promote or activate ICT in socio-economic development in low-income communities and disabled groups living with mental and physical diseases.

4.4. Role of the Private Sector

In order to achieve a holistic smart city development, collaboration and cooperation of different stakeholder carries at most importance as the interaction between different actors assure a sustainable ecosystem through participation. As Henry Etzkowitz and Loet Leydesdorff (2019) asserts in their triple helix model of innovation, interplay between government, institutions and industry (private sector) reinforces product and service development along with innovative knowledge creation. This model and interactive cooperation of these stakeholders foster both economic and social development. This cooperation not only sustain a multi-stakeholder ecosystem, but it also facilitates the process with financial and operational collectiveness. Within this system private sector has an important role as a catalyst within the smart city process. The technological firms not only provide smart and innovative technologies but through their leading role in the technology they shape the process of becoming smart.

As the innovative technologies and systems create a major economic market, private sector stakeholders directly step in and take their share. Within the universal context, it could be seen that the smart development process goes directly parallel with the agenda of private sector. The technology firms such as BIM, Cisco, Intel, Microsoft, General Electric, Google, AT&T and similar ones play direct role within the smart city initiations and implementations. They realize smart systems and they guide and conduct the smart city process. As it was discussed in 2.6. Opportunities and Treats of Smart City Concept this could raise concerns and treats to the main approach of smart development as only focusing on the technology market it created.

In the Turkish context, the role of technology firms and private sector in the process of smart cities is limited and mostly dominated by the subsidiary companies of municipalities such as İSBAK and İSTTELKOM. As it can be seen in Turkey Smart City Evaluation Report (Nouvens, et al., 2016) most of the of the smart projects are financed by metropolitan municipalities and as it was discussed part 4.3, the collaboration in the local level very little and the smart projects are implemented by the IT departments or by the departments that are related with the subject of the project.

The one area in which the private sector activity is evident in smart city projects in the Turkish concept is the communication infrastructure. GSM Operators such as Vodafone, Turkcell Avea have several activities within the ICT and infrastructure component of smart development. Following that white good market (Arçelik, Beko, Bocsh etc.) adapt some smart implementation in their own structure in order to achieve efficiency. These companies realize smart systems on their own fields but also affect the technology (smart city market) in general which is projected to grow 20% annually (Technavio, 2016). Ausis in smart transportation systems, Deloitte in "Smart Mobility, Smart Safety, Smart Energy, Smart Water, Smart Waste, Smart Buildings, Smart Homes and Living, Smart Health, Smart Education, Smart Finance, Smart Tourism and Leisure, Smart Retail, Smart Logistics, Smart Manufacturing, Smart Construction, Smart Government areas", Logiba in smart lighting solutions, smart waste tracking solutions, meteorology solutions, power analysis (in smart environment) areas, Proline in GIS and smart security management systems, Turksat in IT and IOT platforms and networks (also including smart health, transportation, infrastructure) and Türk Telekom in smart infrastructure are the prominent private sectors that play active role in the Turkish smart city agenda (Dener, 2018). It can be seen that the most of this sector is focused on smart infrastructure primarily.

4.5. Summary of Findings

4.5.1. Current Situation

As in 2018, more than 75% of total population in Turkey lives in urban areas. This extensive rise in urban population comes along with problems in urban services and threats to the environment. In order to use technological advancements to tackle these problems, several different smart city initiatives have realized in the context of Turkey within different levels. The initial policies, projects and implementations in the concept of smart city have been observed to have piecemeal, siloed approach. Today in order to provide a common ground a new strategy document; 2019-2022 National Smart City Strategy and Action Plan by MEU had taken the issue into agenda of urban planning.

In order to accomplish a comprehensive understanding of the Turkish case a matrix that relates smart city components with the indicatives in Turkey is creates. Table 4.15 shows the comparison between smart city implementation areas with national and local smart city initiatives in Turkish context. In this respect, the smart city implementation areas that are referred to consist of two categories. The first category is the universal smart city components that are constituted according to Cohen (2012) "Smart City Wheel" and Giffinger et al. (2007)'s six smart city component and 33 factors (implementation areas) that are sub-titles according to the six components. The second category refers to the smart city components in the Turkish context. 17 components are adopted from Ministry of Environment and Urbanization smart city agenda (MEU, 2019a; 2019c). The overlapping components of universal and Turkish case are marked with a different color as shown in the legend (Table 4.15). Both national and local level smart city initiatives are reviewed within three groups according to their level of realization. These are policy level, pilot implementation level and implementation level. Thereby the distribution of different levels of smart initiatives along different sector are obtained. According to this analysis, findings are summarized and evaluated in this part.

Among different smart city component, not all of them are addressed and implemented in the same level within the Turkish context. This results from the lack of holistic approach and common ground in the understanding of this concept. Most of the defined smart city components are stayed in the policy level and implementations are not realized. Even through there are implementations in some of the target areas, they became limited solemnly by pilot project and further improvements or wide range of implementations are not realized in that areas.

The Table 4.15 shows that the implementations are mostly carried out in the fields of smart mobility and smart environment. Both of these fields have been addressed in national level (National Smart Transport Systems Strategy Document and 2018-2020 Action Plan, Turkey Climate Change Strategy 2010-2023), and their implementation in several sub-components of smart city is realized. Within the domain of smart mobility, use of IOT and ICT for the local accessibility is highly encouraged. On the other hand, (inter-)national accessibility is mainly neglected. Use of renewable energy systems, sustainable, innovative transportation systems are mostly addressed in several policy documents (2006-2010 Information Society Strategy and Action Plan, 10th Development Plan, National Smart Transportation Systems Strategy Document and 2018-2020 Action Plan), those policies are not turned into actions. Several metropolitan municipalities focused on use of non-motorized modes of transportation (use of bicycle and bicycle sharing programs in İstanbul and Konya), but these projects did not become widespread, instead their own sustainability of these projects are not achieved after pilot projects.

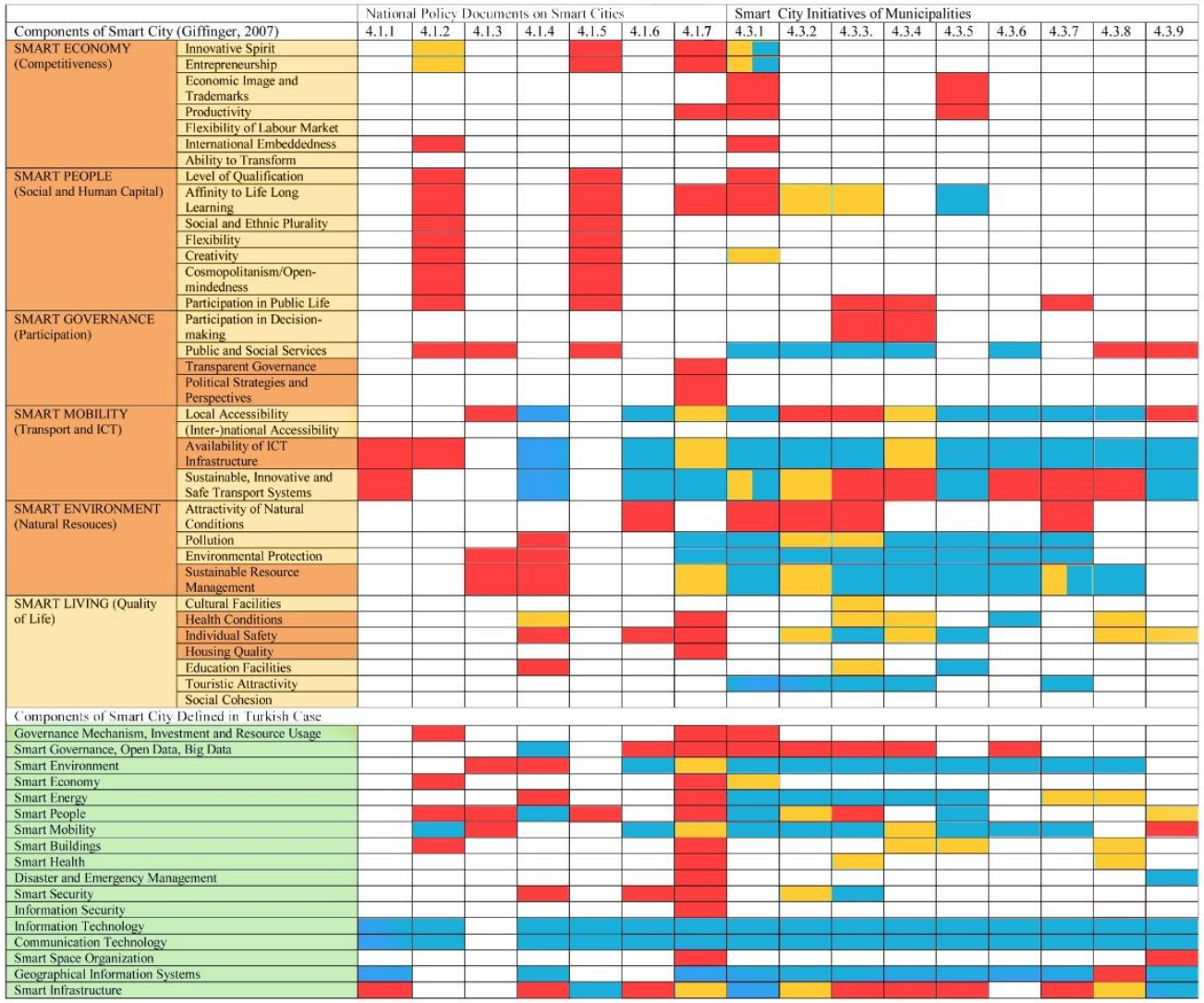
The smart environment and sustainability issues emphasized both in national policies and local implementations. Most of these implementations are constituted of use of meters (SCADA) and sensors for energy and water management, and waste management/disposal systems. Even though pollution is highly taken into account, environmental protection and attractivity of national conditions are not taken into

account in the smart city agenda. Other components like smart governance, smart economy, smart people and smart living does not partake prominently in most of the smart initiatives in Turkey and only small portions of these components are taken into account. For example, under the smart component, implementations covered by smart health are initiated by several metropolitan municipalities (Bursa, Antalya, Konya, Kahramanmaraş) but most of these projects are carried our with a fragmented sense and they did not penetrated to community level as they are not supported by smart people aspects and awareness raising campaigns.

Throughout the inquiry İstanbul Metropolitan Municipality strikes as the public agency in the local level that tries to achieve a holistic and connected smart city approach with its Directorate of Smart City established in 2015. Subsidiary companies of İMM; İSBAK and İSTTELKOM also supported the smart city ecosystem. This enabled a coordinated approach for the İstanbul case. Recently, Bursa Metropolitan Municipality announced that it has formed a Smart Urbanism Unit under Directorate of R&D to assemble all the smart city indicatives of Bursa M.M under the same roof in 2019. Other metropolitan municipalities that do not have a coordinated smart city approach, conduct their smart initiatives under IT Departments or within the domain of departments related to the subject of the initiatives. This is mainly seen in Ankara's case in which, each department configurated their own smart strategy in their own work-area. For example, ASKİ initiates the implementation of Smart Water Management Systems (SCADA) and Smart Water Meters[28].

[28] Ankara Water and Sewerage Administration

Table 4.15. *Matrix of Smart City Projects and Policies in Tukey, and Smart City Dimensions*



4.1.1.2003-2023 National Science and Technology Policies Strategy Paper
4.1.2.2006-2010 Information Society Strategy and Action Plan
4.1.3. Integrated Urban Development Strategy and Action - Kentges
4.1.4.10th Development Plan 2014-2018
4.1.5. Renewal of Information Society Project and 2015-2018 Information Society Strategy and Action Plan
4.1.6. National Smart Transportation Systems Strategy Document and 2018-2020 Action Plan
4.1.7. Smart Cities White Paper and 2019-2022 National Smart Cities Strategy and Action Plan

4.3.1 İstanbul Metropolitan Municipality
4.3.2 Ankara Metropolitan Municipality
4.3.3 Bursa Metropolitan Municipality
4.3.4 Antalya Metropolitan Municipality
4.3.5 Konya Metropolitan Municipality
4.3.6 Kayseri Metropolitan Municipality
4.3.7 Gaziantep Metropolitan Municipality
4.3.8 Kahramanmaraş Metropolitan Municipality
4.3.9 Attempts and Initiatives in Other Cities

Legend

Giffenger et al. (2015)'s Smart City Components and Indicators

Smart City Components defined by MEU in the Turkish Context

Mutual Components

policies

implementations

pilot implementations

Smart Economy aspect is mostly address by İMM with the use of several platforms such as *Beyaz Masa* and Başakşehir Living-Lab to encourage innovative spirit and entrepreneurship.

Social and Human capital that forms the smart people is only addressed through course centers that are provided by municipalities which aims to reinforce life-long learning. This component is not further supported with inclusiveness, social and ethical plurality, creativity or qualified human resources. Following the inclusion of community, people aspect in the smart city structure, while smart governance and participation is one of major principles of smart cities, the participation is not actively encouraged. Instead the smart governance is embraced through an intention of informing. ICT and mobile applications are put to use for the purpose of information sharing with the citizens and providing easily accessible public and social services through digital devices.

The smart city initiatives in Turkey revolve around several concepts and they neither directly focus on the universal smart components, nor tackle all the local problems, threats and opportunities. The implementations are mostly in the fields where the implementations would be easier and rapid outcomes would be achieved. Inherently these are the low hanging fruits that are collected while urgent and vital problems are largely dismissed. Political and governance related dimensions are overlooked along with participation of citizens. The collaborative ecosystem that smart city concept underlines is not achieved. Inter or intra-operability between institutions are not secured. This is why efficiency and effectiveness concepts that comes with compatibility between different systems and implementation is not sustained. Even though smart city is mainly based on use of data and cloud computing, because of confidentiality concerns the big data is not referred to any of the implementations so the advantages and opportunities of data analysis for more efficient urban management and planning became a lost opportunity.

The smart city ecosystem gathers different stakeholders and forms a common ground, in which a collective decision making is achieved. As Lombardi (2011) inserts the innovation is only achieved by the collaboration and reciprocal relations of public sector, institutions, private sector and community. Each actor plays an important role both social, governance and financial level. In the universal context the dominant role of private sector creates concerns about the prominent role of technology market, and the focus on a technology-oriented smart approach (Viitanen and Kingston, 2014). In the Turkish context, this is not the case. The domain of smart city highly dominated by public sector in Turkey. Other stakeholders become passive spectators of the process. Even though, several technology firms play role in the financial aspect of smart city implementations, these are mostly related with information and communication technologies and their infrastructure.

The haphazard and fragmented initiates of smart systems are aimed to be gathered under the same roof by the initiation o 2019-2022 National Smart Cities Strategy and Action Plan. During the preparation of this document, workshops with academicians (institutions), NGOs, national and local governments and private firms are executed. These workshops enabled different stakeholders to take part within the preparation of national smart city document and forged collective creation of vision, objectives, visions and actions. In this sense the preparation of this document raises the promise of a collaborative and cooperative environment. Despite the multi-stakeholder environment of Triple Helix model of Innovation is achieved, the community and citizen-participation are not included in this process (Etzkowitz, and Leydesdorff, 1995).

CHAPTER 5

CONCLUSION

5.1. Discussion

Smart city concept is a wide domain, which is defined in many different ways. It is an interdisciplinary umbrella term that covers different planning concepts; such as sustainability, creative class, digital city, knowledge city and so on (Cocchia, 2014, Albino et. Al, 2015). This broad concept includes diverse fields of application. It has wide and un-certain boundaries. The direct explanation of this concept is closely related with its use and capitalize of information and communication technologies in order to achieve efficiency, effectiveness, sustainability, high quality of life, competitiveness in socio-economic level, participatory policies, ubiquitous accessibility etc. The use of big data and ICT in order to reinforce urban services, their inter-operability and achieve an effective and efficient management of resources constitute an important essence of this concept. Ubiquitous networks enable fast and real-time responses to urban problems and the big data that is generated through sensors and meter becomes an important input for the future planning decisions.

Even though the concept contains wide range of possibilities with its connected systems, use of purely technology-based approach could outpace these opportunities. This would not only create a technology market, but it would reinforce the smart process forged by the economic market value of the technology and dominant technology firms that aims to grab a piece of this market. In the universal context, it could be seen that high-tech firms sch as IBM, CISCO and so on, leads the smart process. Viitanen and Kinston (2013) asserts that the dominant role of private sector results the outpace of efficiency and inclusiveness concepts in smart city by the commercial interest. This could result the opposite outcomes that the concept of

smartness intended to achieve. It creates a threat for equality within the society by promoting a privileged societal order who can afford these technologies and spin the wheel of commercial interest. On the other side, the presence of private sector is not active enough in Turkish smart city approach. This also results in not achieving the desired level of economic investment. As the first investment price of these systems are quite high, the lack of presence of private sector, creates a financial burden for public sector especially local governments. The collaborative systems with multi-stakeholders not only reinforce participation and collective decision making but with an active private sector presence it also strengthens the smart economy components such as entrepreneurship and innovative spirit.

The way of implementation of smart cities also bears diverse discussions on the concept as well as the intentions and approaches that generate this concept. The manner of implementation, either Greenfield (from scratch) Projects or Brownfield (on to the existing cities) Projects, this concept changes with the local initiatives. While in Europe and North America Brownfield projects and their implementations are adopted, in the Gulf Region the dominant approach is side with Greenfield projects that start from the scratch. Even though both of the approaches have their own advantages and disadvantages, the risks and threats Greenfield projects have been highly criticized. Angeliou (2014) mentions that even-though Greenfield projects do not have the limitations that are caused by an existing infrastructure and thus a project from scratch could enable a calculated and full purposeful implementation without constraints, it could have uncalculated social and economic problems. The Greenfield projects like Masdar in Gulf Region, that labels itself as a eco-city that uses green technology are open to threats of not attracting enough residents to the area for achieving sustainability level and deepening the economic gap between citizens with high rent that are due to the high first investment rates in these projects. In the Turkish context, Brownfield projects predominates the smart city arena. Only in the case of Antalya Kepez Santral Neighborhood Urban Transformation Area- Smart City

Projects a Greenfield project is implemented as a pilot study. The project has taken its first pace in 2019, and only when it is finished the success of the project will be determined according to its inclusiveness and sustainability.

As the concept of smart city is a fuzzy term, it could be easily manipulated and used as a labelling without any benefits in social, environmental and economic aspects. The labelling also is evident in piecemeal and siloed smart city projects. This results in missing the real aims and targets that smart city have. The fragmented projects is also result from the lack of collaboration and inter-operability (in-) between different actors and institutions.

5.1.1. Components of Smart Cities

In order to achieve a deeper understanding of this wide term, several components that explain the implementation opportunities in smart cities has been defined by different institutions. These range from Boyd Cohen (2012)'s wheel to Giffinger et. al. (2007)'s smart city components and indicators. 6 components (Smart Governance, Smart Economy, Smart Mobility, Smart Environment, Smart Living and Smart People) are excepted universally and smart city initiatives and projects are planned accordingly. Within the Turkish context, recently Ministry of Environment and Urbanization created a consensus on 17 components (Figure 4.1, Figure 4.2). These components are determined according to its own unique case of Turkey. In chapter 4, these components are used to form a matrix which presents that which aspects of smart city is highly referred to in the Turkish context. As presented in Table 4.15 the policies, implementations and pilot projects on smart cities mainly distributed along transportation and environment components. While smart people and smart living are the characteristics of smart cities in which not enough initiatives are realized. Other components like smart governance and smart economy are realized partially neglecting important aspects of these characteristics. In the case of smart governance, the main chrematistic of this component; participation is not referred to, instead this

component is realized with digitalized public and urban services. This indicates that the smart city concept in Turkey, misses the important and urgent problems, instead focuses on easy implementation areas.

5.1.2. Collaboration of Different Actors in Smart City Ecosystem

Patrizia Lombardi (2011) asserts that in order to achieve a successful smart city ecosystem, a four helices model should be followed. The traditional "triple helix of innovation" model refers to the reciprocal relations between government, industry and institutions (university, NGOs). This model mentions to have interactive innovation system which fosters economy and social development, these three stakeholders should come together. Lombardi (2011) proposes that civil society should also be a part of this system in order to sustain participation of citizens. Furthermore, an innovative implementation would be accepted much faster if the citizens become a part of the decision-making system. The smart city ecosystem of Turkey consists of 5 actors which are; public sector (both national and local governments), private sectors, non-governmental institutions, institutions and citizens. The level of integration of these actors differs from each other. As most of the smart city implementations are done by municipalities with their own funding or with the collaboration of private sectors; the innovative model is realized only by two stakeholders, leaving other actors out. This would become an obstacle in from of citizen participation. Furthermore, professional expertise of other institutions would not be taken into account, and the common ground NGOs create for the needs and potentials of each stakeholder could not be established.

On another level, nor cooperation between the departments of the same public institutions, neither collaboration in-between different governmental organizations (ministries, municipalities etc.) is not realized. This result into piecemeal implementations. Also, without a collaborative ecosystem, the experiences, best practices and failed attempts are not shared. lack of a collaborative ecosystem

including institutions, NGOs and other actors neglects the opportunities and advantages social capital create.

5.1.3. Social Capital and Qualified Human Resources

In a people-based smart city approach, social capital has significant impact. Unfortunately, lack of qualified human resources becomes obstacles on the way of realizing several smart city implementations. In order to breakthrough this barrier "smart people" components that include creativity, flexibility, plurality, life-long learn and participation in the public life is suggested in the universal concept. This would not only reinforce human-capital but also sustain inclusiveness of citizens within the created smart system.

The smart cities in Europe pursue the people-based smart city approach while giving importance to the indicators of smart people, while Gulf Region focuses on the technology aspect primarily. Other examples in the world gives different amounts of importance to this concept. Within the Turkish concept, in order the penetrate the idea behind smart people, two national policy documents prepared. These are 2006-200 Information Society and Action and Renewal of Information Society Project along with 2015-2018 Information Society Strategy and Action Plan. In policy level the importance of inclusiveness, life-long learning and qualified human resources had been addressed extensively. When we analyze the reflection of these policies in the local level, it is seen that these components have not been implemented with a holistic approach and he smart people component approach only styed in the policy stage.

5.1.4. Big Data and Open Data and Democracy

The smart city concept has its roots from advanced information and communication technologies, and use of data. The information that is collected through sensors and meter accumulate to form a vast variety of knowledge. The data that is obtained from ICT and IOTs are analyzed in order to figure out optimum solutions for urban problems. The big data has a major role along with cloud computing within the smart city concept, in order to create ubiquitous (real-time) responses and to form a basis for decision-making. Sharing the big data, enables other institutions to benefit from this major information source. Open data also enables interoperability within different actors. Even though these two concepts carry several opportunities for smart cities, they are also open to threats related with data safety and protection of personal information.

In the Turkish context, neither big data nor open data is embraced. The data-sets that are obtained from IoTs and sensors are only assessed within the component of transportation. Open data approach is not pursued not even within the departments of same institutes with the concern of information safety. This raises issues in interoperability and collaborative ecosystem. The control of data and who can access it plays an important role. Corporate and governed based control on communication systems and internet, have the opportunity to manipulate people and control their role in participation, this would result in tears in internet democracy. The advantages of this system depend on who have access to this waste range of information. Even though, open data is achieved, human capital and "know-how" plays an influential role. If the decision-makers do not support life-long learning, the citizens who lack the basic knowledge to access the services would not be included.

5.2. Recommendations,

According to the analysis that are made both in Chapter 4 and Chapter 5, some recommendations are made by the author in order to overcome the problems that are faced in the smart city initiatives in the context of Turkey.

- Establishment of both internal and inter-institutional cooperation ecosystem
- Establishing a national mechanism to formulate national strategy, smart urban transformations, standards, cooperation, interoperability of systems, inter- and intra-institutional data exchange on smart cities.
- Creation of funds or creation of new economic systems for financing difficulties faced by municipalities in the implementation of smart cities
- Creating a platform for experience and best-practice sharing, so that several successful smart cities can be taken as examples.
- Observing the success levels of the smart implementations by selecting pilot application areas
- Processing big data and creating an input through the its' analysis in the decision-making mechanism.
- Adoption of open-data system
- Ensuring the participation of citizens in the smart city process. Involving other stakeholders (NGOs, institutions) within decision making mechanism.

REFERENCES

Achmad, K. A., Nugroho, L. E., & Djunaedi, A. (2018, July). Smart City Model: A Literature Review. In *2018 10th International Conference on Information Technology and Electrical Engineering (ICITEE).* (pp. 488-493). IEEE. doi: 10.1109/ICITEED.2018.8534865.

Adıgüzel M. (2017). *An Evaluation Model for Turkish Cities in the Context of Smart City*. (Unpublished master's thesis). Middle East Technical University, Department of City Planning , Ankara.

Akgül, M. K. (2013). *Kentlerin e-Dönüşümü "Akıllı Kentler"* [e-Transformation of Cities "Smart Cities"]. (Unpublished government document). Directorate General for Productivity, Ministry of Industry and Technology, Ankara.

[*Akıllı Şehirler*]. (2018). Retrieved May 20, 2019 from https://www.akillisehirler.gov.tr/

Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart Cities: Definitions, Dimensions, Performance, and Initiatives. *Journal of Urban Technology*, *22*(1), 3-21.

Angelidou, M. (2014). Smart City Policies: A Spatial Approach. *Cities,* 41, s3-s11.

Ankara Metropolitan Municipality. (2018). *Ankara Büyükşehir, Akıllı Şehir* [Ankara Metropolitan, Smart City]. (Unpublished government document). Department of Information Technology, Ankara.

Antalya Metropolitan Municipality. (2018). *Antalya'da Akıllı Kent Uygulamaları Yaygınlaşıyor* [Smart City Application are becoming widespread in Antalya].

Retrieved May 20, 2019 from http://antalya.bel.tr/haberler/antalyada-akilli-kent-uygulamalari-yayginlasiyor

Antalya Metropolitan Municipality. (2019). *Akıllı Şehir Projesi MAtchUP için 'Çalıştay' Düzenlendi.* [Workshop is organized for Smart City Project MatchUp]. Retrieved May 5, 2019 from http://antalya.bel.tr/haberler/akilli-sehir-projesi-matchup-icin-calistay-duzenlendi

Anthopoulos, L. G. (2015). Understanding the Smart City Domain: A Literature Review. *Transforming City Governments for Successful Smart Cities*, ed. M. P. Rodriguez-Bolivar, Switzerland, Springer International Publishing, 9-21.

Anhopoulos, L.G., Janssen, M., Weerakkody, V. (2016) A Unified Smart City Model (USCM) for Smart City Conceptualization and Benchmarking. *International Journal of Electronic Government Research,* 12(2), 77-93.

Anthopoulos, L.G. (2017). The Rise of the Smart City. *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?.* Switzerland, Springer International Publishing AG, 5-45.

Antiroiko, A. V. (2014). Smart Cities in the New Service Economy: Building Platforms for Smart Services. *AI & Sociey*, 29(323), 323-334.

Arroub, A., Zahi, B., Sabir, E., Sadik, M. (2016). A Literature Review on Smart Cities: Paradigms, Opportunities and Open Problems. *2016 International Conference on Wireless Networks and Mobile Communications* (Dec 8, 2016), Morocco.

Balaban, O. (2019). Smart Cities as Drivers of a Green Economy. In *Handbook of Green Economics,* eds. S. Acar, E. Yeldan. Elsevier, 69-92.

Baraçlı, H. (2017). İBB'nin Akıllı Şehir İstanbul Projesi Kapsamında Yürüttüğü Çalışmalar ve Uygulamalar. *İTÜ Vakfi Dergisi* (77), 44-50.

Batty, M. (2013). Big Data, Smart Cities and City Planning. *Dialogues in Human Geography*, *3*(3), 274- 279.

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazani, A., Wachowicz, M., Ouzounis, G., & Portugali, Y. (2012). Smart Cities of the Future. *The European Physical Journal Special Topics*, *214*(1), 481-518.

Benli, B., & Gezer M. (2017). Akıllı Şehirlere Dönüşüm Yolunda Türkiye. *İTÜ Vakfi Dergisi* (77), 28-32.

Bilici, Z., & Babahanoğlu, V. (2018). Akıllı Kent Uygulamaları ve Konya Örneği. *Akademik Yaklaşımlar Dergisi*, *9*(2), 124-139.

Bıyık, C. (2019). Smart Cities in Turkey: Approaches, Advances and Applications with Greater Consideration for Future Urban Transport Development. *Energies*, *12*(12), 2308.

Bursa Metropolitan Municipality (2018) Akıllı Şehir Bursa http://akillisehir.bursa.bel.tr/ Access Date: 24.05.2019

BUSKİ (2017) Akışkan Yataklı Çamur Yakma ve Enerji Elde Etme Tesisi://www.buski.gov.tr/tr/icerik/on_aritma_ve_derin_deniz_d_480 Access Date: 24.05.2019.

Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart Cities in Europe. *Journal of Urban Technology*, *18*(2), 65-82.

Chen, Y.T. (2012). Sketch Industry Promotion Framework for Smart City Services by Leveraging Living Lab Harmonization Cube". *International Journal of Electronic Business Management*, *10*(2).

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J.R., Mellouli, S., Nahon, K., Pardo, T.A., &

Scholl, H. J. (2012, January). Understanding Smart Cities: An Integrative Framework. In *2012 45th Hawaii International Conference on System Sciences* (2289-2297). IEEE.

Cocchia, A. (2014). Smart and Digital City: A Systematic Literature Review. *Smart City : How to Create Public and Economic Value with High Technology in Urban Space* , eds. R. Dameri, C. Rosenthal-Sabroux. Switzerland, Springer International Publishing, 13-43.

Cohen, B. (2012) *Top Ten Smart Cities on the Planet*. Retrieved 6, June 2019 from www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet

Dameri, R. P. (2013). Searching for Smart City Definition: A Comprehensive Proposal. International Journal of Computers and Technology, 11(5), 2544-2551.

Deloitte, & Vodafone. (2016). Akıllı Şehir Yol Haritası [Smart City Road Map]. Retrieved July 20, 2019 from https://www.vodafone.com.tr/VodafoneBusiness/iot/pdf/akilli-sehir-yol-haritasi.pdf

Dener, M. (2018). Smart Cities Companies in Turkey. *The Eurasia Proceedings of Educational & Social Sciences (EPESS),* (9), 344-348.

Dijital Araştırmalar Derneği. (2015). Dijital Varlık Reytingi Raporu [Digital Asset Rating Report].

Dirks, S., & Keeling, M. (2009). A Vision of Smarter Cities: How Cities can Lead the Way into a Prosperous and Sustainable Future. *IBM Institute for business Value*, *8*.

Doğan, M. (2017). *Akıllı Şehirler ve Dünya Şehirlerinin Geleceği. İTÜ Vakfı Dergisi* (77), 32-35.

EIP-SCC. (2017) Roadmap 2017 – *Supporting Action Clusters' Initiatives to Deliver Business Cases and Scale Them up*. Retrieved July 6, 2019 from https://eu-smartcities.eu/sites/default/files/2017-08/EIP%20SCC%20Market%20Place%20-%20Roadmap%202017%20Public%20Version.pdf

Ericsson.(June 2019). *Ericsson Mobility Report.* Retrieved June 7, 2019 from https://www.ericsson.com/49d1d9/assets/local/mobility-report/documents/2019/ericsson-mobility-report-june-2019.pdf

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix--University-industry-government relations: A laboratory for knowledge based economic development. *EASST review*, *14*(1), 14-19.

[*European Innovation Partnership On Smart Cities And Communities (EIP-SCC*)]. (2017). Retrieved july 6, 2019 from https://smartcities.at/europe/networking/european-innovation-partnership-on-smart-cities-and-communities-eip-scc/

Foth, M., Brynskov, M., & Ojala, T. (2015). *Citizen's Right to the Digital City. Urban Interfaces, Acivism, and Placemaking.* Berlin: Springer.

Galderisi, A., Colucci, A. (2018) Smart, Resilient and Transition Cities. Emerging Approaches and Tools for a Climate-Sensitive Urban Development. Amsterdam, Netherlands: Elsevier Publication.

Geffray, E., & Auby, J. B. (2017). The Political and Legal Consequences of Smart Cities. Interview with Edouard Geffray/ Legal Perspective with Jean-Bernard Auby. *Field Actions Science Reports. The journal of field actions*, (Special Issue 16), 11-15.

Gil-Garcia, J. R., Pardo, T.A., Nam, T. (2015). What Makes a City Smart? Identifying Core Components and Proposing an Integrative and Comprehensive Conceptualization. *Information Polity*, (20), 61-87.

Giffinger, R., Fertner, C., Kramar, H., & Meijers, E. (2007). Smart Cities Ranking of European medium-sized cities. *Vienna: Centre of Regional Science*, Vienna UT.

Giffinger, R., Kramar, H., & Haindl, G. (2010). The Role of Rankings in Growing City Competition. *Urban Research & Practice,* 3(3), 299-312.

Global Footprint Network. (June 26, 2019). *Earth Overshoot Day 2019 is July 29th, the earliest ever.* Retrieved July 7, 2019 from *https://www.footprintnetwork.org/2019/06/26/press-release-june-2019-earth-overshoot-day/*

Gürsoy, O. (2019). *Akıllı Kent Yaklaşımı ve Türkiye'deki Büyükşehirler İçin Uygulama İmkânları* [Smart City Approaches and Implementation Opportunities for Metropolitan Cities in Turkey] (Unpublished master's thesis). Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Hollands, R. G. (2008). Will the Real Smart City Please Stand Up? Intelligent, Progressive or Entrepreneurial?. *City: Analysis of Urban Trends, Culture, Theory, Policy, Action*, 12(3), 303-320.

Hollands, R. G. (2015). Critical Interventions In to the Corporate Smart City. *Cambridge Journal of Regions, Economy and Society,* (8), 61-77.

IBM. (nd). Smarter Cities. Retrieved January 15, 2019, from IBM Website: https://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/

IEA. (2018). G20: *Energy End-Use Data and Energy Efficiency Metrics Initiative*. Retrieved July 7, 2019 from https://www.iea.org/classicstats/g20energyend-usedataandenergyefficiency/

IPCC. (2014). *AR5 Climate Change 2014: Mitigation of Climate Change Report.* Cambridge University Press.

İSBAK. (2018). *İSBAK – Akıllı Şehirin Mimarı*. Retrieved 3 May, 2019 from http://www.musiad.org.tr/F/Root/ISBAK.pdf

İstanbul Technical University, Türkiye Bilişim Vakfı, Novusens, Intel & Mastercard. (2016). *Türkiye Akıllı Şehirler Değerlendirme Raporu* [Turkey Smart Cities Evaluation Report].

Kayapınar, Y. E. (2017). Akıllı Şehirler ve Uygulama Örnekleri [Smart Cities and Implementation Examples]. *İTÜ Vakfi Dergisi* (77), 20-22.

Kayseri Metropolitan Municipality (2019) *Büyükşehir'den Akıllı Şehir Projeleri*. Retrieved June, 10 from https://www.kayseri.bel.tr/haberler/buyuksehirden-akilli-sehir-projeleri

Kitchin, R., Cardullo, P., & Di Feliciantonio, C. (2019). Citizenship, Justice, and the Right to the Smart City. In *The Right to the Smart City* (1-24). Emerald Publishing.

Kocalar, A. C. (2018) Akıllı ve Ekolojik Kentlerle Sürdürülebilir Kentsel Tasarım: Arazi Yönetim Sistemi (ABYS) ve Mülkiyet ve İmar Hakkı Aktarımı (MİHAM). *Social Sciences Studies Journal 4*(18), 1684-1697.

Konya Metropolitan Municipality (2018) *Akıllı Şehir Konya Uygulamaları.* Retrieved from http://www.konya.bel.tr/akillisehir/ Access Date: 26.05.2019

Köseoğlu, Ö., Demirci, Y. (2018). Smart Cities and Employing Innovative Technologies for Tackling Urban Policy Issues. *International Journal of Political Studies*, 4(2), 40-57.

Lombardi, P. L. (2011a). New Challenges in the Evaluation of Smart Cities. *Network Industries Quarerly*, 13(3), 8-10.

Lombardi, P. L., Giordano, S., Caragliu, A., Del Bo, C., Deakin, M., Nijkamp, P., Kourtit, K. (2011b). An Advanced Triple-Helix Network Model for Smart Cities Performance. *Research Memorandum*, (45).

Lombardi, P.L., Giordano, S., Farouh, H., Yousef, W. (2012). Modelling the Smart City Performance. *Innovation: The European Journal of Social Science Research*, 25(2), 137-149.

Meijer, A., Rodriguez Bolivar, M. P. (2015). Governing the Smart City: A Review of the Literature on Smart Urban Governance. *International Review of Administrative Sciences*, 82(2), 392-408.

Manville, C., Cochrane, G., Cave, J., Millard, J., Pederson, J. K., Thaarup, R. K., Wik, A. L., Wissner, M., Massink, R., & Kotterink, B. (2014). Mapping Smart Cities in the EU. European Parliament.

Ministry of Development. (2013a, April). *Bilgi Toplumu Stratejisinin Yenilenmesi Projesi – Bilgi ve İletişim Teknolojileri Desekli Yenilikçi Çözümler Ekseni Mevcut Durum Raporu* [Renewal of Information Society Project - Information and

Communication Technologies Supported Innovative Solutions Axis Current Status Report].

Ministry of Development. (2013b, May). *Bilgi Toplumu Stratejisinin Yenilenmesi Projesi – Bilgi ve İletişim Teknolojileri Desekli Yenilikçi Çözümler Ekseni, Küresel Eğilimler ve Ülke İncelemeleri Raporu* [Renewal of Information Society Project - Information and Communication Technologies Supported Innovative Solutions Axis, Global Trends and Country Reviews Report].

Ministry of Development. (2013c). *Onuncu Kalkınma Planı (2014-2018)* [10th Development Plan (2014-2018)]. Retrieved May 5, 2019 from http://www.sbb.gov.tr/wp-content/uploads/2018/11/Onuncu-Kalk%C4%B1nma-Plan%C4%B1-2014-2018.pdf

Ministry of Development. Information Society Department (2014, December). *2015-2018 Bilgi Toplumu Straejisi ve Eylem Planı* [2015-2018 Information Society Strategy and Action Plan].

Ministry of Environment and Urbanization. (2010). *Kentges Bütünleşik Kentsel Gelişme Stratejisi ve Eylem Planı 2010-2023* [Integrated Urban Development Strategy and Action Plan 2010-2023 – Kentges].

Ministry of Environment and Urbanization. (2017). *Kentges*. Retrieved June 6, 2019 from https://kentges.csb.gov.tr/

Ministry of Environment and Urbanization. (2019a). *Akıllı Şehirler Beyaz Bülteni* [Smart Cities White Paper].

Ministry of Environment and Urbanization. (2019b). *Akıllı Şehirler Bilgi Notu* (Unpublished government document). Directorate General of Geographic Information Services, Ankara.

Ministry of Environment and Urbanization. (2019c). *2019-2022 Ulusal Akıllı Şehirler Strateji ve Eylem Planı - Taslak* [2019-2022 National Smart Cities Strategy and Action Plan Draft]. (Unpublished government document). Directorate General of Geographic Information Services, Ankara.

Ministry of Foreign Affairs. (2019). *Turkey's Energy Profile and Strategy*. Retrieved June 5, 2019 from http://www.mfa.gov.tr/turkeys-energy-strategy.en.mfa

Ministry of Transport and Infrastructure, General Directorate of Communicaion. (2018). *Ulusal Akıllı Ulaşım Sistemleri Strateji Belgesi ve 2018-2020 Eylem Planı* [National Smart Transport Systems Strategy Document and 2018-2020 Action Plan].

Nam, T., Pardo, T. A. (2011). Conceptualizing Smart City with Dimensions of Technology, People and Institutions. *The Proceedings of the 12th Annual International Conference on Digital Government Research*. New York. 282-291.

Okaria, D., Suhardi, S., Kurniawan, N. B. (2017). Smart City Services: A Systematic Literature Review. *2017 International Conference on Information Technology Systems and Innovations* (ICITSI) (October 23-24, 2017). Bandung.

Ooredoo. (2015). *Lusail Smart City Guide*. Retrieved June 20, 2019 from http://www.lusail.com/wpcontent/File%20Store/LCAC/Guidelines%20For%20Developers/DGGRS/Lusail%20Smart%20City%20Guidelines.pdf

Örselli., E. (2018). Bir Kenti Geleceğe Taşıma ve Kent Alışkanlıklarını Değiştirme olarak Akıllı Kentler. In M. Mecek, B. Parlak, E. Atasoy (Eds.), *Kent Yönetiminde Yeni Yaklaşımlar ve Etkin Belediyecilik Uygulamaları* (pp. 1108-1118). Ankara, Turkey: Nobel Academic Press.

Örselli, E., & Akbay, C. (2019). Teknoloji ve Kent Yaşamında Dönüşüm: Akıllı Kentler. *Uluslararası Yönetim Akademisi Dergisi*, *2*(1), 228-241.

Rabari, C., & Storper, M. (2015). The Digital Skin of Cities: Urban Theory and Research in the Age of the Sensored and Metered City, Ubiquitous Computing and Big Data, *Economy and Society*, (8), 27-42.

Ruthlandt, R. W. S. (2018). The Governance of Smart Cities: A Systematic Literature Review. *Cities*, (81), 1-23.

Sağ, N. S. (2011). *Dönüşüme Bağlı Kentsel Gelişmenin Yönetilmesinde Bir Araç Olarak Akıllı Büyüme; Konya Kenti Örneği* (Unpublished Doctoral dissertation) Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Konya, Turkey.

Saunders, T., & Baeck, P. (2015). Rethinking smart cities from the ground up. *London: Nesta*.

Shapiro, J. M. (2006) Smart Cities: Quality of Life, Productivity, and the Growth Effects of Human Capital. *The Review of Economics and Statistics, 88*(2), 324-335.

Shelton, T., Zook, M., Wiig A. (2015). The 'Actual Existing Smart City'. *Cambridge Journal of Regions, Economy and Society 8*(1), 13-25.

Sınmaz, S. (2013). Yeni Gelişen Planlama Yaklaşımları Çerçevesinde Akıllı Yerleşme Kavramı ve Temel İlkeleri. *Megaron*, *8*(2), 76-86.

Shaw, J., & Graham, M. (2017). An Information Right to the City? Code, Content, Control, and the Urbanization of Information, *Antipode 49*(4), 907-927.

Smart Cities Council. (2013). *Smart Cities Readiness Guide*.

State Planning Organization. (2006a, July). *Bilgi Toplumu Stratejisi (2006-2010)* [2006-2010 Information Society Strategy].

State Planning Organization. (2006b, July). *Bilgi Toplumu Stratejisi, Eylem Planı (2006-2010)* [2006-2010 Information Society Strategy, Action Plan].

Tekir, A. (2017). Neleri daha İyi Yaparsak Öne Çıkabiliriz! 'Akıllı Şehirler'e Yolculuğumuz. [What shall we do better to stand out! Our Journey to 'Smart Cities'] *İTÜ Vakfı Dergisi* (77), 23-27.

Terzi, F., & Ocakçı, M. (2017). Kentlerin Geleceği: Akıllı Kentler [Future of Cities: Smart Cities]. *İTÜ Vakfı Dergisi* (77), 10-13.

TÜBİTAK (2003) *Ulusal Bilim ve Teknoloji Politikaları – 2003-2023 Strateji Belgesi, Vizyon 2023* [2003-2023 National Science and Technology Policies Strategy Paper – Vision 2023].

TÜBİTAK (2016) *Bilim ve Teknoloji Yüksek Kurulu 29. Toplantısı* [High Council of Science and Technology 29th Meeting], Vali Galip Demirel Ankara Vilayetler Evi, Ankara.

TÜİK (2018) *Population and Demography*. Retrieved May 5, 2019 from http://www.tuik.gov.tr/PreTablo.do?alt_id=1047

Uçar, A., Şemşit, S., & Negiz, N. (2017). Avrupa Birliği Akıllı Kent Uygulamaları ve Türkiye'deki Yansımaları [European Smart Cities Practices and Reflections in

Turkey.]. *Süleyman Demirel University Journal of Faculty of Economics & Administrative Sciences*, *22*.

Vanolo, A. (2013). Smartmentality: The Smart City as Disciplinary Strategy. *Urban Studies,* 51(5), 883-898.

Varol, Ç. (2017). *Sürdürülebilir Gelişmede Akıllı Kent Yaklaşımı: Ankara'daki Belediyelerin Uygulamaları* [Smart City Approach to Sustainable Development: Implementations of Municipalities in Ankara]. *Çağdaş Yerel Yönetimler,* 26(1), 43-58.

Viitanen, J., & Kingston, R. (2014). Smart Cities and Green Growth: Outsourcing Democratic and Environmental Resilience to the Global Technology Sector. *Environment and Planning*, (46), 803-819.

Willis, K. S. (2019). Whose Right to the Smart City? In *The Right to the Smart City* (27-41). Emerald Publishing.

Yılmaz, Ö. (2012). *Karayolu Ulaşımında Akıllı Ulaştırma Sistemleri* [Intelligent Transportation Systems in Highway Transportation] (Unpublished specialist's thesis). Ministry of Development, Information Society Department, Ankara, Turkey.

Yılmaz, Ö. (nd). (Unpublished government report). *Akıllı Kentler ve Bilgi Toplumu Straejisi* [Smart Cities and Information Society Technology]. Ministry of Development, Department of Information Technology, Ankara.

Zanella, A., & Vangelista, L. (2014). Internet of Things for Smart Cities. *IEE Internet of Things Journal, 1*(1), 22-32.

APPENDICES

A. List of Smart Cities in the World

Region	Cities
Asia	Bangalore (India), Chongqing (China), Doha (Qatar), Gangnam District – Seoul (Korea), Hong Kong, HwaSeong-Dong Tan (Korea), Hyderabad (India), Ichikawa (Japan), Jaipur – Rajasthan (India), Jia Ding (China), Seoul (Korea), Singapore, Suwon (Korea), Taipei (Taiwan), Taoyuan County (Taiwan), Tel Aviv (Israel), Tianjin (China), Yokosuka (Japan).
Africa	Cape Town (South Africa), Nelson Mandela Bay (South Africa)
Europe	Besançon (France), Birmingham (UK), Dundee – Scotland (UK), Eindhoven (Netherlands), Glasgow – Scotland (UK), Hammarby Sjostad (Sweden), Issy-les-Moulineaux (France), Karlskrona (Sweden), Malra (Malta), Manchester (UK), Reykjavik (Iceland), Sopron (Hungary), Stockholm (Sweden), Talinn (Esonia), Sunderland (UK), Trikala (Greece)
North America	US: Albany (New York), Ashland (Oregon), Arlington County (Virginia), Bettendorf (Iowa), Bristol (Virginia), Chattanooga (Tennessee), Cleveland (Ohio), Corpus Christi (Texas), Dakota Country (Minnesota), Danville (Virginia), Dublin (Ohio), Florida High Tech Corridor – LaGrange (Georgia), Northeast Ohio – Loma Linda (California), Riverside (California), San Francisco – Spokane (Washington), Westchester County (New York(, Winston-Salem (Carolina) Canada: Burlington (Ontario); Calgary (Alberta); Edmonton (Alberta), Fredericton (New Brunswick), Ottawa (Ontario), Quebec City (Quebec), Stratford (Ontario), Toronto (Ontario), Vancouver (British Colombia), Waterloo (Ontario), Western Valley (Nova Scotia), Windsor-Essex (Ontario), Winnipeg (Manitoba)
Middle/South America	Barceloneta (Puerto Rico), Curitiba, Parana (Brazil), Pirai (Brazil), Porto Alegre (Brazil)
Ocenia	Ballarat (Australia), Gold Coast City (Australia), Ipswich Queensland (Australia), State of Victoria (Australia), Whittlesea – Victoria (Australia)

B. 2019-2022 National Smart Cities Strategy and Action Plan List

1. A City-Specific Local Smart City Strategy and Roadmap will be prepared.
2. Smart City Maturity Development Programs and Guidance Mechanism will be prepared and implemented.
3. Smart City Index will be created by using Smart City Maturity Assessment Model and its sustainability will be provided.
4. 2019-2022 National Smart Cities Strategy and Action Plan will be implemented, monitored and evaluated.
5. Smart City Projects with High Public Value shall be developed to ensure effective planning, implementation and dissemination.
6. A holistic and planned investment environment will be provided for the efficient and efficient use of resources in smart city investments.
7. Financial encouraging and facilitating environment will be created in smart city transformation.
8. Smart City Technology Radar will be created.
9. Smart City Market Will Be Created.
10. National Smart City Governance Mechanism and Organization will be established; its operability and sustainability will be ensured.
11. Local Smart City Governance Mechanism and Organization will be established; its operability and sustainability will be ensured.
12. With the use of smart city solutions, urban services will be provided with service integrity.
13. Capacity of qualified human resources in the development and presentation of urban services will be increased.
14. Cooperation and coordination among smart city stakeholders will be ensured.
15. Maturity of smart city components will be increased.

15.1 Maturity of the Smart Governance component will be increased.

15.2 Maturity of the Smart Environmental component will be increased.

15.3 Maturity of the Smart Economy component will be increased.

15.4 Maturity of the Smart Energy component will be increased.

15.5 The Maturity of the Intelligent Human component will be increased.

15.6 Maturity of the Smart Transportation component will be increased.

15.7 Maturity of the Smart Structures component will be increased.

15.8 Maturity of the Smart Health component will be increased.

15.9 Disaster and Emergency Management component maturity will be increased.

15.10 Maturity of the Smart Security Component will be increased.

15.11 Maturity of Information and Communication Technologies component will be increased.

15.12 The Maturity of the Smart Space Management component will be increased.

15.13 The Maturity of the Geographic Information Systems component will be increased.

15.14 The Maturity of the Smart Infrastructure component will be increased.

16. Smart city terminology, smart city data dictionary, smart city interoperability model and reference architecture model will be created.

17. National smart city architecture and national smart city data sharing governance platform will be developed, and its operability and sustainability will be ensured.

18. Local smart city architecture and data sharing platforms will be established; its operability and sustainability will be ensured.

19. National and local intelligent city open data platforms will be established; its operability and sustainability will be ensured.

20. Service delivery channels will be improved and diversified to expand the use of urban services using smart city solution.

21. Promotional channels for smart city solution used urban services will be diversified.

22. Environments that will enable the transformation of city dwellers to smart city solution producers will be created.

23. Smart city information security governance mechanism and organization will be established.
24. Protection of personal data created and used within the scope of smart city shall be ensured.
25. Participation of users on the use of smart city solutions in the development and improvement of urban services will be increased.
26. Urban regeneration and urban development areas will be evaluated as smart regions.