

AN EVALUATION OF THE SMART CITY APPROACH

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Approval of the thesis:

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## **ABSTRACT**

### **AN EVALUATION OF THE SMART CITY APPROACH**

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Contemporary cities challenge with complex problems. Different aspects of problems can be listed like ecological, demographical, economical or spatial. These problems require smart solutions. Increasing population and urbanization also force us to develop intelligent approaches to create economically, socially and environmentally sustainable cities.

It's important that local authorities and planners have to have precise data to take actions against day to day urban problems. Collecting data and turning them in a knowledge are valuable for taking decisions and formulating urban policies. ICT technologies help spatial planners and decision-makers for collecting data and using them for taking agile and smart decisions. These smart solutions can be applied to different domains of cities.

This thesis aims at elaborating the smart city concept and its potentials for solving complex urban challenges. A general analysis of world examples and a more profound analysis of a case study, namely Singapore Intelligent Island, have helped understanding the principles and criteria for attaining smartness in cities. The inferences from these analyses can provide a basis for the Turkish context. There are certain policies driven by Ministry of Environment and Urbanism in Turkey. Strategic action plans and legislative regulations can be a base for smart solutions for Turkish context.

## ÖZ

### AKILLI KENT YAKLAŞIMI ÜZERİNE BİR DEĞERLENDİRME

Karadağ, Tunç

Yüksek Lisans, Şehir Planlama Bölümü

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Kentlerimiz kompleks problemlerle karşı karşıyalar. Sorunlar; ekolojik, demografik, ekonomik veya mekansal gibi farklı boyutları ile sıralanabilir. Bu problemler akıllı çözümler gerektirir.

Nüfusun ve kentleşmenin artması, bizi ekonomik, sosyal ve çevresel açıdan sürdürülebilir kentler yaratmak için akıllı yaklaşımlar geliştirmeye zorluyor. Yerel yönetimlerin ve kent plancılarının kentsel problemlere karşı aksiyon alabilmeleri için kesin verilere ihtiyaçları vardır.

Bilgi ve iletişim teknolojileri, onlara bu verileri toplamaları ve bunları kullanarak hızlı ve akıllı karar almalarında yardımcı olur. Bu akıllı çözümler şehirlerde farklı alanlara uygulanabilir. Bu tezin amacı,akıllı kent kavramını ve kompleks kentsel sorunların çözümünde barındırdığı potansiyelleri incelemektir. Bir akıllı kent örneği olarak Singapur incelendi. Türkiyede, Çevre ve Şehircilik Bakanlığı belli politikaların yürütücüsü durumundadır. Stratejik aksiyon planları ve kanuni düzenlemeler Türkiye örneğinde akıllı çözümler için bir zemin oluşturabilir.

*To my family*

*Selin Karadağ, Sibel Karadağ, and to my mother Nesrin Karadağ*

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# **CHAPTER 1**

## **INTRODUCTION**

### **1.1. Background**

Increase in population and scarcity of resources are getting crucial issues in our global agenda. Rural population is also agglomerates in urban areas. Today more than 50% of the world population lives in cities.

Our cities are economically, politically, technologically and operationally, main scene of our global world. Beside their key roles, cities face distinctive challenges. Preventing brain migration, giving adequate healthcare services, reducing bureaucratic costs, solving transportation problems, investing communication infrastructure, maintaining effectiveness of water and energy systems, ensuring environmental sustainability are major challenges that cities have to deal.

### **1.2. Smart City and its domains**

We can define Smart City as services and infrastructures that are supported by using information and communication technologies. The amalgamation of conventional city services and infrastructures with ITC based technological advancements and applications, smart city operations become more effective, agile, flexible and sustainable.

In the transformation process of smartness, cities adopt new technologies to their core systems to maintain effective use of limited resources.

Smartness or intelligence can be defined as the ability to use the information and turn them into knowledge by the help of information and communications technologies.

Smart city transformation requires an integrated framework based on existing social, economic, organizational and competitive assets of city. Developing and operating a strategic framework helps for effective urban planning and efficient allocation of limited sources. Smart city approach can be divided in to 6 core domains that carry smart services. These are smart economy, smart people, smart governance, smart mobility, smart environment and smart living.

### **1.3. World Example**

Singapore is one of the leading city that applies ICT strategies and smart policies in urban area extensively. The government set a vision of an Intelligent Island in 1992. IT education, IT infrastructure and IT economy are the three pillars of the Singapore IT strategy. With an iterative master plans, Singapore turned in a hub for international trade, transportation and technology.

### **1.4 Turkish Context**

Population and urbanization trends force Turkish authorities for preparing strategic plans and regulations. There are certain policies driven by Ministry of Environment and City Planning in Turkey. Strategic action plans and legislative regulations can be a base for smart solutions for Turkish context. Urban Development Strategy and Action Plan that targeting 2023 is the leading study for Turkey.



## CHAPTER 2

### SMART CITY APPROACH

#### 2.1. “Smartness” as a Concept

The terms “smartness” or “intelligence” usually represent an individual mental ability. *Human intelligence* has some key specifications like perception, communication, learning, memory and planning. *Artificial intelligence* is the study of intelligent components that perceive their environment and make right decisions. On the other hand, *collective intelligence* is the intellectual cooperation of community in order to create, innovate, exchange knowledge, learn and invent. Combination of human, artificial and collective intelligence creates smart environments (Mitchell 2008).

From another perspective, “smartness” is the amalgamation of different components that are working together, taking quick actions and making efficient decisions. Each component has its own capability of monitoring certain situations, generate data, work autonomous or collaboratively.

Additionally we can list different capabilities like attention, memory, producing, understanding, learning, reasoning, problem solving, decision making. These mental processes constitute *cognition*. When translated to the urban sphere, smartness is a combination of components that create informational and cognitive processes *spatially*. Similar to the mental one, the processes related with “urban smartness” can be stated as information gathering, data evaluation, real-time monitoring, future estimations, learning, collective intelligence and cooperative problem solving.

Collective smartness is an important aspect of smart cities because it supports creative human capital, learning, technological development and citizen participation. In recent years, with the help of ICT, social media has become a hub for agglomeration of collective intelligence, collaboration that supported by internet and different forms of participation opportunities (Kominos, 2008).

Apart from cognitive and collective smartness, with the rise of ICT, a new aspect of smartness emerges bringing new forms of interfaces to the citizens and enabling Cloud Services<sup>1</sup>, the use of probes like smart cell phones, smart meters, interconnected sensor webs and RFIDs<sup>2</sup>.

---

<sup>1</sup> **Cloud Services** is a general term that includes delivering services over internet. It can be stated as a next phase of internet. The cloud can be defined as a group of devices, networks, software, services and storage that are connected.

<sup>2</sup> **Radio Frequency Identification (RFID)** is a technology which helps automatic recognition of objects or people by wireless devices, called RFID readers.



Figure 1 - Cloud Services (istockphoto.com)

With the help of these new precise data collection channels, taking quick actions and making efficient decisions become possible.

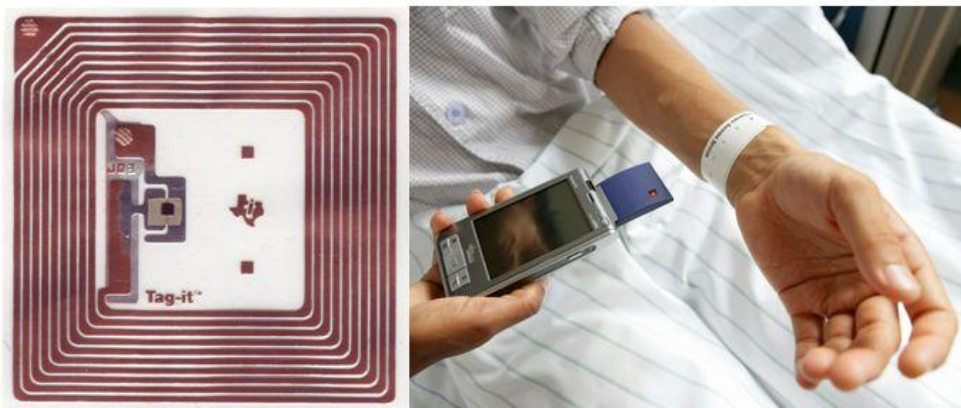


Figure 2 - RFID Technology and RFID augments hospital processes<sup>3</sup> (Siemens)

The term "smart" has become a common term in urban policy making after the 2000s, referring to the intelligent use of information technologies (IT) to improve the productivity and efficiency of a city's infrastructure and services (Hodgkinson 2011, 2-3). Below are elaborated the descriptions and components of the "smart city" phenomenon.

<sup>3</sup> Radio bracelets can inform physicians of a patient's medical history almost instantly. An **RFID** (Radio Frequency Identification) chip stores the wearer's data, which can be accessed by a hand-held computer or laptop. Treatment and administrative procedures are made more transparent and economic through this technology; it also makes patient identification more reliable. RFID patient bracelets from Siemens are currently in use at the Saarbruecken Clinic and at the New York Jacobi Medical Center. (Siemens, 2007)



## 2.2. Smart City: An ICT - Based Approach

Ecological, demographically, economical or spatial problems require smarter solutions in the face of the ever networking society. With the increase in population and rapid urbanization, we need smart approaches that help us to create economically, socially and environmentally sustainable cities.

We can define Smart City where services and infrastructure are provided by using information and communication technologies.

These new systems maintain smart city operations more effective, agile, flexible, sustainable (Gonzales and Rossi 2011, 9). Smart services transform the city and its inhabitants technologically, governmentally, economically and socially.

The term “Smart City” has not been defined recently. The term generated from “Smart Growth” movement at the end of the 1990s, which supports new policies for urban planning (Harrison and Donnelly 2011, 2-4).

According to Smart Growth approach, development decisions effect on our health, schools, taxes, traffic, environment, economic growth, fairness, opportunities, house prices, safety of neighborhoods. In other words, development decisions effect on anything ranging from our personal life to our communities and nations. In order to overcome the side effects of development, smart growth strategies can help to maintain and develop attractive, convenient, safe and healthy city environments.

These strategies support social, civic and physical activities, protect environment, create choices for residents (Emerine 2006, 1-2).

Certain smart growth principles are:

- Mix land use
- Take advantage of compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas
- Strengthen and direct development towards existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair and cost effective
- Encourage community and stakeholder collaboration in development decisions

The term was re-coined again during the mid-2000s by some technology companies like IBM, Cisco and Siemens in order to integrate information systems into the urban infrastructures and services. These infrastructures and services can be listed as buildings, transportation systems, electric, water and sewage infrastructures, security, health and public safety. Later, Smart Growth approach has given way to Smart City approach, which relies on ICT based advancements in planning, development, operation and sustainability of urban services and facilities (Harrison 2011, 2-3).

Besides the ICT-related conveniences that make the Smart City an increasingly popular approach, the growing interest towards this approach can also be linked to the ability of Smart City to take part in the interurban competition game.

Multi-national economic activities brought an interurban competition after the 1980s. This competition diversified cities and some cities are called as world cities. The advances in communication and transportation technologies have enabled easy circulation of finance, knowledge and skilled labor. World cities use these technological advancements in order to spread out their economic activities into international market places (Gedikli, 2001).

What has been added to this ongoing interurban competition during the 2008 economic crisis is that, cities have started to compete also for the Generation Y and Generation Z people who will be the developers of new economic strength of their cities (Francese P., 2003).

Generation Y people were born between the years 1983 - 2000. They are also called as Echo Boomers or Millennial Generation. The term "Generation Y" was first appeared in 1993 on a magazine named Advertising Age to describe teenagers. Millennial's characteristics change from region to region, depending on social and economic conditions. But their general characteristics are the usage and familiarity with internet, communication, multi-media, and digital technologies (Deresiewicz, W., 2011, 1-4).

Generation Z is a common name of people who were born between the years 1989 – 2010. They are also called as iGeneration, NetGeneration or Internet Generation. While Generation Y, born in the 1980s and early 1990s, experienced the transformation of analog technologies into digital; Generation Z did not have a chance to see the era before the widespread use of mobile phones and internet (Grail Research 2011, 2-9).

Generation Y were born at the beginning of Digital Revolution, but Generation Z is the first generation that can be entitled as a "native" to the era of social networking and high speed internet.

As it is shown in Graph 1, usage of internet and mobile technologies by generations increase drastically each year. Generation Z is highly connected and many of them are online everyday by use of ICT & other media devices such as the World Wide Web (www), instant messaging (sms), mp3 players, mobile phones, YouTube, Facebook and the like. That is why they are called "Digital Natives". They are not dependent on home computers, but they access to the internet by their mobile phones instantly and stay online continuously (Schmidt, L. and Hawkins, P., 2008).

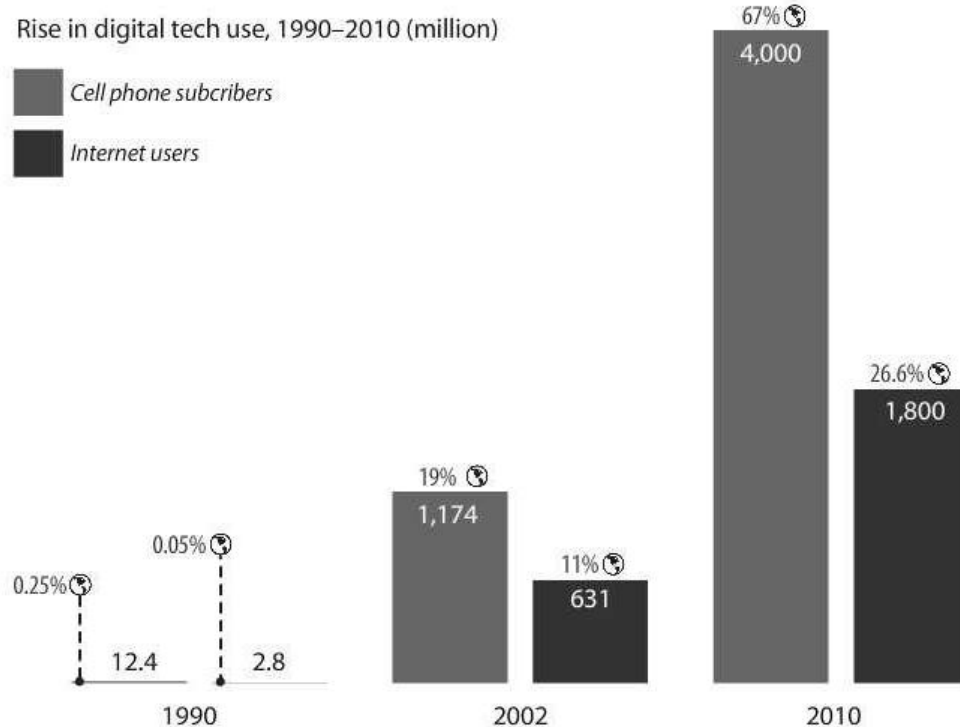


Figure 3 - Internet And Cell Phone Users Between 1990-2010 (University of Sheffield)

What differentiates the above-mentioned generations is that Generation Y is characterized as optimistic, tech-comfortable, style conscious and brand royal; while Generation Z is characterized as proficient in the use of technology, globally connected, flexible, smarter and tolerant of diverse cultures.

Cities want to attract these younger members of what is also called as the *Creative Class* for their own branding or image, but more importantly for their economic growth. While globalization has created an interconnected world, this interconnectedness is still concentrated in a relatively small number of cities and regions. For a city, to become “smart”, it has to attract Generation Y and Z people (Grail Research, 2011). It should be a digital city to match these Internet Natives’ experience. It should offer public wireless network access.

The contemporary era requires that the city should interact with its citizen through instant access, digital interfaces rather than offices with long queues, paper forms and bureaucracy.

While these new creative classes are the fuel of economic development of smart cities, they want to contribute their energy and ideas in organizations quickly. Generation Z are the workforce, intellectual capital and sources of innovation for smart cities. Waiting their turn in a line and wasting time is completely unusual to them.

Governments have to develop new agile forms of interfaces and connectivity for delivering services like education, access to healthcare or employment. The benefit behind this effort is the capturing Generation Y and Z’s creativity and entrepreneurship.

### 2.3. How "Smartness" Associates with the "City"

*What makes a city smart, and how does this feature differentiate from green, eco, digital, wireless and zero-carbon cities in current urban conversations?*

*If an eco-city is often defined as an urban site focused on pioneering sustainability by using strategic planning and smart technologies, how comes it isn't actually a smart city? (Ted Talks, 2012)*

A century ago, there were less than 20 cities around the world with population sizes of more than 1 million people. In the 18<sup>th</sup> century, less than 5% of the global population lived in a city and the vast majority of people were engaged in simply generating enough food to live (UN Demographic Yearbook 2011, 368-383; IBM 2010, 1-2). In 1955, the share of urban population reached to 30% of the total population (2.75 billion) of the world.



Figure 4 - Major Cities of the World- 1955 (UN DESA)

Today more than 50% of the population lives in a city and this ratio is rising. By the end of this century, 80% of the population will be living in cities. Meanwhile, number of big cities which have more than 1 million urban population has reached to 450 and will continue to increase in the near future (BBC Urban Growth Map).

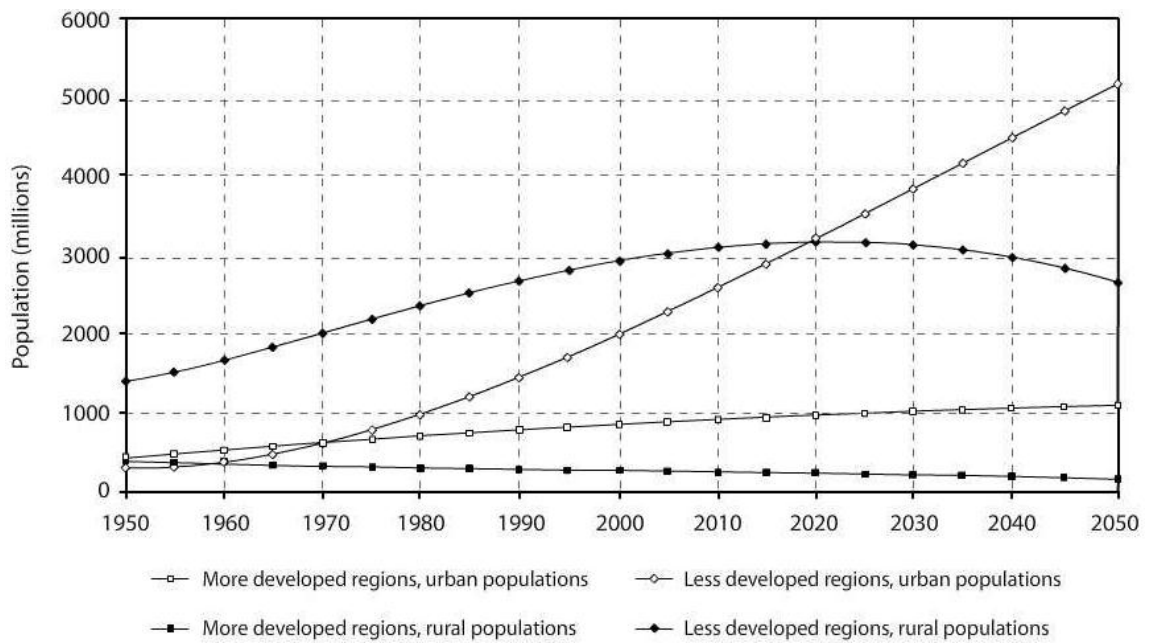


Figure 5 -Urban and Rural Population by Development Group, 1950-2050 (UN, World Urbanization Prospects)

As Wellington E. Webb, the former Mayor of Denver, previously said

*"The 19th century was a century of empires, 20th century was a century of nation states and the 21st century will be a century of cities".*

(IBM 2009, 12)

Cities are gaining more *economic power*, developing greater *political* influence and increasingly employing more advanced *technological* capabilities to enhance their *operations*.



Figure 6 - Major Cities of the World - 2015 (UN DESA)

*Economically*, cities have turned into agglomeration centers for global services. By becoming such centers, cities attract human and physical capital.

*Politically*, governance systems around the world are changing from national scale into local scale. This requires multi-level administration but gives cities greater freedom. Cities also gain greater legal and financial powers.

*Technologically*, they can monitor and control their operations and development projects precisely, successfully and frequently.

*Operationally*, cities are based on systems which serve to the areas like infrastructures, networks and environments. They have directly related with *people, business, transport, communication, water and energy*. The effectiveness and efficiency of these systems show to what extent the city is self-sufficient. As I have mentioned at the definition of “smartness”, these systems work autonomously or collaboratively. Below table shows the content of the mentioned systems:

Table 1 – City's Core Systems (Vienna University of Technology)

<b>System</b>	<b>Definition</b>	<b>Content</b>
<b>People Systems</b>	Focus on citizens and social groups	Public safety, disaster affairs, health care, education, lifetime learning
<b>Business Systems</b>	Covers regulations and policies related with trade and business life	Legislative and administrative regulations about national and international trade, investment, labor markets, product markets and intellectual properties.
<b>Operational Systems</b>	Involve transport system which includes different modes, public transport network, harbors and airports.	It covers administrative, legislative and financial provisions.
<b>Communication Systems</b>	Includes telecommunication infrastructures, like telephony mesh, broadband and wireless systems.	Mobile Systems, sms, web based applications, Interactive Voice Response (IVR), open wireless networks
<b>Water System</b>	Includes water systems, reserves, refinement, storage and sanitation.	Capacity management, Water basin management, quality control and regulations. Efficiency and leakage issues
<b>Energy System</b>	Include power supply and transmission networks.	Grid systems, Energy efficiency, smart power meters, renewable energy, decentralized energy production

These core systems ideally have to work collaboratively in order to gain efficiency. In a holistic manner, these systems work together and create a **“system of systems.”**

## **2.4. Major Problems Related to the Core Systems of Cities**

Cities are the agglomeration centers for services, regulations, economic activities, technological innovations and investments, population, culture, intellectual capital, social capital, infrastructures etc. In previous section, we grouped these areas under the system of systems.

Beside their key roles in cities, each component of the “system of systems” has its distinctive challenges. Smart city approach can supports sustainable development and brings solutions for diverse problems of development and competition. Before dealing with smart city framework, we can look at to some different aspects of challenges related with development.

### **2.4.1. Brain Migration**

The cities of the developed countries face the challenge of population decrease. These cities have to implement new action plans to stay competitive and attractive for creative and skilled inhabitants. Meanwhile, in cities' of developing countries, while population is increasing, there is a harsh competition because of brain migration. Cities with advanced communication technologies have an advantage upon others as they are capable of attracting creative people.

### **2.4.2. Healthcare**

Cities also have struggle in their healthcare systems because of increasing population. Migration of people from rural to urban areas or from one country to another one can create risk of disease.



Figure 7 - Slums (Favelas) - Domenico Marchi 2007



Overcrowded residential areas like slums can create infectious diseases. Other negative effects of urban life are emotional stress, weakened family structure, and environmental pollution affect people. There are also infant mortality, hiv/aids pandemic, protracted treatments and maintenance problems of financial operations can be seen in healthcare systems.

### 2.4.3. Bureaucracy

In the bureaucracy side of city life, there are lots of complex regulatory and administrative processes that bother citizens. For the achievement of business systems and reducing administrative costs, local governments have to decrease bureaucracy.

Table 2 - Administrative costs by Member State in share of GDP (EU Commision)

Country	Spain	France	Greece	Hungary	Italy	Poland
Administrative costs of some countries in share of GDP	4.6	3.7	6.8	6.8	4.6	5.0

As it is stated in Table 2, due to inefficient administrative regulations, some economies pay up to 6.8 % of GDP.

Table 3 - GDP effects by 2025 of a 25% reduction in administrative costs (EU Commision)

Country	Spain	France	Greece	Hungary	Italy	Poland
GDP Effects of 25% reduction in administrative costs	1.7	1.4	2.4	2.6	1.7	1.9

According to Dutch Bureau for Economic Policy Analysis, reduction administrative costs by 25% like time spent filling out forms, could lead saving of up to 1.6 % of EU GDP<sup>4</sup> and up to 2.6% of some countries. (European Commission, Measuring administrative costs and reducing administrative burdens in the European Union, 2006)

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<sup>4</sup> GDP: Gross Domestic Product is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports.

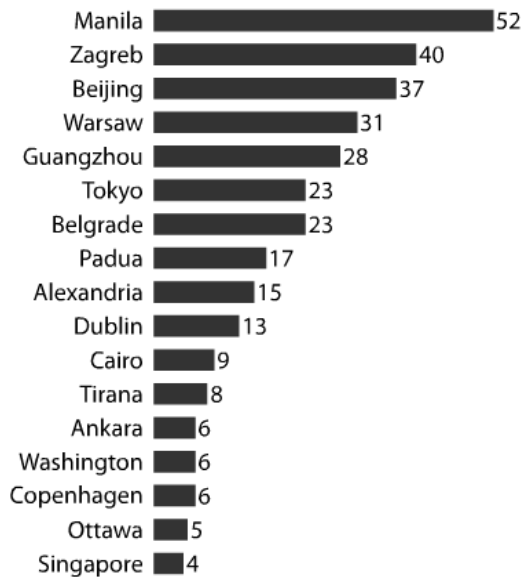


Figure 8- Number of days to start a business (World Bank 2013)

As Figure 8 shows, different cities require different number of days to establish business. If local governments want their cities to become politically and economically central at national or international scales, they have to reduce bureaucracy and maintain effectiveness for cities' business systems (Worldbank, 2013).

#### 2.4.4. Transportation Problems

Cities increasingly accumulate economic activities, structures, networks and these are connected by transportation systems. The management of this complex web is getting increasingly difficult.

Because of heavy traffic congestion, transportation costs are rising in local economies. Increase in population, tourism, global trade, and increasing quality of life create more passengers to be transferred and more products to be carried.

Demand for parking space is another problem related with transportation systems. Because of the physical limitations of central business districts, finding parking lots is getting difficult. Looking for a parking lot while driving in CBD is also creates additional traffic and time loss.

While cities are turning into metropolitan areas, distance between CBD (central business district) and residential areas getting higher. This leads to an increasing travel time. Everyday, people spending more time and fuel for commuting between offices and houses.

Without smart solutions most of the public transport systems are used with under or over capacity. In CBD, over capacity use of different transport nodes creates displeasure in citizens during peak hours. In suburban areas, inefficient use of public transport systems creates unsustainable operations. Public transportation services are not optimum solution for low density usage. It turns in to an expensive solution for scattered urban areas.

Traffic congestion and its economic side effects have the priority for municipalities. Municipalities tend to allocate more financial source and physical space into vehicle transportation. Pedestrian and bicycle based solutions are pushed to the background. The shift in the allocation of scarce urban space from public use as green open spaces in to vehicle transit systems has direct effects on quality of life. Urban pedestrian areas with social activities in large open spaces and opportunity of social interaction between citizens being replaced with increased traffic and accelerated flow.

Traffic congestion is also an issue for environmental protection. Pollution created by traffic effects quality of life. Also energy consumption requires alternative solution like efficient public transportation solutions. Traffic accidents are another aspect of transportation problems. It causes financial loss, time cost, fatality.

#### 2.4.5. Communication

With the increasing population and technological improvements, there is an excessive demand occurred for communication and connectivity. In 1985, the “internet” has come into the picture. Number of internet users has grown by almost 350% since 2000 (Ogden 2012).

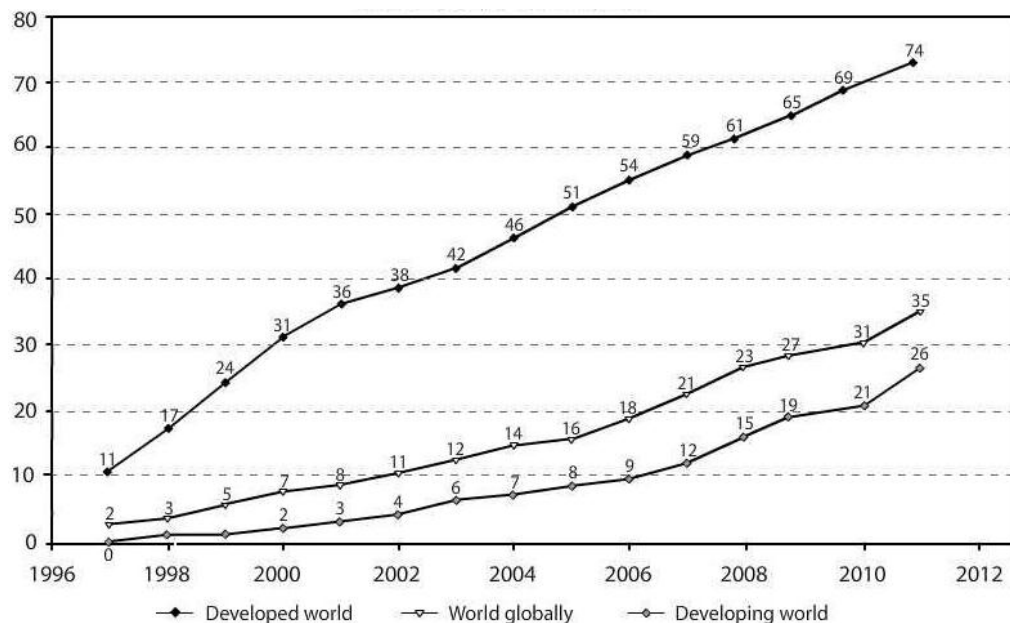


Figure 9 - Internet Users per 100 Inhabitants (ITU, 2012)

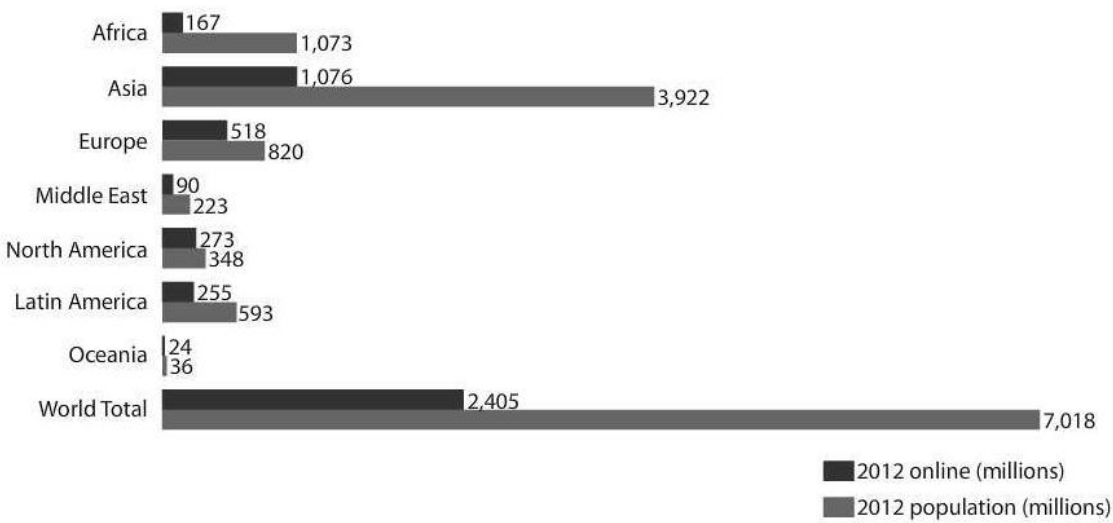


Figure 10 - World Internet Users and Population Statistics (Akamai, 2011)

In 2012, average speeds for those with broadband<sup>5</sup> varied from 44 megabits per second in Asia to 1.1 megabits<sup>6</sup> per second in Africa. As the citizens of Tokyo and Yokohama prepare for gigabit<sup>7</sup> per second connectivity, city managers must begin planning for a terabit<sup>8</sup> world (Netindex, 2013, Akamai, 2011).

Communication systems interconnect citizens, companies and governmental bodies like a nervous system. By the help of mobile technologies and internet connectivity, citizens and companies demand communication services without any location and time limitations.

Rapid urbanization and increased population create an excessive demand which brings a necessity for new ICT infrastructure investments. Without these investments, broadband connectivity and data flow between different nodes of city possibly be interrupted which slow down economic activities, negatively effects financial services, decrease quality of life and more importantly reduce the effectiveness of city core systems' operations.

#### 2.4.6. Water

Problems with water efficiency, leakage and quality are critical for local governments. Water is the vital service for urban life. Water system is sensitive to economic and demographic development of cities. Increasing population creates increased demand for water.

<sup>5</sup> **Broadband** is defined as a high bandwidth connection to the Internet.. International Telegraph and Telephone Consultative Committee (CCITT) defined broadband service in 1988 as 1.5 to 2 Mbit/s transmission capability.

<sup>6</sup> **Megabit** is one million bits (bit: smallest unit of data in a computer known as 0&1) in data communication.

<sup>7</sup> **Gigabit** is one billion in data communication. It's commonly used for measuring the amount of data that is transferred in a second between two telecommunication points.

<sup>8</sup> **Terabit** is one trillion bits in measuring data transmission speed.

Today, cities consume 60% of all water allocated for human use. In water system, one of the problems is leakage which reaches up to 60% of water supplied, costs US\$14 billion/year worldwide. (World Bank Water Supply & Sanitation Sector Board, NRW Report, 2006)

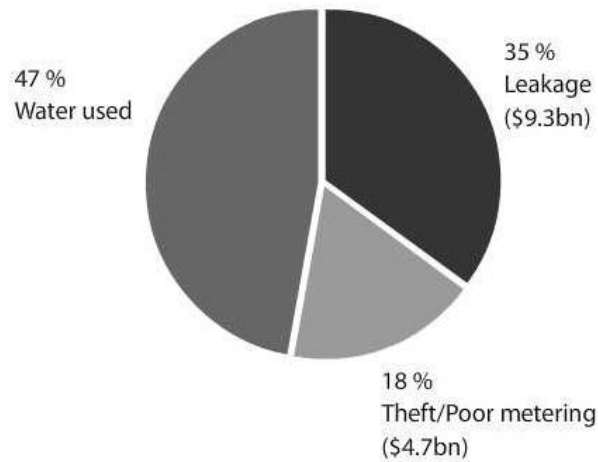


Figure 11 - Usage of global water supplies and estimated costs (IBM, 2009)

In 2009, 2.8 billion people (44% of the world's population) live in areas where the water supply is insufficient. It is estimated that this picture will turn to worse, up to 4 billion by 2030 (World Economic Forum Water Initiative, 2009, p 10).

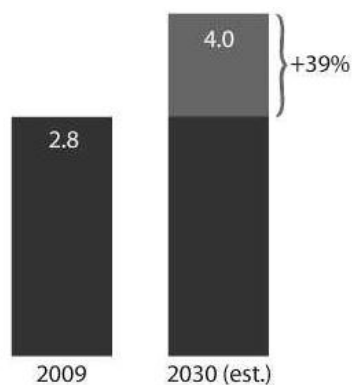


Figure 12 - Global population in high water stress areas (billions) (IBM, 2009)

Globally, water shortages slow down the economic growth, creates pressure on food prices. Growing number of population and economic development of citizens effects water usage. Increase in the number of residences, changed and diversified daily usage of water in middle classes, footprint of water on the production of commodities effect water shortage

Business and energy related water usage will be an important issue in near future especially for developed countries. Average water footprint of one pizza margherita (725 gram) is 1,260 liters of water. The production of 1 kg of milk requires 1,020 liters water. Average water footprint of 1 cup of coffee is 130 liters of water. Meanwhile, 39,000 gallons of water is required to make a car (Arjen, Ashok, Chapagain, 2011).

#### 2.4.7. Global Warming

Global warming is overall rising of atmosphere's and oceans' temperatures. One of the main causes of temperature change is greenhouse gases. Major greenhouse gases are water vapor, carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ) and ozone ( $\text{O}_3$ ). Urbanization and industrialization increase greenhouse gases. Global emissions of  $\text{CO}_2$  increased more than 45% between 1990 and 2010, driven largely by the growth of cities (IBM 2009, 7).

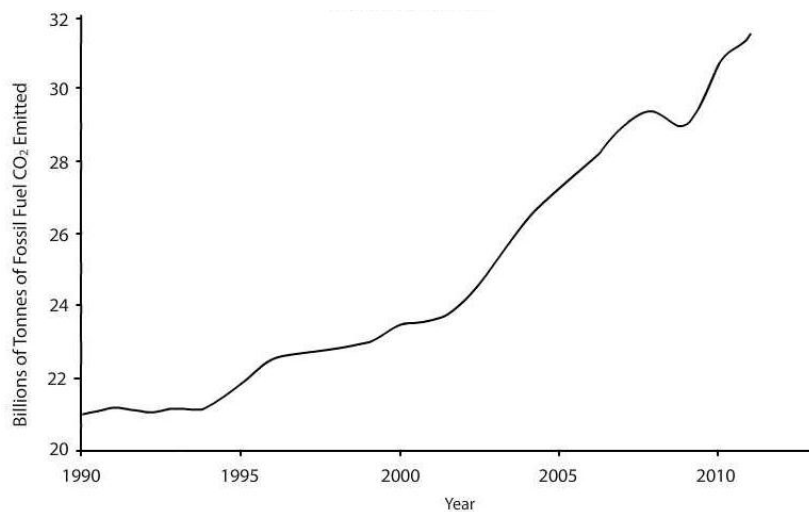


Figure 13 - CO<sub>2</sub> Emission per year (International Energy Agency-IEA 2012)

Cities emit large portion of CO<sub>2</sub>, but they are also the center of economic development and technological improvements. Transportation system is one of the main consumer of energy and an emitter of CO<sub>2</sub>. Transportation and buildings creates 25 % of total CO<sub>2</sub> emissions (IEA 2009-2010).

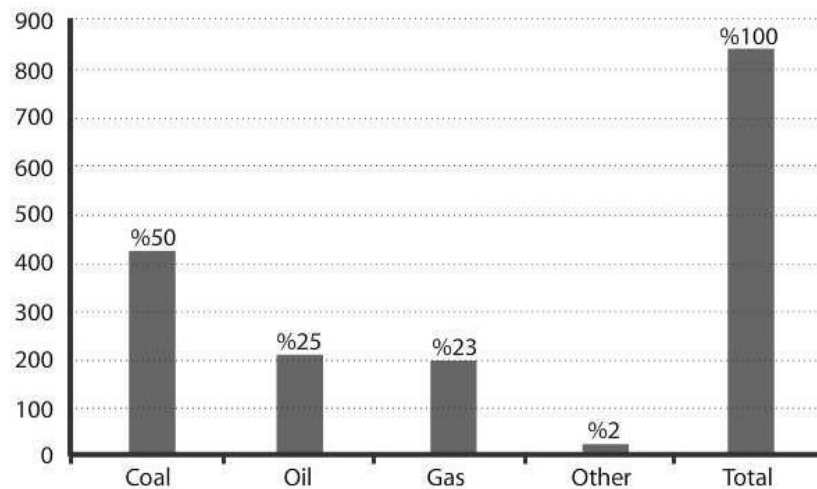


Figure 14 - Global CO<sub>2</sub> emission in Non-Annex<sup>9</sup> countries (IEA 2009-2010)

So globally, cities should assume significant roles to control and reduce greenhouse gas emission. Local authorities and city policy-makers are under pressure to prepare regulations, maintain environmental sustainability and decrease greenhouse gas emissions.

Cities take this environmental issue into account increasingly. For example, Europe 2020 Initiative, which covers 400 European cities, works on strategic plan to maintain smart, sustainable economic development. One of the main targets is about climate change and energy issues. By 2020, European Union aims to reduce greenhouse gas emissions 20% that is lower than 1990, increase 20% of energy usage from renewable sources and increase the energy efficiency by 20% (IEA 2009-2010).

#### 2.4.8. Evaluation On the Problems Of Core Systems

Cities have to provide a healthy, civilized and safe living environment for their residents. They also try to attract business and investment in order to become a competitive actor of the global economy. Creative people, social and intellectual capital are important assets for cities. Competition and technological advancements simplify brain migration between cities. Without preserving these assets, sustainability of innovation and development of a city is not possible.

Ideally, urban population should be healthy and have better access healthcare services more than rural settlers. While population increases excessively, public safety and healthcare issues have to be taken in to account under the people system by local governments.

Because scale and proximity advantage of cities can be turn in to a disadvantage by creating an environment that is suitable for infections and chronic diseases. From the business system perspective, regulations and processes must be simplified by government. Reducing bureaucracy and administrative costs requires integrated solutions which directly foster economic development.

<sup>9</sup> Non-Annex Countries: Countries that are not signed United Nations Framework Convention on Climate Change. They are mostly low-income developing countries.

Excessive urbanization creates different urban transportation problems. Traffic congestion, limited parking lots in CBDs, increased travel times, capacity issues, loss of urban lands for creating roads, air pollution are the major problems of transportation.

If local authorities did not interfere to these problems, they affect other core systems of cities like economic activities under business systems or health care problems in people systems.

Urbanization and technological advancements created an environment for the development of ICT based communication. Connectivity is an important aspect of urban life. All city systems are based on ICT networks.

Insufficient ICT networks can create various problems and interruptions can be seen in city systems. Insufficiency of an ICT network can be resulted from excessive connection request that creates lags,

Similar to ICT networks, water systems can become insufficient with the increased population and urbanization. Water systems are the crucial services for cities and they have direct relation with production, healthcare, energy and quality of everyday life.

Green house gases are the main reason behind global warming. Our cities produce heat, air pollution - CO<sub>2</sub>, methane and ozone gases. Industrialization and urban development trigger the emission of these gases. Reducing greenhouse gas emission is one of the major challenges of city authorities.

All these problems stated above are complex, diversified and solutions related with core city systems require comprehensive efforts. Common ground of these problems is based on efficient use of scarce resources. Smart city operations bring efficiency oriented approaches. To deliver and establish smart services, cities must focus on to the core systems and make them more efficient, effective and smart.

## **2.5. Components of the Smart City Framework**

The term “Smart City” cannot be used for describing a city as a whole. But it can be used to discuss its different dimensions like its citizens, environments, economy, governance, communication or transportation. Wide range of urban activities can be related with the Smart City like industry, education, participation, technical infrastructure, etc.

We can discuss Smart City by means of “smart industry” which covers issues and areas like ICT usage in production process, relation of local and global economies, labor markets, technoparks. The term Smart City is also related with the education of its citizens. A Smart City has to have smart inhabitants in terms of their education. Smart City includes strong relation between the city administration and its citizens. Competency in governance is an important aspect of a smart administration which has direct relation with the usage of new channels of communication with the citizens, like e-government services.

Another usage of “Smart City” takes place in the association of modern technology with everyday urban life. This may include different ICT solutions and modern transport technologies. Logistics as transport systems can be formalized in a “smart” way which improves traffic and mobility by means of vehicles and pedestrians. Moreover different other terms can be associated with Smart City and solutions in urban life, like public safety, security, environmental protection, environmental sustainability and energy (Vienna Univ. of Tech. – Centre of Regional Science 2007, 10-11; Boyd Cohen 2012).



The report published by the Centre of Regional Science at Vienna University of Technology (2007) describes Smart City with six core domains and their sub-domains:

Smart Economy	Smart People
Smart Governance	Smart Mobility
Smart Environment	Smart Living

Figure 15 - Six Core Domains of a Smart City (Source: Vienna Univ. of Tech – Centre of Regional Science 2007, 12)

To describe a smart city and its core domains it is necessary to list the sub-domains as well. There are 33 sub-domains chosen to describe the 6 core characteristics of smart city.

<b>Smart Economy (<i>Competitiveness</i>)</b> <ul style="list-style-type: none"> <li>· Innovative spirit</li> <li>· Entrepreneurship</li> <li>· Economic image and trademarks</li> <li>· Productivity</li> <li>· Flexibility of labour market</li> <li>· International embeddedness</li> <li>· Ability to transform</li> </ul>	<b>Smart People (<i>Social &amp; Human Capital</i>)</b> <ul style="list-style-type: none"> <li>· Level of qualification</li> <li>· Affinity to life long learning</li> <li>· Social and ethnic plurality</li> <li>· Flexibility</li> <li>· Creativity</li> <li>· Cosmopolitanism / Openmindedness</li> <li>· Participation in public life</li> </ul>
<b>Smart Governance (<i>Participation</i>)</b> <ul style="list-style-type: none"> <li>· Participation in decision-making</li> <li>· Public and social services</li> <li>· Transparent governance</li> <li>· Political strategies and perspectives</li> </ul>	<b>Smart Mobility (<i>Transport &amp; ICT</i>)</b> <ul style="list-style-type: none"> <li>· Local accessibility</li> <li>· (Inter-)national accessibility</li> <li>· Availability of ICT-infrastructure</li> <li>· Sustainable, innovative and safe transport systems</li> </ul>
<b>Smart Environment (<i>Natural Resources</i>)</b> <ul style="list-style-type: none"> <li>· Attractivity of natural conditions</li> <li>· Pollution</li> <li>· Environmental protection</li> <li>· Sustainable resource management</li> </ul>	<b>Smart Living (<i>Quality of Life</i>)</b> <ul style="list-style-type: none"> <li>· Cultural facilities</li> <li>· Health conditions</li> <li>· Individual safety</li> <li>· Housing quality</li> <li>· Education facilities</li> <li>· Touristic attractivity</li> <li>· Social cohesion</li> </ul>

Figure 16 - Core and Sub-Domains of a Smart City (Source: Vienna Univ. of Tech – Centre of Regional Science 2007, 12)

Technology has an important role in being a smart city. The use of ICT transforms cities in significant ways. An information and communication infrastructure is necessary but not enough to become a smart city. IT infrastructure and applications are primary components, but without collaboration and cooperation between local governments, public and private actors, NGOs, schools, social groups and citizens, smart city operations can not be succeeded.

Amalgamation of technological developments and ICT creates innovative solutions in resource allocation, management and monitoring in city's system of systems. Also cities may perform innovative actions for achieving targets like reduced carbon emission, increased quality of life, smart grid systems, increased renewable energy usage.

An integrated hardware, software and network technologies that provide ICT systems with real-time monitoring and analytics help city administrations and citizens to make more intelligent decisions.

**Smart Economy** includes competition, simplified and supported entrepreneurship, productivity, creativity, innovation and labor market flexibility and connection to local and international markets.

**Smart People** is related with qualification of individuals and education level of the citizens. It also related by the quality of social interaction of people and integration with entire community with enriched public relations and global interconnectivity.

**Smart Governance** includes citizen participation, services that facilitate participation process for citizens, cooperation between local administration and non-governmental organizations (NGO).

**Smart Mobility** covers local and international accessibility, access to ICT and modern transport systems.

**Smart Environment** can be described as preserved natural urban environments (passive urban green areas, weather quality, parks, reduced noise pollution, etc.), waste management, resource management and other environmental protection operations.

Finally, **Smart Living** covers several aspects of quality of life such as culture, health, safety, housing, tourism, energy, etc (Vienna Univ. of Tech – Centre of Regional Science 2007, 11-12).

## 2.6. How to make the city a "smart" one: Process

So as to become smart, cities must use new technologies to transform their core systems to optimize the use of limited resources. The opportunity presented by smart cities is the opportunity of sustainable welfare.

*New technologies provide a much greater scope for instrumentation, interconnection and intelligence of a city's core systems.* (IBM, 2009)

Instrumentation means the digitalization of a conventional system. Interconnection is that each part of city's systems can work collaboratively and the data provided separately can be evaluated holistically.

*The true sign of intelligence is not knowledge but imagination.*  
Albert Einstein

Intelligence is the *ability to use the information and turn them into knowledge* in order to use for action plans. A smart city uses technology to transform its core systems and resources effectively. Smart use of resources drives innovation, supports competitiveness and economic growth. Investment in smart city is also a source of sustainable employment. Each core system can be made smarter by making it digital which enables more informed and agile decision making (European Commission, 2010).

While cities deal with massive and complex phenomena and problems, authorities have to consider that these issues are interrelated. For example, information and communication infrastructure is vital for business and mobile investment. Business networks are closely integrated with transportation usage.

City's core systems are also interrelated and operate not in isolation but in an interconnected way. This association makes them "system of systems". Transportation, business and energy systems are closely interrelated. Connecting these systems will create greater value-added, greater efficiency and sustainability.

The connection of infrastructures like water and energy systems is another example of collaboration of systems. We use water to produce energy, and in order to collect, transport, treat and supply water we use energy. Improvements in the efficiency of water systems help to increase efficiency in the energy systems (Thirlwell 2007). Similarly scarcity in water systems will lead to greater use of the energy systems with increased costs. For example; with the scarcity of water, electricity production pass over to coal which is expensive and creates air pollution. These systems support each other for the persistence of service delivery.

One remarkable example of multiple city system integration is False Creek Energy Center in Vancouver.



Figure 17 - False Creek Energy Center (Vancouver NEU Report, 2010)

False Creek neighborhood community uses False Creek Energy Center for heating. Energy facility is connected with city's sewage system, and it uses sewage waste heat as a source of energy. Sewage heat is cost-effective when compared to other systems, because of its higher heat source temperatures and inexpensive installations costs.

The Neighborhood Energy Utility has three main parts. First part is False Creek Energy Center in which thermal energy is captured using a process integrated with sewage pump station. Thermal energy in sewage systems turns in to a form of heated water. The energy center gets most of its energy from sewage heat recovery. The energy centre building is designed as a facility to showcase the innovative use of sustainable technology (Crowe 2012). Second part is Pipe System. Insulated pipe system distributes hot water to False Creek residential areas.

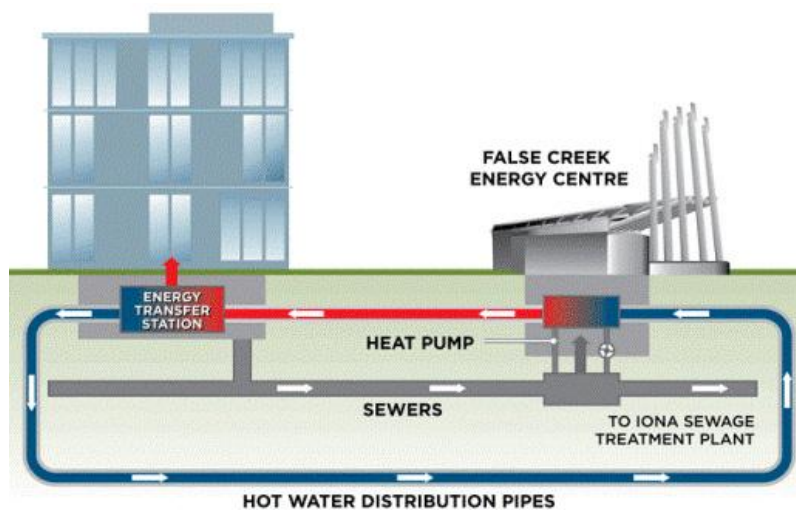


Figure 18 - False Creek Energy Facility (Vancouver NEU Report, 2010)

Third part is Heat Exchangers and Meters that transfer thermal energy from pipe system to buildings for space heating and daily hot water usage.

### 2.6.1. A Framework for Smart Transformation

Becoming a “smart city” is not only a decision, but a process and transformation. This transformation is much more revolutionary than evolutionary. In order to establish and perform this process, city authorities have to implement an integrated framework, based on cities existing social, economic, organizational and competitive assets. This should solidify strong competencies and clarify weak activities. We can make an analogy with SWOT Analysis to better explain this process. SWOT analysis examines the strengths, weakness, opportunities and threats as a strategic planning tool.

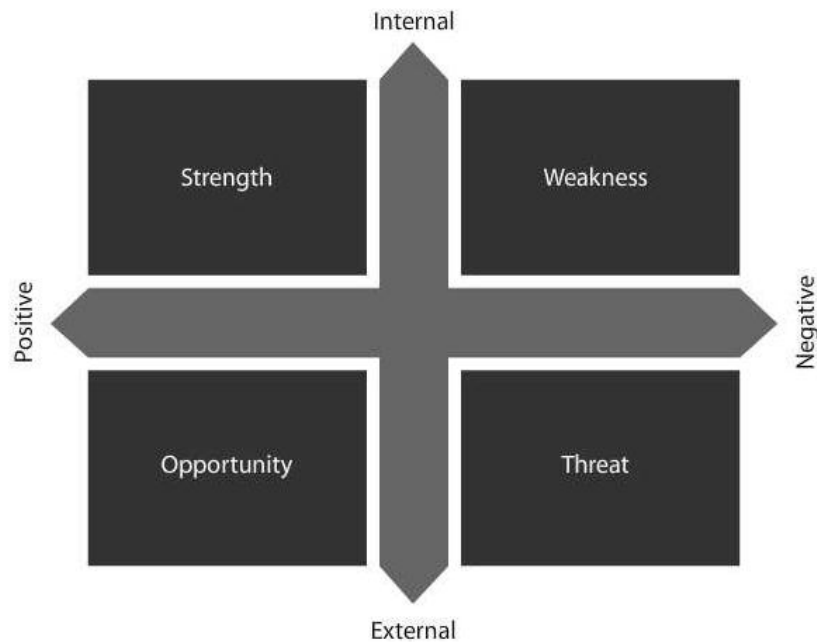


Figure 19 - SWOT Analysis

Performing this kind of analysis for a city helps to develop a strategic framework for planning and allocate limited resources. City administration can examine core activities, capabilities and processes for the strength section.

For the non-core competencies that currently at internal activities areas can be stated as a weaknesses section. These internal activities can be human or physical sources, finances, services or programs.

Core competencies that call new activities to the city can be defined as opportunities in this framework. These new activities may be related with the areas like trends, economy, environment and legislation.

Some activities may not have direct relation with the core competency of a city. Instead of trying to initiate an activity by using local sources, city authorities can use external expertise to fortify competition, efficiency for overcoming threats in a non-core competency area.

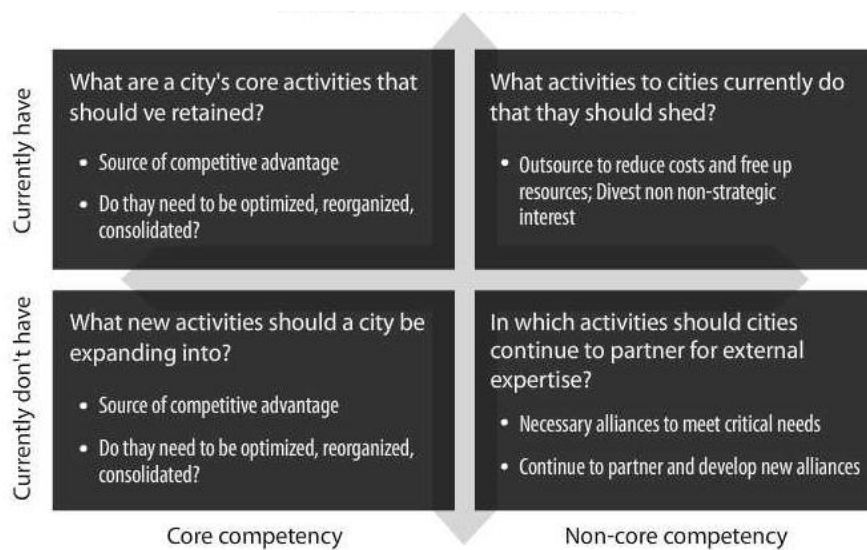


Figure 20 - A Framework for strategic planning (IBM 2009, 11)

The domains and sub-domains mentioned above are the areas where local governments, city planners, private companies and NGOs develop project collaboratively. In smart cities, these domains carry smart services. With the help of ICT technologies, smart city operations can be performed more effectively. For a smart urban transformation, installation of ICT technologies is essential.

The main ICT elements for a smart city are internet technologies and services. ICT infrastructure for Smart City can be established by four progressive phases.



Figure 21 - Four phase of ICT implementation

**Phase 1 – Network Infrastructure:** Internet as an infrastructure is the data highways for city and must be a part of planning stage of development plans. Buildings should have a connection to main internet network with high speed fiber optic during construction.

**Phase 2 – Content and communication:** Network infrastructure maintains core services like telephony, internet access, video-on-demand services, instant messaging etc. These services enable smart homes and business.

**Phase 3 – Building intelligence:** Intelligent infrastructures like environment systems, mobility and transport systems, smart buildings and smart energy grids can be founded. Wireless

sensors can start capture data from designated critical points of city. With the help of sensors, local administrators and decision makers extend their vision through transportation, utilities, energy, water and buildings with providing real-time data.

**Phase 4 – E-Services to citizens:** With the help of sensors, collected data can be turn in knowledge. Applications can use these data and knowledge to give services in different areas like; information sharing, healthcare, education, entertainment, culture, commerce, security, and finance.

## 2.7. Framework for Smart City implementation

From the perspective of information and communication based characteristics, smart city consists of different layers. These layers create a framework together.

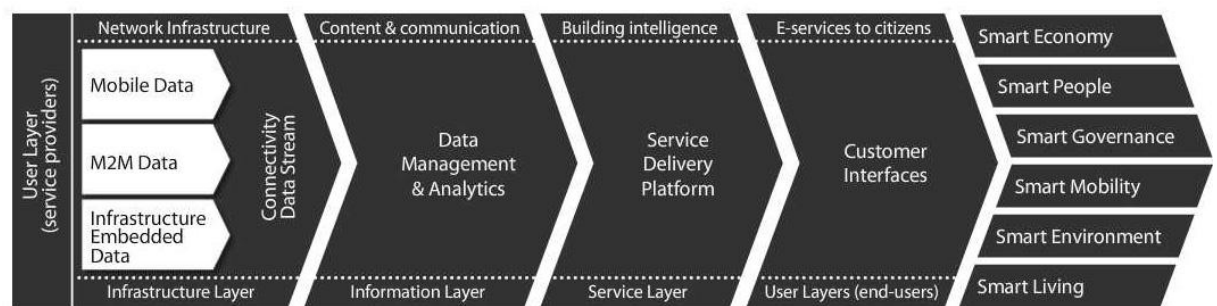


Figure 22 - Framework for Smart City implementation

First layer is called “User Layer” which contains citizens that can be called *end-users*. Service providers constitute other form of end-user as a user layer which provide e-services to citizens. Another layer is called “Service Layer” which contains all e-services provided by smart city. “Infrastructure Layer” includes information systems, networks and other ICT based installations. These are mobile data networks, M2M<sup>10</sup> data “Data Layer” covers all information that is created, collected, distributed and interpreted.

With the government involvement, Smart City projects are considered as long-term projects. These projects cover variety of many sub-strategies and policies. Even if a smart city project initiated or managed by private companies, local administrations still plays a key role. (Alcatel 2012, 10)

When we want to differentiate projects according to their size and scope, there are two main branches can be define; Greenfield Projects & Brownfield Projects.

<sup>10</sup> M2M: Machine to machine is the technology based on wireless and wired systems to communicate with other devices. M2M uses a device (sensor or meter) to capture an event (temperature etc) and translates into a meaningful information with an application on network.

**Greenfield Projects:** Greenfield projects are huge turnkey projects. They generally start from scratch and have fewer constraints during implementation. These projects have long-term plans changes between 10 and 25 years. Because of their extensive time span, these projects can also focus on revenue realization and return on investment. As their “turn-key” dealings, these projects have strong budgets for long-term execution.

**Brownfield Projects:** Brownfield projects are much smaller sized projects focused on a limited number of implementation areas. These projects have a shorter term for projects execution like 3 to 6 years. Because of their fast implementation process, investors prefer these projects by means of projects revenue and investment return. Brownfield projects have more restrictions in the phase of implementations, because they sit on existing infrastructure and field conditions.



## **CHAPTER 3**

### **A SUCCESS STORY: SINGAPORE AS SMART CITY**

Today there are more than 100 smart city projects underway globally. Scale and the rate of ICT utilization differ from one to another. Main areas in which the smart city approach has been initiated can be listed as energy, telecom networks, transportation, business support, intelligent community framework, public utilities, industry sectors and eco-sustainability (Alcatel-Lucent 2012)

Some of the most remarkable smart city projects are took place in Chattanooga (USA), Copenhagen (Denmark), Masdar (UAE), Paredes-PlanIT Valley (Portugal), Songdo (South Korea), Toronto (Canada).

Singapore case has a distinctive difference from other cities. As a city state, government initiated numerous comprehensive transformation plans iteratively from 1960s. The inclusion of technologic developments in to city's daily life started with 80s.

The government has a pioner role in these efforts. In Singapore, smart transformation has not been limited with the use technology but also maintained the inclusion of citizens in to the transformation progress actively.

So, I preferred Singapore case for representing different aspect of Smart transformation.

#### **3.1. Urban Planning in Singapore**

Singapore is an island with approximately 32 km x 24 km area where has no any natural resources. The only advantage of island is its geographic position where located at the intersection point of different transportation nodes.

Singapore, urban planning, based on the concept of sustainability Economy, Environment and Equality was built on. Modern Singapore's vision is to create a global urban identity. To achieve this goal, succeeded urban planning is the most important effort in the last 40 years.

Due to constraints such as limited area, geographical location, Singapore's urban planning governance held by central government. Central planning legislation is performed by Urban Redevelopment Agency (URA) which controls urban development and makes legal regulations since 70s. Also there are some other institutions and companies exists in urban planning area like Housing and Development Directorate and JTC Corporation.

Singapore's planning model was built on economic sustainability. Social, cultural, demographic, educational, environmental sustainability and political stability are constitutes the pillars of planning model in Singapore. Spatial planning is used as an umbrella which ensures the continuity of this model.

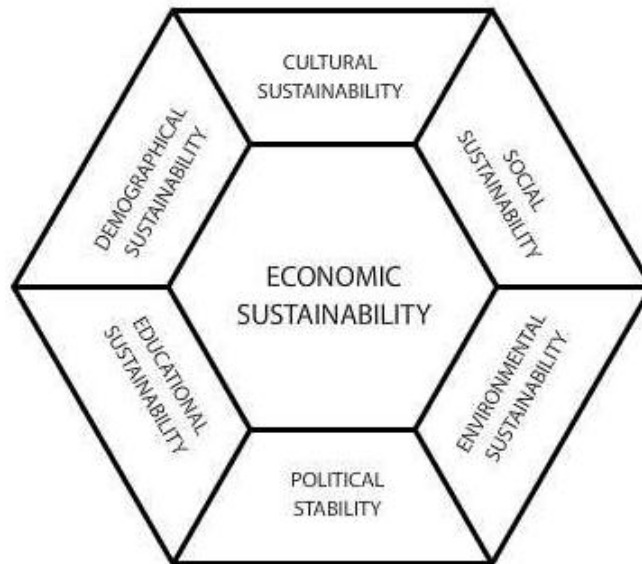


Figure 23 - Singapore's Sustainable Planning Model

Singapore's basic limitations are being a small city state, having limited area for development and limited local resources, world's busiest port without a hinterland. Despite these limitations, Singapore set a vision since 60's for being a center for global investment and distribution. There are two different plan type to reach these vision; Concept Plans and Master Plans.

### 3.1.1. Concept Plan

Singapore's Conceptual Plan is guiding physical development of country for 40-50 years. It aims to create a livable environment for future populations with limited land. Conceptual Plan is not stays constant and stationary but it is updated every 10 years which acquires new governmental policies and developments. Implementation tool of Concept Plan is Master Plans.

Current Singapore's Conceptual Plan is approved in 2001 which aims to create a global city with 5.5 millions of population, dynamic, adaptive to changing world standards, livable. The main focal points of the current concept plan are housing, recreation, industry, infrastructure and identity. This plan supports high-rise (30-50 storey) residential buildings, light rail transportation systems, recreation areas. Preperation of a conceptual plan takes 2 years. In 2010, Ura started to revise the Conceptual Plan with 800 employees and 200 of them are city planners, architects, landscape architects, economists and environmental engineers.

### 3.1.2. Master Plan

Master plan is an implementation tool for visionary and strategic decisions of conceptual plans in to a physical environment. It regulates physical regulations of residential areas, maximum height of building bloks, minimum distances between buildings etc. In every 5 years, this plan revised collaboratively. URA (Urban Redevelopment Agency) controlling regulations by the help of "Development Control System". URA controls and give permissions to new constructions, additional flats, changes in use rights.

Singapore is divided into 55 plan zones. Each of these zones have 80-150 K population, centers and subcenters.

### **3.1.3. Conservation**

Besides its rapid development and scarcity of land, Government pay importance to conservation projects and conservation culture. Conservation progress started in 70's with an incubation phase. In 80's conservation awareness is being constituted. In 90's, detailed restoration projects prepared and consciousness about the importance of conservation firmed. In 2000's collaboration based activities increased.

### **3.1.4. Waterfront Management**

Singapore's economic development has strong strategic relation with waterfront management and planning. City is in the junction point of marine trade between Europe and Eastern Asia. This region is developed and specialised as marine trade storage, international tourism center and oil refinery industry. Besides tourism, local authorities focused especially on marine engineering and repairment, and oil refineries.

In 80's, Singapore's economic model based on capital accumulation and sophisticated tourism investments, communication and military systems take place in waterfront areas. At the same time, shipyards, trade and civil aviation sectors takes places in waterfront areas.

### **3.1.5. Organizational Structure**

Singapore has a compact and manageable administrative structure which helps central government to control every aspects of development. In this manner, there is no any local planning authority established in sub-regions. URA controls these regions with the help of head offices and other institutions collaboratively according to existing master plans.

The main uses of the coastal zone are non-polluting industrial buildings, oil refineries, chemical factories, shipyards, warehouse, residential and recreational areas. Use of scarce resources such as land along the coast in Singapore is being prioritized by its economic return. By the time, usage type of these areas shifted from hotels and residences to harbor, factories whose economic return is higher.

Urban waterfront planning and controlling urban development are counterpart to each other. Each new license application for a construction is appraised by related authority according to its economic benefit.

Some of these authorities are Jurong Town Corporation (JTC), Urban Redevelopment Authority (URA), the Port of Singapore Authority (PSA) and the Housing and Development Board (HDB). JTC leasing lands for industrial usage for 30-60 years periods. URA leasing lands for commercial, residential and recreational usage for 99 years periods. Because of the scarcity of urban waterfront areas, land fill projects creates valuable lands.

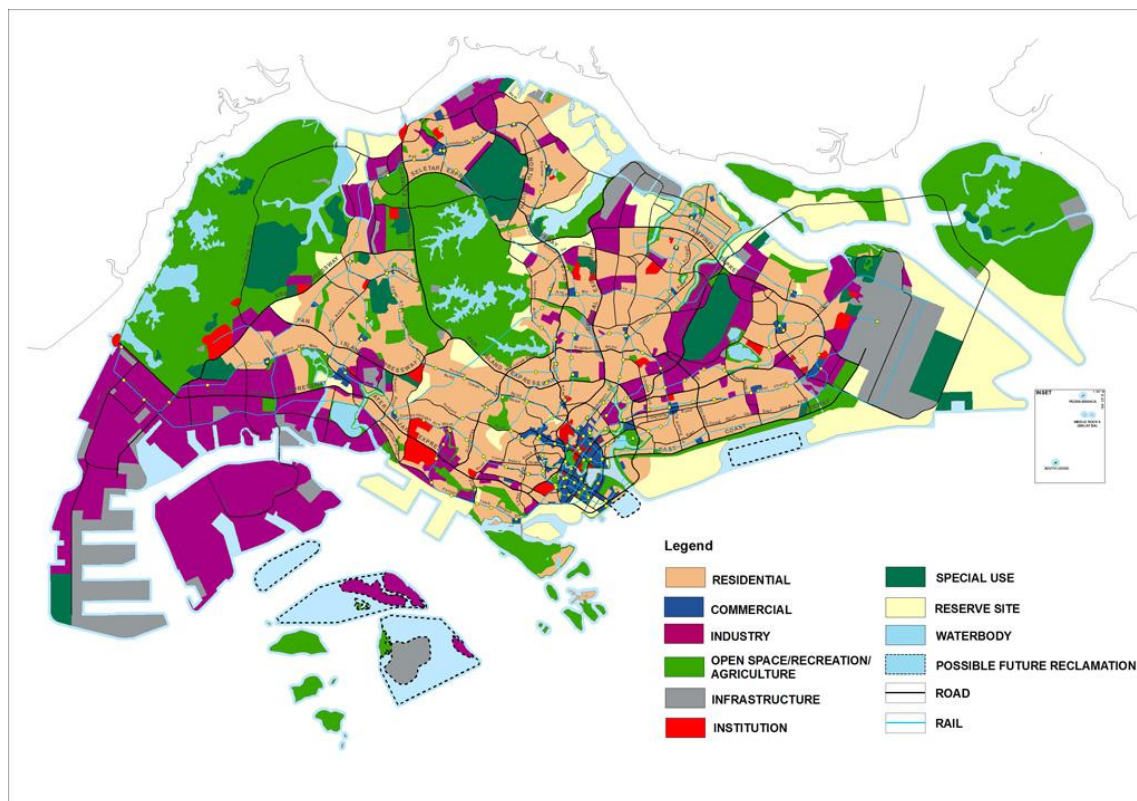


Figure 24 – Land Use Proposal for 2030 (Ministry of National Development of Singapore)

### 3.2. Singapore's Smart Island Vision

Singapore became independent in 1965. Main economic activity was warehouse or storage services. As becoming a hub of international air and sea trade hub, Singapore was connected to the international trade.

However this kind of business was created a limited job in labor market. Because of increasing population, government decided to take an action to increase labor market with an industrialisation program by the help of multinational companies. According to Singapore government, multinational companies are the source for jobs, new technologies, finance and know-how. Also they are bridge for connecting in to world markets.

From the multinational companies point of view, Singapore means cheap land and labour in 1960s. This cooperation created an economic success and development for 20-25 years. Singapore was producing and trading low level products with low tech and low skilled labors which created negative impact in competition. Besides to developed manufacturing and trading, development of service sector is become essential in 80s. In order to maintain competitiveness, authorities decided to invest in areas like information, knowledge and creativity.

In Singapore, the economy of the pre-1960s could be characterised as a trading economy, the economy of the pre-1990s as an industrial economy and with 1990s as information economy that is conceptionalized as Intelligent Island.

Government took information and telecommunication technologies as highest priority sector and set up the National Computer Board (NCB) in 1981 as a kickstart of information age.

NCB's main role is to lead Singapore's information age strategies by maintaining the usage of IT extensively to increase economic competitiveness and quality of life.

The first National IT Plan was prepared in 1986. Plan aims the increase IT familiarity of public and private sectors which also increase economic competitiveness and quality of life.

In 1992, NCB released A Vision of an Intelligent Island: IT2000 Report that creates a strategic vision for Singapore's IT development in the future. It examined how IT can create competitive advantages and enhance the quality of life in Singapore. The report prepared by IT2000 Committee which included 200 members from the private and public sectors and educational institutions.

"In our vision, some 15 years from now, Singapore, the Intelligent Island, will be among the first countries in the world with an advanced nation-wide information infrastructure. It will interconnect computers in virtually every home, office, school, and factory." (NCB, 1992).

The report amalgamates the potentials of its small population and maintain a world class infrastructure in order to become a major hub city of the world.

### **3.2.1. Technology Based Education**

For Singapore, IT skills is required not only for business or industry but for everyday life. Ability to use computer is become a must skill for education like reading, writing and arithmetic. Singapore's Ministry of Education prepared a master plan for adding computer skills in to their curriculum in 1997. According to this plan, IT based learning environment is maintained for every school. Ministry of Education invested one computer for every two children and %30 of total curriculum covered by computer based learning.

Besides given IT supported education in schools, other training projects prepared for professional area. There was a huge gap between demand and supply of IT specialists. In 1997, total number of IT professionals was just 30.000. In order to increase IT awareness and provide training to large mass of employees, NCB and National Trades Union Congress (NTUC) started a project called IT Coach.

Main goal was to train employees and workers of factories and explain information and computer technologies from beginning. IT Coaches had computer, printer, camera, training schedule that covered 200 days and approximately Each coach trained approximately 16.000 workers.

### **3.2.2. ICT Infrastructure**

For the economic development, infrastructure is the key point for government. Singapore's vision is to become an intelligent island, best telecommunication, air and sea port facilitator. Singapore

is one of the first countries in the world that have National Information Infrastructure (NII) With this network, every home, school and office interconnected.

Every citizen can use this network for personal, business or government related transactions from home, office or public kiosks.

The NII is the main infrastructure of public services and applications. Examples of these services include electronic identification, secure services, payment services and the national directory service.

National directory service is called National Contact Information Service (NCIS) that facilitate communication between citizens, organisations, products and services. It brings together different directories, constitutes a directory of directories and creates a gateway.

Every household in Singapore have a connection to NII. Building regulations requires every new home must have built-in broadband connections in the same way as it is required to have water and electricity connections. Wireless networks are another option for user to connect NII.

All government ministries and their departments have their own websites. Many transactions and getting information related with these Ministries can be performed by these web sites easily. Tax payments can be done by email.

One of the most important traffic management application of Singapore is road pricing systems which serves as an effective tool for manage traffic congestion. Road pricing was first implemented as Area Licencing System that charge of fee for each vehicle enters to Central Business District. Later, this system replaced with Electronic Road Pricing (ERP) System. Radio Frequency Identification (RFID) technology used for charging fee while vehicle passing under a toll gate.



Figure 25 - Electronic Road Pricing (ERP) System

The ERP system provides a target oriented solution for congestion pricing, enable the authorities to focus on specific points of congestion. Therefore, the charges can increase or decrease according to demand of usage of the roads or highways, which is reviewed quarterly.

By pricing congested sections, the ERP system helps to moderate and spread the use of vehicles for optimal use of the road network by encouraging drivers to consider alternatives.



Figure 26 - Electronic Road Pricing (ERP) System

These alternatives include the use of other routes, traveling during low demand periods, orienting to the public transportation or carpooling which is the sharing a car to a destination to reduce fuel use, pollution and travel costs.

### 3.2.3. The Role of ICT in Economy

In order to keep its position as an international business hub, Singapore has to elaborate its information economy. E-commerce can be stated as an important term under information economy. Also communication systems that works as an technical infrastructure should supported by administrative and legislative systems. Citizens' online presence and online transfers have to be validated legally. Intellectual property rights is another important term and has to be protected over internet. Security of personal and financial data of citizens is also another issue in information economy.

National Computer Board (NCB) prepared a series of programs for the maturity of E-Commerce environment. In 1996, Electronic Commerce Hotbed (ECH) program initiated. Electronic Commerce Policy Committee (ECPC) is established by 1997. Next year, ECPC prepared list of advices to government which creates a framework for e-commerce in particular.



- Private sector should be a leading actor for developing electronic commerce,
- Government should create legal framework which is constant and reliable environment,
- Government should provide a secure and safe environment,
- Government has to be a catalyst for the growth of e-commerce by joint ventures,
- Policies have to be innovative and transparent,
- E-commerce regulations have to be compatible with international regulations and actors.

According to this e-commerce framework, government has an important role in business development by being a partner in joint ventures. These joint ventures make government an active business partner and investor in e-commerce. In other countries, governments stay away from these kind of business involvement and take role as a regulator.

In 1998, ECPC prepared legal regulations in order to support electronic transactions and E-Commerce. Electronic Transactions Act (ETA) formulated authentication of buyers and sellers, recognition of digital signatures and the validity of electronic contracts.

While preparing e-commerce framework, compatibility between national and international standards took into account by NCB. In this manner, NetTrust was established in 1997 as a certification authority. It provided online identification and security infrastructure and digital signature for secure digital transactions.

By the help of these efforts for being electronic trade hub, world's first secure online transaction was succeeded in 1998 by the credit card company Visa International.

In 1999, Government merged NCB with Telecommunication Authority of Singapore (TAS) and established as Infocomm Development Authority of Singapore (IDA).

By the 2000, government decided to liberalise the telecommunication industry and mobile telecommunication services. At the same time, there was an action plan prepared as known as eGov Master Plan (eGap I).

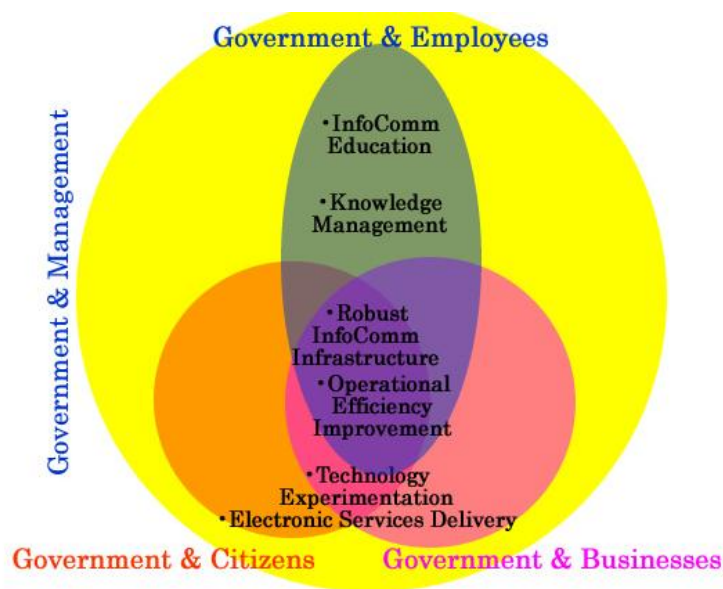


Figure 27 - e-Government Strategic Framework (2000)



There were 6 programmes appointed in eGov Framework. These were ICT education, knowledge management, robust ITC infrastructure, operational efficiency improvement, technology experimentation and electronic services delivery. In order to increase the involvement of government in the digital economy, officers have to be prepared for the process of e-government transformation. Popularity and the demand of the public services was increasing and government set a goal for public services.



Figure 28 - eCitizenPortal Logo

eCitizen Center established as a service portal for public. Government also reformed existing services and processes in order to increase their responsiveness and agility. Departments of government have to enhance internal processes, build new skills and competencies. In order to facilitate e-Government services effectively, innovation and experimentation are also crucial. Public officers have to be trained to these new technologies in order to deliver government services more effectively. .

Next year, IDA prepared a training framework for the different segments of officers and citizens. The framework focused on supporting an e-lifestyle, workforce training, skill development for individuals, increase the competency of population, enhance quality of life and to improve employability. In 2001, IDA announced 3g licensing framework and issued three provisional 3g rights.

In 2003, The e-Government Action Plan II (eGAP II) was launched to deliver accessible, integrated and value-adding public services. The main vision behind this plan is to lead e-government that serves to the nation in the evolving digital economy.

## E-Government Strategic Framework

Strategies To Realise The Vision & Outcomes

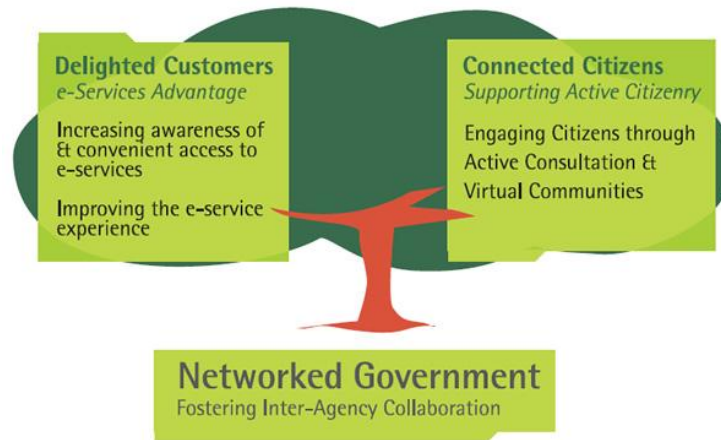


Figure 29 - e-Government Strategic Framework (2003)

With the new strategic framework, government aimed to increase effectiveness of services, accomplishment of user experience, overall quality of services and the rate of utilization.

Government information and services are brought together under one portal. The Singapore Government Online Portal [www.gov.sg](http://www.gov.sg), launched in 2004 and positioned as the Internet gateway to all government information and e-services.



Figure 30 – Singapore Government Online Portal Logo

By 2005, all government agencies started to give their services from public kiosks in order to access information and e-services.

EGap II framework tried to engage citizens in to play active role in the formation and definition of e-government services and transformations by the help of ICT.



Figure 31 – Government & Citizens Session Logo

Government tried to explain different aspects of online transformation of public policies to the citizens in order to optimize and to be claimed.



Figure 32 - Government & Citizen Conversation Sessions

All citizens invited to participate in the policy creation and review processes individually or by the use of ITC. Electronic matching services helping for the volunteers for finding and taking responsibilities in information and community services.

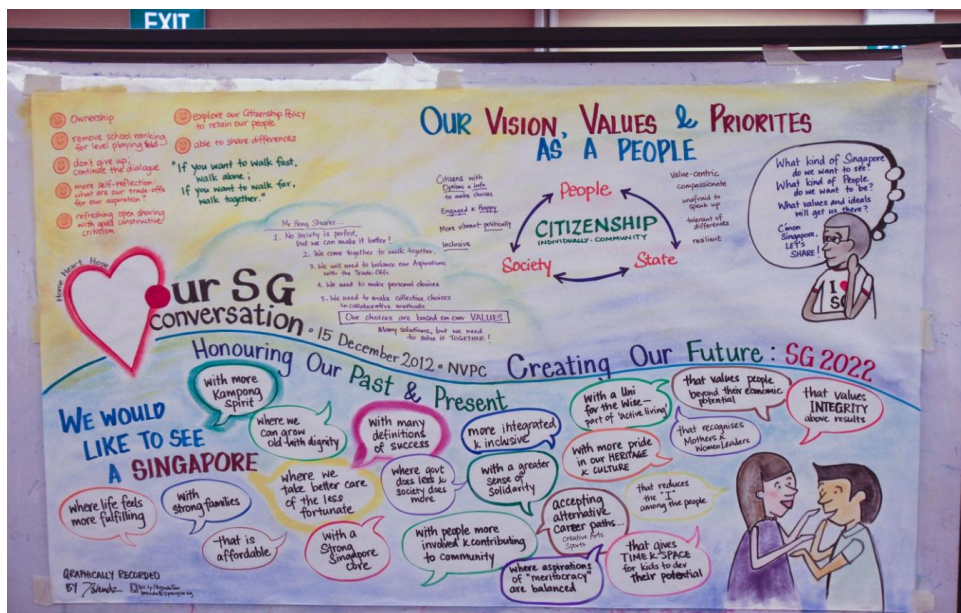


Figure 33 - Government & Citizen Conversation Sessions

With eGOV-II framework, government clarified the use of ICT as a key tool for remove physical boundries, collaborate and share information, create a collective knowledge, deliver value added services, integrate services and increase their agility.

In 2006, Singapore Government's 5 year master plan (iGov2010) initiated.

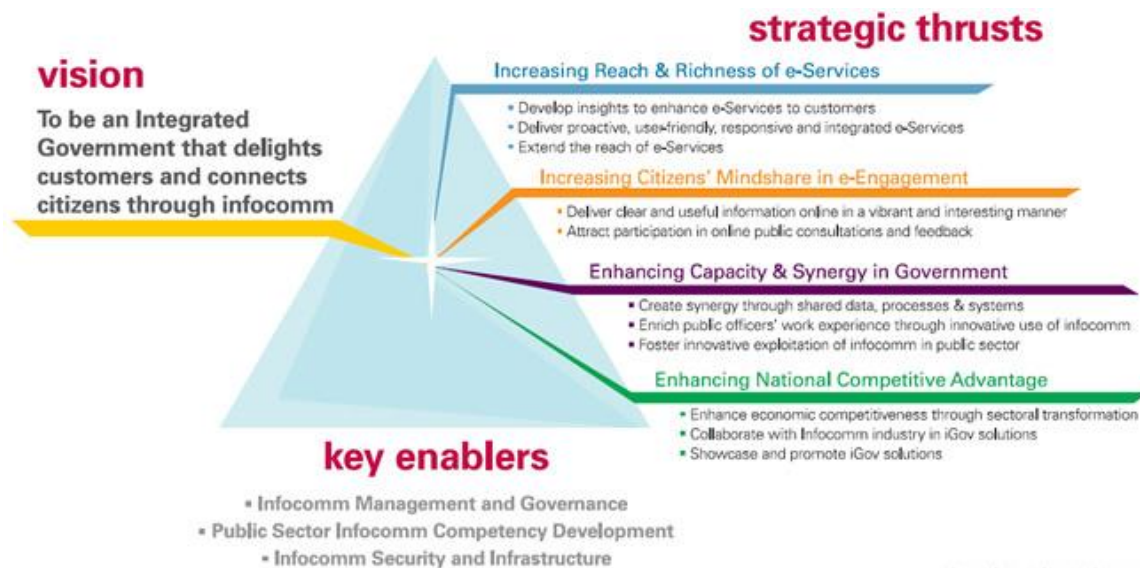


Figure 34 - Singapore Goverment's 5 year master plan (iGov2010)

The vision behind iGov2010 was increase accesibility and enrichment of e-services, increase the citizens e-engagement, aggregate human resource, financial processes of different government department in a pool (VITAL shared services) inorder to decrease operational costs.



Figure 35 - VITAL Shared Services Logo

Inorder to increase the capacity and cooperation Singapore Government Enterprise Architecture programme(SGEA) created. SGEA included a set of framework as the business architecture, information architecture, solution architecture and technical architecture of the Singapore Government. It collects broad range of business functions, data standards and shared ICT functions and infrastructure.

iGov also targets enhancing competitive advantage of Singapore. Government has sets 3 level of achievement for this goal. These are Industry, national and international level. At the industry level, government tries to support private sector with the ICT invesments. ICT industry and government agencies are encouraged to work collaboratively. At the national level, government try to attract investment to Singapore.



Figure 36 - TradeXchange Logo

TradeXchange is founded as a trade and logistics platform. It serves information about legislative, trade, customs, permits and insurance. At the international level, iGov supports cross-border associations with neighbouring countries.

In 2006, IDA launched the Wireless@SG programme that offers free wireless broadband connection at homes, offices, schools and other public places islandwide. IDA developed this programme as a part of Next Generation NII as a part of Intelligent Nation 2015 (iN2015) master plan.

Everbody can freely reach wireless broadband access at public areas. The users of this wireless network are defined as "people on the move" who needs wireless access while they are away from their homes, schools and offices. These include tourists, students, white collars who are not at their offices. Once connected, users are able to access all web based services like online gaming, surfing, instant messaging, VoIP and email.



Intelligent Nation 2015 (iN2015) launched in 2006 as Singapore's 10-year masterplan to reach the vision of being an Intelligent Nation and Global City.



Figure 37 - Intelligent Nation 2015 (iN2015) Header

iN2015 will support creativity and enable innovation. It will connect businesses, individuals and communities over ultra-high speed, intelligent and secure ICT infrastructure. iN2015 will be the channel accessing world's resources and export ideas, products and services to the global marketplace. By the help of innovative and sophisticated ICT infrastructure, key economic sectors, government and society are going to be more globally competitive and collectively smart. Labor force will gain hi-end ITC skills.

In 2011, Singapore initiated a new eGovernment Master Plan (2011-2015) called eGov2015. Plan's vision is to be a collaborative government that co-creates and connects with citizen participation. eGov2015 is targeting to create an interactive environment where government, private sector and citizens work together by ITC technologies.

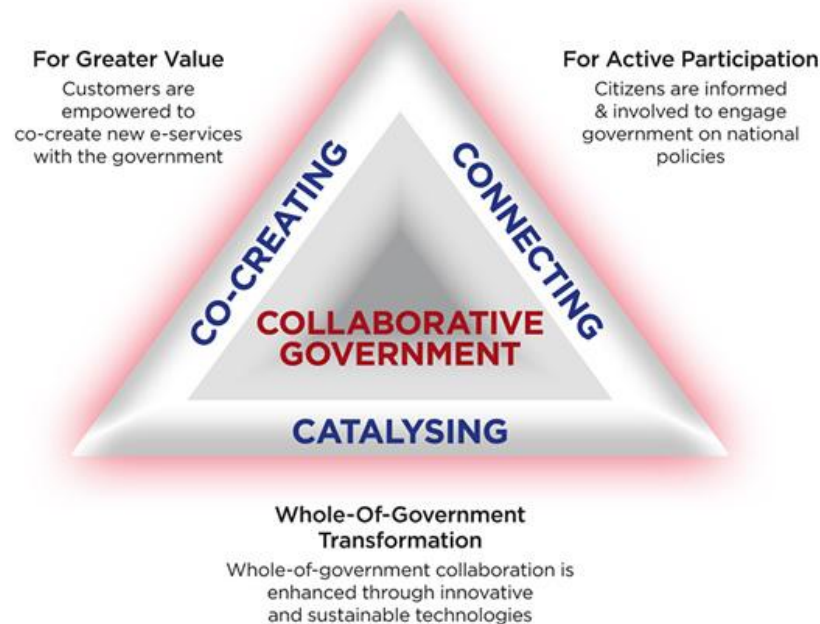


Figure 38 - eGovernment Master Plan (2011-2015)

Collaborative Government will be created on 3 pillars:

The *Co-Creating*, citizens and businesses can define and create new e-services with government. Like Mobile Government (mGov) and OneInbox programmes and services, government enrich its services. Today citizens and businesses can access more than 1600 online services and more than 300 mobile services provided by government.

Second pillar is the *Active Participation* of citizens to national policies. Singapore had one of the highest internet access rate with 80% of population use internet daily. They use social networks frequently like facebook, twitter, youtube and blogs etc. eGov2015 supports e-engagement of citizens. The REACH (Reaching Everyone for Active Citizenry@Home) is an example for enhancement efforts of government. REACH is positioned as an official channel for news and updates on all government activities.

Third pillar is *Catalysing Whole-of-Government Transformation*. Creative and innovative class powered with ICT has an important role in a Collaborative Government. In order to continue the technological development, Singapore government decide to invest to a next generation whole-of-government infrastructure to support collaboration between governmental units. High speed Next Generation Nationwide Broadband Network, Cloud Computing which is the use of computing sources as services over network and other technologies. Singapore government will establish a government private cloud (G-Cloud) for creating secure ICT environment where every governmental units design, develop and execute applications and services

Government Business Analytics program is developing for business analytics. It provides services such as common tools and consultancy services. This will help to governmental bodies for quickly access to a specific analytics when they need. With these services, public authorities can analyse the governmental data with extended query tools.

Governmental bodies can also improve their internal processes, and identify weaknesses, gaps, opportunities and can make resource optimizations.

As it is stated before, smart city vision directly effects the quality of life of the citizens of Singapore. Developments and services maintained by this vision creates an increased benefits on public environment. With the help of ICT there are time and cost related efficiencies achieved.

Online and mobile payment solutions, e-shopping and e-trade opportunities, booking hotel and concert services, reservation solutions, accessing online resources and libraries, accessibility to museums and art galleries, online social communities, online education solutions, accessing public services like healthcare, security, municipality services are just a small portion of other developments and services that increase the quality and efficiency of Singapore's life standards.



## CHAPTER 4

### TURKISH CONTEXT

21st century will be the century of cities. This is why our cities will be a driving force in global competition, information, development and innovation.

More than two-third of our population is living in urban and suburban areas. Because of that, with an increased quality of life, improved physical standards, disaster-resistant and environmentally sustainable cities should be the main vision of our country.

Turkish urban population reached to 58.5 million in 2012. This number is expected to rise to at least 71 million in 2023 (TÜİK, 2012). This shows a significant increase during a period of 10 years. Excessive increase in population creates problems because of the composition of these masses.

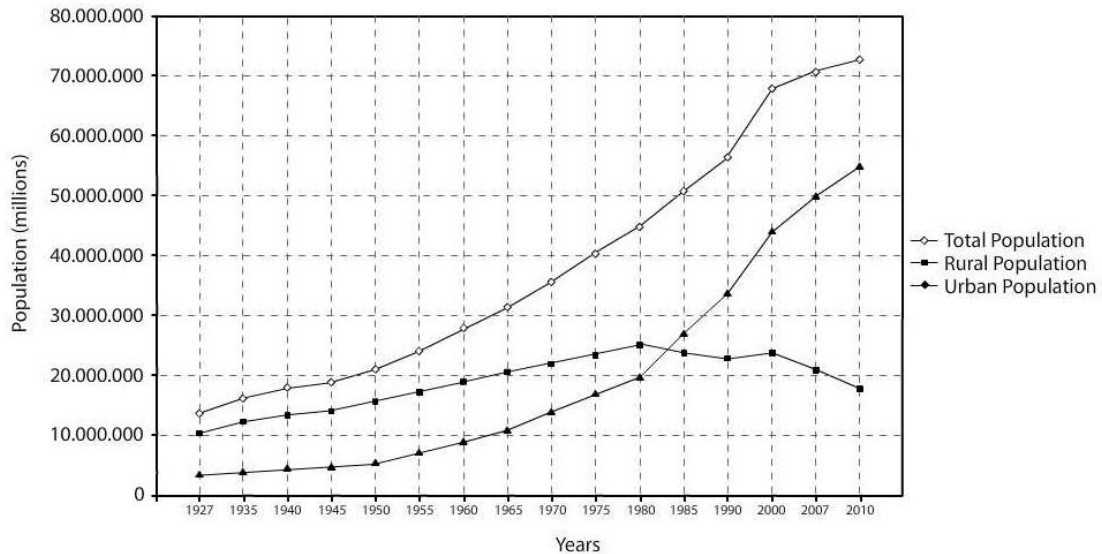


Figure 39 - Urban and Rural Population Change of Turkey (TÜİK/DİE Nüfus Sayımı Sonuçları 1927-2007)

In 1960s, migration from rural areas to cities started. In 1980's, migration in to urban periphery is accelerated. This was the resulted by economic development in cities and decreased job opportunities of rural areas. But today this over populated urban areas created various problems to local authorities. Our cities and city systems are not competent on creating sufficient solution on housing, employment, core services or high quality living standards.

Municipalities trying to find solutions to these spatial, demographic, economic and environmental problems suffered from rapid urbanization. Today smart city approaches may seem fancy to many of us and local authorities. Roots of problems are not in lack of advanced IT infrastructures. Main problems are insufficiency city core systems and inefficient use of urban resources.

Today, our municipalities don't integrate smart city solutions with core city systems with a holistic approach. Their understanding of smart city concept is just limited with the remote access to an IT infrastructure (internet) and limited number of applications (web page). Smart City does not mean just using more technology. Basis of this concept also includes participatory and democratic society, collaboration and governance. Smart city approaches are also embrace rational use of common wisdom of citizens as a whole.

Global warming, environmental pollution and its side effects on daily life and cities are become more noticeable. Weather conditions like climate change and drought will adversely affect the quality of life of our cities. With the development of communication technologies there is a rising awareness and paying attention occur to these issues.

At the same time, regulations and laws related with sustainability, environmental protection, and efficient use of resources must become a part of development strategies and took place an important agenda item for the municipalities.

#### **4.1. Turkish Planning System**

Urban planning system in Turkey can be described under four main hierarchical levels.

1. National Strategies and Development Plans,
2. Regional Plans,
3. Environmental Order Plans,
4. Construction and Development Plans.

The first layer is the *National Plans* which create a strategic framework and concern general policies and action plans.

The *Regional Plans* are prepared in the scale of 1/100.000 and their status, law sanction and ownership are inexplicit in Turkish planning system.

The *Environmental Order Plans* clarify land-use decisions related with housing, commerce, industry, agriculture, tourism, and transportation in the scale of regional and national level. The Environmental Order Plans are executed in the scales of 1/50.000 and 1/100.000.

The *Construction and Development Plans* can be examined under 2 plan type called Master (Nazım) Plans and Construction Application Plans.

Master (Nazım) Plans are prepared in the scale of 1/25.000 and 1/5.000. Construction Application Plans are prepared in the scale of 1/1.000 for every urban settlement with a population over 2000 (Ersoy, 2006).

#### 4.2. Strategic Actions and Plans in National Scale

Being a Smart City requires integrated policies, systematic approaches in all city systems, continuous analysis and assessments through statistics/indicators and horizontally distributed continuous monitoring

In Smart cities, national plans and programs should be evaluated according to strategic priorities with multi-dimensions. Because Smart city operations and applications have to be coherent with macro policies. Smart cities vision require being simplified and efficient planning authorization, congruent plan hierarchy and effective application tools.

In recent years, governmental bodies like Ministry of Environment and Urbanism, Ministry of Internal Affairs or Ministry of Transport prepared strategic action plans. The main reason behind these efforts are to create an ecosystem for comprehensive management in desired areas.

With the increased usage of ICT systems; ministries and their departments aim to give better services to citizens. For example; the vision of Ministry of Transport is to provide and monitor transport, information and communication services for all users in a qualified, balanced, safe, environmental friendly, fair and economic manner. Under this vision, ministry's mission is to increase global competitiveness of the country and quality of life for the citizens by providing transport and communications services over the level of contemporary civilization ([www.ubak.gov.tr](http://www.ubak.gov.tr)).

This vision has a similar intention with smart city approach. In general, different strategic plans that are prepared by different governmental bodies have similar point of views that can be correlated with principles of smart cities. Municipalities are also prepare strategic plans for the formation of their services in future. Cities with the population more than 50.000 have to prepare strategic plans.

Ministry of Environment and Urbanism have binding role between different actors of urbanization for the creation of environment suitable for smart solutions. Creating a strategic development vision is an important step for this binding process.

Ministry of Environment and Urbanism is guiding authority about spatial planning, urban transformation, environmental management, environmental protection. It defines and regulates strategies, policies, procedures, and guidelines.

Ministry as a regulatory authority, has not a spokespersonship of one certain fraction like Smart City, Knowledge City, Green Economy, Sustainable Development, Green Growth, Green Planning, Ubiquitous City, etc.

Instead of initiating one approach, ministry trying to set standards, prepare regulations, initiate data warehouses<sup>11</sup> like a GIS center, prepare strategic action plans for long terms and deploy tasks between other central governmental bodies.

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<sup>11</sup> **Data warehouse** is a database used for reporting and data analysis. It is a central repository of data which is created by integrating data from one or more disparate sources. Data warehouses store current as well as historical data and are used for creating trending reports for management reporting

By these efforts, they want to prepare a suitable environment where smart city requirements can easily met by public and private actors. There is an increasing necessity of enhancing the quality of urban life, strengthening the economic and social structure, reconfiguring of spatial planning system in Turkey.

The Ministry sets a strategic vision about planning, environment and brand cities for the period 2013 - 2017. In order to attain this vision, a series of action plans, laws and regulations were enacted. These can be the buildig blocks of a smart city.



Figure 40 - Urban Development Strategy and Action Plan (Kentges) Logo

In 2010, Urban Development Strategy and Action Plan (Kentsel Gelişme Stratejisi ve Eylem Planı-KENTGES in its Turkish abbreviation) prepared which targetting 2010-2023 period.

iDEP - National Climate Change Action Plan (2011-2023) for the actions against global warming. Energy Efficiency Law that brings regulations for transportation and infrastructure



Figure 41- iDEP - National Climate Change Action Plan (2011-2023) Header

In 2009, Ministry of Transportation and Communication held 10th. Transportation and Communication Forum in Istanbul.



Figure 42– The 10th. Transportation and Communication Forum Logo

With the motto of Target 2023, forum focused to develop long term projects and solutions for the needs of transportation and communication sectors that are the backbone of economy.



Figure 43 - Energy Identity Certification Logo

Energy Identity Certification Application that sets new standards about energy efficiency for Turkey. This certification represents energy requirement, energy consuming class, insulation specifications, efficiency of heating and cooling system information about buildings. After 2011, Energy Identity Certification is mandatory for new buildings.

#### 4.2.1. Kentges - Urban Development Strategy and Action Plan

KENTGES, being a major strategy document for the development of settlements in Turkey, covers different aspects of settlements, urbanisation and spatial planning in an integrated manner for the period of 2010- 2023.

It determines the main working areas as follows:

- Urban transformation projects
- Regional planning and urban design projects
- Investment for public infrastructures and alternative financial solutions
- Renewable energy technologies
- Climate change and controlling greenhouse gas emission
- Earth, water pollution and control
- Water treatment technologies

The document has 3 main axes for its strategies. These are;

**Axis 1:** Reconfiguration of spatial planning system.

**Axis 2:** Increasing the quality of life and physical quality of the settlements .

**Axis 3:** Strengthen the economic and social structure of settlements.

This vision is compatible with all aspects of smart cities approach. When we look at the strategies of KENTGES from the smart city point of view, relation and parallelism can be seen with the smart city vision. We can list some of strategic actions of KENTGES under the Smart City domains, which have been elaborated in Chapter 2.5.

#### 4.2.1.1. Strategic Actions Related With Smart Living Domain

As one core domain of smart city, smart living focus on quality of life. Smart living embrace citizens as a social capital and promises social, cultural and education oriented facilities. At the same time, healthcare, security and disaster prevention solution can be stated under smart living domain

Table 4 – Strategic Actions of Kentges related with Smart Living

Axis 2	Increasing the quality of life and physical quality of the settlements.		
<b>Targets</b>	No:12	Target	Creating secure, high quality life standarts and urban environments
<b>Strategies</b>	No:12.1	Strategy	In settlementst, safety of the community will be enhanced by taking the necessary precautions.
<b>Actions</b>	No:12.1.1	Action	Belediye zabıta birimleri, polis teşkilatı ve ilgili diğer birimler arasında toplumsal düzeni sağlamaya yönelik işbirliği ve koordinasyon mekanizması kurulacaktır.
	Responsible Authority		Ministry of Internal Affairs
	Related Institutions		Municipalities, Universities, Chambers
	Period		2010-2023
<b>Targets</b>	No:11	Target	Reducing the risks for disasters and residential .
<b>Strategies</b>	No:11.5	Strategy	For the effective intervention in disaster situations, emergency communication infrastructure will be enhanced. Evacuation protocols, temporary shelters, disaster support centers, emergency facilities will be prepared.
<b>Actions</b>	No:11.5.1	Action	National and local level communication, emergency call, information communication system infrastructures and transportation systems will be developed.
	Responsible Authority		Prime Ministry Disaster and Emergency Management Presidency
	Related Institutions		Ministry of Internal Affairs, Ministry of Transportation, Information and Communication Technologies Authority, Türk Telekom, Governorships, Municipalities
	Period		2010-2014

According to strategic actions of Urban Development Strategy and Action Plan, security, healthcare and disaster threads will be detected in city scale. By help of different governmental agencies like General Directorate of Disaster Affairs (Afet İşleri Genel Müdürlüğü in its Turkish abbreviation), critical infrastructures will be monitored under emergency situations.

#### 4.2.1.2. Strategic Actions Related With Smart Economy Domain

Realtime data monitoring and evaluation technologies are one of the crucial elements of ICT supported smart city operations. Main idea behind this operation is three sequential steps; instrumentation, interconnection and intelligency. Shortly, this operation created event based data. Smart sytem proceed and analyze this data for creating new and optimize processes. Ministry set a strategic action that offer a solution with similiar progress.

Table 5 – Strategic Actions of Kentges related with Smart Economy

Axis 2	Increasing the quality of life and physical quality of the settlements.		
<b>Targets</b>	No:3	Target	Enabling sustainable and diversified land and house production and supply.
<b>Strategies</b>	No:3.1	Strategy	Diversified land and house supply will be supported.
<b>Actions</b>	No:3.1.4	Action	Construction costs and times will be reduced by new production technologies and regulations..
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		TOKİ, Universities
	Period		2010-2023
<b>Strategies</b>	No:3.3	Strategy	Structures that are not threaten human and environmental health, safe, constructed in high quality and having international standards will be provided with their maintenance services.
<b>Actions</b>	No:3.3.2	Action	Eco friendly and feasible construction processes and techniques will be developed.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		TOKİ, Universities
	Period		2010-2023
<b>Targets</b>	No: 6	Target	Integration of infrastructure projects and investments with urban plans.
<b>Strategies</b>	No: 6.1	Strategy	Development of new techniques for increasing the quality of urban infrastructure services while maintaining compatibility with sustainability standarts.
<b>Actions</b>	No: 6.2.1	Action	Metropolitan municipalities will use SCADA systems in their infrastructure projects and investments:
	Responsible Authority		Municipalities
	Related Institutions		Ministry of Internal Affairs, Ministry of Environment and Urbanism, Turkish Electricity Transmission Company, BOTAŞ, General Directorate of State Water Works, Governorships
	Period		2010-2017

#### 4.2.1.3. Strategic Actions Related With Smart Governance Domain

Term can be explained as the use of different policies, models and technologies for the implementation of effective service providing. Smart government focuses on Improving public services and processes. ICT supported e-gov services and open data sources creates new channels between governmental organizations and citizens. Coordination of different public sector organizations and making them work collaboratively by the help of ICT are major success indicators. A coordination center will be founded between police, municipal police forces and other organizations. Regulations will be prepared for establishing and operations Urban Information Systems.

National Geographical Information Systems and physical Planning Portal will be established. Digital Database and Tracking Center will be founded for supporting spatial planning

Table 6 – Strategic Actions of Kentges related with Smart Governance

<b>Axis 1</b>	<b>Reconfiguration of spatial planning system.</b>		
<b>Targets</b>	No: 1	Target	Reconfiguration of spatial planning system.
<b>Strategies</b>	No: 1.5	Strategy	Maintaining conformity and coordination system between institutions that generate or use data in nationwide. by establishing effective information
<b>Actions</b>	No: 1.5.1	Action	Regulations that are aims to establishment and operation of national geographical information system and spatial planning portal
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		Ministry of Culture and Tourism, Ministry of Forest and Water, Ministry of Development, TÜİK, General Directorate of Land Registry and Cadastre, General Directorate of Bank of Provinces, Development Agencies, Municipalities, Special Provincial Administrations
	Period		2010-2014
<b>Actions</b>	No: 1.5.2	Action	Ministry of Environment and Urbanism will develop digital database and tracking system that will be the base for spatial planning.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		Ministry of Development, TÜİK, Development Agencies, Municipalities, Special Provincial Administrations, Universities
	Period		2010-2023
<b>Actions</b>	No: 1.5.3	Action	Regulations will be prepared for the foundation and operation of urban information systems.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		Ministry of Internal Affairs, Ministry of Culture and Tourism, Municipalities, Special Provincial Administrations
	Period		2010-2014
<b>Axis 3</b>	<b>Strengthen the economic and social structure of settlements..</b>		
<b>Targets</b>	No:19	Target	Providing awareness about urban culture, citizenship, urban rights and sense of belonging.
<b>Strategies</b>	No:19.1	Strategy	Educational programs and cultural activities related with urban culture, sense of belonging will be supported.
<b>Actions</b>	No:19.1.1	Action	Educational programs for citizenship will be prepared.
	Responsible Authority		Ministry of National Education
	Related Institutions		Ministry of Internal Affairs, Ministry of Environment and Urbanism, Ministry of Culture and Tourism, Governorships, Municipalities, Media Organizations, NGOs
	Period		2010-2023



#### 4.2.1.4. Strategic Actions Related With Smart Mobility Domain

We can shortly define smart mobility is provide transportation needs of citizens and commodities while supporting economy and environmental. Integrated ICT solutions can be used for the support of management facilities and enables mixed modal access. Emergency call centers and emergency action centers with their ICT infrastructures and transportation systems are strategic actions of KENTGES. Increasing service quality of public transportation systems and improvement of technological background are other actions. Smart mobility supports sustainability of environment. In Turkish context, public transportation will be environmentally friendly by the help of technological improvements.

Urban transformation and traffic systems will be improved with ICT based investments and regulations. Transportation systems and core transportation facilities will be prepared for disaster scenarios.

Table 7 – Strategic Actions of Kentges related with Smart Mobility

Axis 2	Increasing the quality of life and physical quality of the settlements.		
<b>Targets</b>	No: 5	Target	Creating sustainable urban transportation system
<b>Strategies</b>	No: 5.1	Strategy	In spatial planning studies related with transportation systems, comprehensive policies, programs and plans will be developed according to the scale of urban settlements.
<b>Actions</b>	No: 5.1.2	Action	Urban transportation plans will be prepared and implemented according to environmental, technical, economic and social variables.
	Responsible Authority		Municipalities
	Related Institutions		Ministry of Internal Affairs, Ministry of Transportation, Ministry of Environment and Urbanism, Universities, Chambers
	Period		2010-2023
<b>Strategies</b>	No: 5.5	Strategy	Integrity of pedestrian and vehicle traffic will be taken in to account.
<b>Actions</b>	No: 5.5.2	Action	Quality and level of technology will be increased in public transportation systems.
	Responsible Authority		Municipalities
	Related Institutions		Ministry of Internal Affairs, Ministry of Transportation, Governorships
	Period		2010-2023
<b>Actions</b>	No: 5.5.3	Action	Public transportation systems will be environmentally sensitive.
	Responsible Authority		Municipalities
	Related Institutions		Ministry of Internal Affairs, Ministry of Transportation, Ministry of Science, Industry and Technology
	Period		2010-2023
<b>Actions</b>	No: 5.5.4	Action	Information technologies will be used extensively in urban transportation.
	Responsible Authority		Municipalities
	Related Institutions		Ministry of Transportation, TÜBİTAK, Universities
	Period		2010-2023

#### 4.2.1.5. Strategic Actions Related With Smart People Domain

Smart cities can be achieved by the presence of inclusive smart people. Participation of citizens into physical planning progress will be maintained. Urban Guides will be prepared.

Table 8 – Strategic Actions of Kentges related with Smart People

Axis 2	Increasing the quality of life and physical quality of the settlements.		
<b>Targets</b>	No: 9	Target	Natural and cultural assets will be protected.
<b>Strategies</b>	No: 9.1	Strategy	In the urbanization and spatial planning processes, approaches like protecting natural and cultural assets will be supported.
<b>Actions</b>	No: 9.1.3	Action	By using contemporary techniques, inventory of natural and cultural assets will be completed and an effective database will be established.
	Responsible Authority		Ministry of Culture and Tourism
	Related Institutions		Ministry of Forest and Water, Ministry of Environment and Urbanism, Development Agencies, Municipalities, Special Provincial Administrations, Universities
	Period		2010-2014
<b>Targets</b>	No: 4	Target	Central business districts, sub-centers and neighbourhood centers will be developed and vitalized by sustainable policies.
<b>Strategies</b>	No: 4.1	Strategy	Preparation of regulations and supervision of applications that enhance the quality of life and physical standards of city centers will be provided.
<b>Actions</b>	No: 4.1.1	Action	Approaches based on local ownership will be developed for central business districts, sub-centers and neighbourhood centers. Guidelines for vitalizing city centers will be prepared. Service standards will be determined.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		Ministry of Internal Affairs, Municipalities, Special Provincial Administrations, Universities, Chambers
	Period		2010-2014
<b>Targets</b>	No:13	Target	Protect and improve the urban identity
<b>Strategies</b>	No:13.1	Strategy	History, nature, culture are an integral part of the identity of the city. In the planning and design of urban space, these elements will be supported.
<b>Actions</b>	No:13.1.2	Action	Urbanization and planing Museum in National Scale will be founded.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		Ministry of Culture and Tourism, Municipalities, Special Provincial Administrations, Universities, Chambers
	Period		2010-2014
<b>Actions</b>	No:13.1.3	Action	City Guides will be prepared.
	Responsible Authority		Municipalities
	Related Institutions		Ministry of Environment and Urbanism, Governorships, Universities, Chambers
	Period		2010-2014

#### 4.2.1.6. Strategic Actions Related With Smart Environment Domain

Urbanisation strategies will be prepared as energy efficient and eco-friendly. Water management regulations and applications will be coherent with spatial plans. Tools and regulations will be developed for urban ecosystems and forests around cities. Air, water and earth pollution measuring, tracking and information infrastructure, instruments and indicator for the quality of sustainable environment and warning systems for conservation areas will be established.

Table 9 – Strategic Actions of Kentges related with Smart Environment

Axis 2	Increasing the quality of life and physical quality of the settlements.		
<b>Targets</b>	No: 3	Target	Enabling sustainable and diversified land and house production and supply.
<b>Strategies</b>	No: 3.1	Strategy	New applications for balanced and fair arrangement of land distribution and urban transformation will be prepared.
<b>Actions</b>	No: 3.1.5	Action	Development of new management models in residential areas.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		TOKİ, Municipalities, Special Provincial Administrations
	Period		2010-2014
<b>Strategies</b>	No: 3.3	Strategy	Construction and maintenance of houses that are free from the risks that threaten human and environmental health, safe, high quality and provided in accordance with international standards will be achieved.
<b>Actions</b>	No: 3.3.2	Action	For the development of environmentally friendly processes and methods of construction will be carried out.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		Municipalities, Special Provincial Administrations, Universities, Chambers
	Period		2010-2017
<b>Targets</b>	No: 6	Target	Integration of infrastructure projects and investments with urban plans.
<b>Strategies</b>	No: 6.2	Strategy	The quality of urban infrastructure services in accordance with the principles of sustainability will be improved.
<b>Actions</b>	No: 6.2.2	Action	In different regions and in different building types, the use of gray water system will be determined by means of benefit-cost.
	Responsible Authority		Ministry of Environment and Urbanism
	Related Institutions		Ministry of Internal Affairs, Ministry of Forest and Water, TÜBİTAK, Universities
	Period		2010-2014
<b>Actions</b>	No: 6.2.3	Action	Legislation to promote the use and storage of rain water will be prepared.
	Responsible Authority		Ministry of Forest and Water
	Related Institutions		Ministry of Environment and Urbanism, Ministry of Internal Affairs, Municipalities
	Period		2010-2014
<b>Actions</b>	No: 6.2.4	Action	Research, inventory and projection works will be made for meeting urban-oriented energy demands by using renewable energy sources as much as possible.
	Responsible Authority		Municipalities
	Related Institutions		Ministry of Energy and Natural Resources
	Period		2010-2023
<b>Actions</b>	No: 6.2.5	Action	Legislation to promote the use of renewable energy sources in urban areas will be organized.
	Responsible Authority		Ministry of Energy and Natural Resources
	Related Institutions		Ministry of Forest and Water, Municipalities, Governorships
	Period		2010-2023

Inventory for natural and cultural assets will be prepared and effective database<sup>12</sup> structure and tracking system will preserve this assets. The usage of renewable energy sources will be supported in Cities and regulations will be revised for this approach

Table 10 – Strategic Actions of Kentges related with Smart Environment

Axis 2	Increasing the quality of life and physical quality of the settlements.		
<b>Targets</b>	No: 9	Target	Ensure the protection of natural and cultural assets.
<b>Strategies</b>	No: 9.2	Strategy	The conservation and sustainability of all natural resources and protected areas, the development of mechanisms for monitoring and controlling will be established. Different protection decisions will be harmonized in the same field.
<b>Actions</b>	No: 9.2.1	Action	For the management of natural sources and protected areas, protection zones will be detected according to international criterias and biological diversity of these areas will be recorded in to inventory records.
	Responsible Authority		Ministry of Forest and Water
	Related Institutions		Ministry of Environment and Urbanism, Ministry of Culture and Tourism, Ministry of Food, Agriculture and Livestock, TÜİK, Development Agencies, Municipalities, Special Provincial Administrations, Universities, Chambers
	Period		2010-2014
<b>Actions</b>	No: 9.2.2	Action	Warning systems will be established in to protection areas.
	Responsible Authority		Ministry of Forest and Water
	Related Institutions		Ministry of Food, Agriculture and Livestock, Ministry of Environment and Urbanism, Ministry of Culture and Tourism, Municipalities, Special Provincial Administrations, Universities, Chambers, NGOs
	Period		2010-2014
<b>Targets</b>	No:14	Target	Constitution of ecologically sensitive environments in cities.
<b>Strategies</b>	No:14.1	Strategy	Approaches like sustainable usage of natural sources, protection of ecological balance, prevention of pollution, energy efficiency and environmental sensibility will be supported in the planning process of urban areas.
<b>Actions</b>	No:14.1.1	Action	Infrastructure of tracking units that measure, monitor and report pollution levels of air, water and terrain will be developed.
	Responsible Authority		Ministry of Forest and Water
	Related Institutions		Governorships, Municipalities, TÜİK
	Period		2010-2014

#### 4.2.2. National Climate Change Action Plan (NCCAP - iDEP)(2011-2023)

Ministry of Environment and Urbanisation prepared and initiated National Climate Change Action Plan. This action plan is the first strategy document for Turkey that includes green growth principles. Government pay importance to use of alternative energy sources in a wide variety of sectors including industry and residential areas.

<sup>12</sup> Database: Systematically organized or structured repository of indexed that allows easy retrieval, updating, analysis, and output of data. Stored usually in a computer, this data could be in the form of graphics, reports, scripts, tables, text, etc., representing almost every kind of information.

National Climate Change Action Plan was approved and initiated in 2010. The National Vision in this strategy is defined as follows:

”Turkey’s national vision within the scope of “climate change” is to become a country fully integrating climate change-related objectives into its development policies, disseminating energy efficiency, increasing the use of clean and renewable energy resources, actively participating in the efforts for tackling climate change within its “special circumstances”, and providing its citizens with a high quality of life and welfare with low-carbon intensity.” (NCCAP Report, 14, 2011)

Beside supporting the global efforts for preventing climate change, National Climate Change Strategy Plan as a framework creates numerous purposes and advancements in different sectors.

Purposes of NCCAP are as follows:

Energy:

- Reducing energy intensity
- Increase the share of clean energy in energy production and use
- Limit Green House Gases emissions originating from use of coal in electricity production, by using clean coal technologies and taking efficiency-increasing measures
- Reduce losses and illicit use in electricity distribution

Building:

- Increase energy efficiency in buildings
- Increase renewable energy use in buildings
- Limit greenhouse gas emissions originating from settlements

Industry:

- Increase energy efficiency in the industry sector
- Decrease the CO<sub>2</sub> equivalent intensity per GDP produced in the industrial sector until 2023
- Strengthen the capacity of the industry sector for combating climate change

Transportation:

- Developing an intermodal transport system and ensuring balanced utilization of transport modes in freight and passenger transport
- Restructuring urban transportation in line with sustainable transport principles
- Dissemination of the use of alternative fuels and clean vehicle technologies in the transport sector
- Increasing efficiency in energy consumption of transportation sector
- Developing the information infrastructure in the transport sector

Waste:

- Ensure Effective Waste Management

Agriculture:

- Increase the sink capacity of the agriculture sector
- Limitation of greenhouse gas emissions from agriculture
- Develop information infrastructure and capacity in the agriculture sector

Land Use and Forestry:

- Increase the amount of carbon sequestered in forests

- Reduce deforestation and forest damage
- Limit the negative impact of land uses and changes such as forests, pastures, agriculture and settlements on climate change
- Strengthen legal and institutional structure for combating climate change with regard to land use and forestry

#### Crosscutting Issues:

- Establish necessary infrastructure for a robust emission inventory
- Develop policy for environmental protection, and strengthening implementation capacity in consideration of climate change and within the framework of sustainable development principles
- More effective utilization of financial resources for combating and adaptation to climate change
- Optimum usage of emission trading mechanisms that contribute to cost-effective limitation of greenhouse gas emissions
- Ensuring coordination in climate change combating and adaptation activities to increase effectiveness
- Carrying out Turkey's regional climate modeling studies and analyzing the effects of climate change
- Develop R&D and innovation capacity for eco-efficiency with regard to combating climate change and adaptation
- Improve human resources with regard to combating climate change and adaptation to climate change
- Increase public awareness to change consumption patterns into climate-friendly manner

#### Management of Water Resources:

- Integrating adaptation to the impacts of climate change into water resource management policies
- Strengthening water resources management capacity, interagency cooperation and coordination with regard to adaptation to climate change
- Develop and expand R&D and scientific studies to ensure adaptation to the impacts of climate change in water resources management
- Integrated management of water resources and water basins for adaptation to climate change
- Planning renewable energy resources taking into consideration the impacts of climate change and the sustainability of the ecosystem services oriented to increase resilience to climate change

#### Agriculture Sector and Food Security:

- Integrating climate change adaptation into the agriculture and food security policies
- Developing and expanding R&D and scientific studies to identify the impacts of climate change on agriculture and to ensure adaptation to climate change
- Sustainable planning of water utilization in agriculture
- Protecting soil and agricultural biodiversity against the impacts of climate change
- Developing institutional capacity and improving interagency cooperation in Turkey with regard to adaptation alternatives in agriculture

#### Ecosystem Services, Biodiversity and Forestry:

- Integration of the climate change adaptation approach to ecosystem services, biodiversity and forestry policies
- Identifying and monitoring the impacts of climate change on biodiversity and ecosystem services

Natural Disaster Risk Management:

- Identifying threats and risks for management of natural disasters caused by climate change
- Strengthening response mechanisms for natural disasters caused by climate change

Public Health:

- Identifying the existing and future effects and risks of climate change on public health
- Developing the capacity to combat risks originating from climate change in the national healthcare system

Crosscutting Issues in The Context of Adaptation to Climate Change:

- Ensuring adaptation to climate change on crosscutting issues

National Climate Change Action Plan has various actions that can be correlated with smart cities approach. We can group some of strategic actions under 6 core domains of Smart City.

#### 4.2.2.1. Strategic Actions Related With Smart Economy Domain

Table 11 –Actions of NCCAP related with Smart Economy

<b>Action Area</b>	<b>E 1.3.1.</b>	Increase financial resources allocated to R&D on energy efficiency by 100% of 2009 figures by 2015
<b>Action</b>	<b>E 1.3.1.2.</b>	Providing R&D and innovation support to energy efficiency technologies that are not yet transformed into products and services
<b>Outputs and Benefits</b>		Number of R&D and innovation projects supported
<b>Action Area</b>	<b>S 3.1.1.</b>	Providing the sector with technical support on renewable energy, energy efficiency, clean production and combating climate change
<b>Action</b>	<b>S 3.1.1.2.</b>	Providing information for industrial sectors
<b>Outputs and Benefits</b>		Number of activities. Increased awareness.
<b>Action Area</b>	<b>S 3.1.2.</b>	Strengthen the capacity for developing energy management systems
<b>Action</b>	<b>S 3.1.2.6.</b>	Establishing the Industry Climate Change Technology Platform
<b>Outputs and Benefits</b>		Establishment of the Platform
<b>Action Area</b>	<b>U 3.2.2.</b>	Encouraging use of clean fuel and clean vehicle technologies by private automobile users and commercial fleets in urban transportation
<b>Action</b>	<b>U 3.2.2.1.</b>	Establishing charging stations for electric automobiles in cities
<b>Outputs and Benefits</b>		Charging stations for electric Automobiles. Decrease in dependence on foreign resources (oil)
<b>Action Area</b>	<b>U 4.1.1.</b>	Spreading use of vehicles with high energy efficiency in land, sea, air transport
<b>Action</b>	<b>U 4.1.1.1.</b>	Supporting R&D studies on clean fuel and vehicle technologies in the production of land, sea, air vehicles that have high energy efficiency
<b>Outputs and Benefits</b>		R&D projects final reports. Innovation and Competitiveness

#### 4.2.2.2. Strategic Actions Related With Smart Living Domain

Table 12 –Actions of NCCAP related with Smart Living

<b>Action Area</b>	<b>B 1.1.1.</b>	Identifying energy efficiency potential and priorities in order to ensure heat insulation and energy efficient systems in buildings
<b>Action</b>	<b>B 1.1.1.1.</b>	Preparing a database containing energy consumption data for building subsectors, and developing benchmarking indicators
<b>Outputs and Benefits</b>		Database, benchmarking indicators
<b>Action Area</b>	<b>B 1.5.1.</b>	Reducing the annual energy consumption of the buildings and premises of public institutions
<b>Action</b>	<b>B 1.5.1.1.</b>	Building databases for public buildings, identifying the buildings with highest energy consumption.
<b>Outputs and Benefits</b>		Building and Energy Database for Public Buildings, Improvement in public information System
<b>Action Area</b>	<b>B 3.1.2.</b>	Developing policies and legal arrangements for energy-efficient and climate-sensitive settlement/ building, and implementing them through pilot projects
<b>Action</b>	<b>B 3.1.2.1.</b>	Developing energy-efficient and climatesensitive planning and settlement principles and criteria for different climatic zones; preparing a guide for effective implementation of sustainable urban plans
<b>Outputs and Benefits</b>		Publication of sustainable urban settlement guide and delivering them municipalities, Capacity building, increase in life quality, sustainable settlements, increase in employment opportunities
<b>Action</b>	<b>B 3.1.2.2.</b>	Developing and implementing urban settlement plans covering sustainability elements such as land use, ecology, transportation, water management, gray water, green/white roofs etc, using lifecycle cost evaluation methods, within the framework of pilot projects
<b>Outputs and Benefits</b>		Sustainable urban settlement plans for pilot zones, number of new model settlements/ districts/building complexes/ neighbourhood units developed / constructed by means of national and international energy efficiency methods, Sustainable settlements, ensuring effectiveness/ efficiency in material, water, land and energy use, increase in life quality
<b>Action Area</b>	<b>U 2.1.2.</b>	Development and improvement of bicycle and pedestrian transport
<b>Action</b>	<b>U 2.1.2.4.</b>	Promoting the “Slow city” (Slowcity) concept, implementing practices in this line
<b>Outputs and Benefits</b>		Increase in the number cities getting “Slow city” certificate. Realization of sustainable city concept and applications
<b>Action Area</b>	<b>U 3.2.2.</b>	Encouraging use of clean fuel and clean vehicle technologies by private automobile users and commercial fleets in urban transportation
<b>Action</b>	<b>U 3.2.2.2.</b>	Offering free or low-priced parking areas to clean fuel and clean vehicle users in urban centres
<b>Outputs and Benefits</b>		Legislative arrangement Municipalities. Decrease in dependence on foreign resources (oil)



#### 4.2.2.3. Strategic Actions Related With Smart Governance Domain

Table 13 –Actions of NCCAP related with Smart Governance

<b>Action Area</b>	<b>B 3.1.2.</b>	Developing policies and legal arrangements for energy-efficient and climate-sensitive settlement/ building, and implementing them through pilot projects
<b>Action</b>	<b>B 3.1.2.3.</b>	Identifying principles and procedures for energy-efficient, climate-sensitive, sustainable urban settlement planning and, using the results of pilot projects, transferring the outputs to the physical development planning legislation so as to put sustainable urban plans into practice
<b>Outputs and Benefits</b>		Publication of legal arrangements regarding sustainable urban settlement in Official Gazette, Efficiency in material, water, land use, increase in level of health, prosperity and life quality, sustainable settlements
<b>Action Area</b>	<b>U 2.1.3.</b>	Implementing travel demand side management techniques that discourage use of automobiles in travels to city centre
<b>Action</b>	<b>U 2.1.3.2.</b>	Evaluating the practices for limiting automobile entrance to city centers
<b>Outputs and Benefits</b>		Assessment report. Additional income for local administrations
<b>Action Area</b>	<b>U 3.1.2.</b>	Developing a taxing and pricing system based on limiting greenhouse gas emissions in motor vehicles
<b>Action</b>	<b>U 3.1.2.1.</b>	Examining examples of low-toll passage practices and surveying their feasibility for Turkey
<b>Outputs and Benefits</b>		Study report. Technological development, Capacity development
<b>Action</b>	<b>U 3.1.2.3.</b>	Offering low-toll passage opportunities to vehicles with low GHG emission in motorway and bridge toll fees
<b>Outputs and Benefits</b>		Implementation of differentiated tariffs. Reduced air pollution
<b>Action</b>	<b>U 3.1.2.4.</b>	Promoting alternative fuels and clean vehicles by making arrangements in the tax legislation within the framework of currently implemented economic programme and budget policies
<b>Outputs and Benefits</b>		Legal arrangements. Alignment with the EU, Promotion of the technology development national capacity

#### 4.2.2.4. Strategic Actions Related With Smart Mobility Domain

Table 14 –Actions of NCCAP related with Smart Mobility

<b>Action Area</b>	<b>U 1.1.1.</b>	Improving the infrastructure and superstructure of railroads
<b>Action</b>	<b>U 1.1.1.1.</b>	Renewing the existing railroad network, raising its standards and completing its electrification and signalling
<b>Outputs and Benefits</b>		New line ratio defined. Decrease in dependence on foreign resources (oil)
<b>Action Area</b>	<b>U 1.1.3.</b>	Increasing the passenger transport service quality in railways
<b>Action</b>	<b>U 1.1.3.1.</b>	Implementing operational approaches that shortens journey time and ensures delivery of prompt and comfortable services
<b>Outputs and Benefits</b>		Guidelines for good operational practices, in-service personnel training, performance evaluation guides, increase in number of passengers. Decrease in traffic density on highways
<b>Action</b>	<b>U 1.1.3.2.</b>	Improving information and online purchase services regarding tariffs, train schedules and ticket sales
<b>Outputs and Benefits</b>		User-friendly website, increase in informative materials and methods. Decrease in traffic density on highways. Economic gains
<b>Action Area</b>	<b>U 1.2.1.</b>	Improving the maritime transport infrastructure
<b>Action</b>	<b>U 1.2.1.1</b>	Improving technology, infrastructure and standards in existing ports
<b>Outputs and Benefits</b>		Advanced technology and infrastructure investments in ports. Decrease in traffic density on highways
<b>Action Area</b>	<b>U 1.2.2.</b>	Renewing and improving the fleet used in maritime transportation
<b>Action</b>	<b>U 1.2.2.3.</b>	Implementing modern operation techniques in ports
<b>Outputs and Benefits</b>		In-service trainings on state of the art operation techniques, operation directives. Decrease in passenger, freight and vehicle density on highways
<b>Action Area</b>	<b>U 1.3.3.</b>	Making use of the developments in the information and communication technologies and smart transport systems in highways
<b>Action</b>	<b>U 1.3.3.1.</b>	Conducting R&D studies to develop smart transport systems
<b>Outputs and Benefits</b>		R&D final reports. Improvement of national industrial and technological capacity
<b>Action</b>	<b>U 1.3.3.2.</b>	Establishment of Main Traffic Management System Centre
<b>Outputs and Benefits</b>		Commercialization of new technologies MoTC. Decrease in traffic accidents and cost of lost time in traffic
<b>Action Area</b>	<b>U 2.1.1.</b>	Developing and improving public transport services
<b>Action</b>	<b>U 2.1.1.3.</b>	Integrating mass transport systems with each other and other urban transport modes
<b>Outputs and Benefits</b>		Integrated public transport plan, increase in use of public transport. Improvement of public services, Improvement of access/ transportation possibilities for all segments of the society, Less traffic jams
<b>Action</b>	<b>U 2.1.1.4</b>	Arranging the common ticket system in public transport in a way that will increase number of users
<b>Outputs and Benefits</b>		Cost/benefit analyses for price arrangements, common ticket and card applications, public information, legal arrangements. Less traffic jams

Table 15 –Actions of NCCAP related with Smart Mobility

<b>Action Area</b>	<b>U 2.1.2.</b>	<b>Development and improvement of bicycle and pedestrian transport</b>
<b>Action</b>	<b>U 2.1.2.1.</b>	Establishing citywide bicycle road networks (bicycle roads or lines), bicycle parking areas, smart bicycle/ bicycle stations
<b>Outputs and Benefits</b>		Increased bicycle road network, increased capacities of bicycle parking areas. Improvement of access/ transportation possibilities for all segments of the society
<b>Action</b>	<b>U 2.1.2.2.</b>	Creating automobile-free pedestrian ways and areas in city centres, ensuring pedestrians can reach everywhere within the urban road network
<b>Outputs and Benefits</b>		Automobile-free pedestrian ways and areas in city centres, easy-to-use urban road network for pedestrians. Improvement of access/ transportation possibilities for all segments of the society
<b>Action</b>	<b>U 2.1.2.3.</b>	Implementing urban planning approaches to turn pedestrian and bicycle trips into attractive alternatives
<b>Outputs and Benefits</b>		Standards and guidelines for public transport, bicycle and pedestrian access in planning and design. Improvement of access/ transportation possibilities for all segments of the society, Alignment with the EU
<b>Action</b>	<b>U 2.1.3.1.</b>	Effective supervision of onroad vehicle parking in urban centres, using existing parking lot capacity for short-duration parking, implementing deterrent pricing policies and installing smart parking lot systems
<b>Outputs and Benefits</b>		Directive on operation principles and procedures for commercial parking lots in urban centres, legislative rearrangement on roadside parking, increase in parking prices. Decrease of the cost of time loss in traffic
<b>Action Area</b>	<b>U 4.1.4.</b>	<b>Developing and implementing climatesensitive urbanization and transport strategies with high energy efficiency</b>
<b>Action</b>	<b>U 4.1.4.2.</b>	Supporting R&D on “Smart Transport Systems” and “Traffic Management” practices, and establishing Smart Transport System Centres
<b>Outputs and Benefits</b>		R&D final reports, transport corridors using Smart Transport System. Increase in sector efficiency
<b>Action Area</b>	<b>U 5.1.1.</b>	<b>Strengthening the information infrastructure for freight and passenger transport</b>
<b>Action</b>	<b>U 5.1.1.1.</b>	Making surveys to establish transport databases in urban transport at the local level, and developing codes that will enable collecting comparative data
<b>Outputs and Benefits</b>		Transport and Travel Survey results report
<b>Action</b>	<b>U 5.1.1.2.</b>	Collecting, computerizing, monitoring and evaluating real and reliable transport data in passenger and cargo transportation in all sectors by building the necessary infrastructure
<b>Outputs and Benefits</b>		Periodically updated data base
<b>Action</b>	<b>U 5.1.1.3.</b>	Conducting research and creating statistical data on use of alternative fuels in passenger and freight transportation
<b>Outputs and Benefits</b>		Periodically published statistical reports, monitoring system, periodically published statistical Reports
<b>Action</b>	<b>U 5.1.1.5.</b>	Keeping data and statistics on emission data of all vehicles used in passenger and freight transportation, developing strategies to limit emissions
<b>Outputs and Benefits</b>		Periodically updating statistical Reports
<b>Action</b>	<b>U 5.1.1.6.</b>	Examining all transport lines in terms of GHG emissions and ensuring the data is recorded as Measurable, Reportable and Verifiable
<b>Outputs and Benefits</b>		Periodically updating statistical reports, with MRV data

#### 4.2.2.5. Strategic Actions Related With Smart People Domain

Table 16 –Actions of NCCAP related with Smart People

<b>Action Area</b>	<b>S 3.1.1.</b>	Providing the sector with technical support on renewable energy, energy efficiency, clean production and combating climate change
<b>Action</b>	<b>S 3.1.1.1.</b>	Developing guidebooks on combating climate change and organizing congresses/seminars/workshops in the industrial sub-sectors
<b>Outputs and Benefits</b>		Guidebooks, congresses, seminars, workshops

#### 4.2.2.6. Strategic Actions Related With Smart Environment Domain

Table 17 –Actions of NCCAP related with Smart Environment

<b>Action Area</b>	<b>E 1.1.1.</b>	Collecting sectoral energy data, identifying and evaluating benchmarking indicators
<b>Action</b>	<b>E 1.1.1.1.</b>	Establishing a database and Collecting sectoral energy data, identifying and evaluating benchmarking indicators
<b>Outputs and Benefits</b>		Regularly updated energy database, periodically published benchmarking indicators
<b>Action Area</b>	<b>E 1.2.1.</b>	Delivering trainings and raising awareness on energy efficiency
<b>Action</b>	<b>E 1.2.1.2.</b>	Evaluating the awareness-raising activities using the “energy efficiency awareness index” method and announcing the results
<b>Outputs and Benefits</b>		Decrease in environmental pollution, Increased public awareness
<b>Action Area</b>	<b>E 4.1.1.</b>	Improving technical infrastructure and preventing illicit use
<b>Action</b>	<b>E 4.1.1.1.</b>	Taking necessary supportive measures to rehabilitate and strengthen distribution networks and move towards “Smart Grid” applications
<b>Outputs and Benefits</b>		Specified reduction objectives on loss/illicit use achieved.
<b>Action</b>	<b>E 4.1.1.2.</b>	Increasing inspections to prevent illicit electricity use, and conducting activities on this issue
<b>Outputs and Benefits</b>		Amount of reduction in illicit energy use
<b>Action Area</b>	<b>S 2.2.1.</b>	Support R&D and technology transfer activities on low GHG emission technologies in the industry sector
<b>Action</b>	<b>S 2.2.1.1.</b>	Conducting a Technology Needs Assessment (TNA) on limitation of GHG emissions in the industry sector
<b>Outputs and Benefits</b>		Sector-based TNA reports, using outputs under UNFCCC
<b>Action Area</b>	<b>U 3.2.1.</b>	Increasing the use of alternative fuel and clean vehicle technologies in public Transportation
<b>Action</b>	<b>U 3.2.1.1.</b>	Determining and putting into practice the strategy of bus and minibus fleets with regard to vehicles with low-carbon emissions
<b>Outputs and Benefits</b>		Increase in the number of vehicles using clean fuel in public transport busses and minibuses. Development of new technologies
<b>Action</b>	<b>U 3.2.1.2.</b>	Determining and putting into practice the strategy of bus and minibus fleets with regard to vehicles with low-carbon emissions
<b>Outputs and Benefits</b>		Increase in the number of vehicles using clean fuel in public transport busses and minibuses. Development of new technologies
<b>Action Area</b>	<b>U 4.1.4.</b>	Developing and implementing climatesensitive urbanization and transport strategies with high energy efficiency
<b>Action</b>	<b>U 4.1.4.3.</b>	Identifying the impacts of smart transport, super/sub structures in the city, OGS and OKS on limiting GHG emissions
<b>Outputs and Benefits</b>		Evaluation reports

Table 18—Actions of National Climate Change Action Plan related with Smart Environment

<b>Action Area</b>	<b>A 1.1.3.</b>	Developing institutional capacity for monitoring and supervision of IWMP practices
<b>Action</b>	<b>A 1.1.3.1.</b>	Integration of the data and information system that will be developed to ensure effective monitoring and supervision of IWMP practices into the Environmental Information System (EIS)
<b>Outputs and Benefits</b>		Development of software system, operation of EIS in a sustainable manner, regular reporting of verifiable data as of 2018. Alignment with the EU
<b>Action</b>	<b>A.1.1.3.2.</b>	Establishing an effective monitoring and supervision mechanism for management of wastes
<b>Outputs and Benefits</b>		Monitoring and inspection Reports. Establishment of an efficient inspection mechanism, a smoothly operating waste management system
<b>Action Area</b>	<b>A 1.2.2.</b>	Utilization of the landfill gas
<b>Action</b>	<b>A 1.2.2.1.</b>	Calculating the landfill gas created on the site, and assessing the necessary systems with a feasibility study
<b>Outputs and Benefits</b>		Landfill gas management plan, application investments. Protection of human health, contribution to the economy, ensuring sustainability, protection of natural resources, alignment with the EU
<b>Action</b>	<b>A 1.2.2.2.</b>	Collecting the landfill gas (biogas) created in the suitable sections of the covered areas of landfill sites and ensuring their use in energy generation
<b>Outputs and Benefits</b>		Number of active gas collection and flaring systems in landfill areas. Protection of human health, contribution to the economy, ensuring sustainability, protection of natural resources, alignment with the EU
<b>Action Area</b>	<b>A 1.3.1.</b>	Effective implementation of source-separated collection of wastes
<b>Action</b>	<b>A 1.3.1.3.</b>	Developing an effective monitoring and inspection mechanism for waste management
<b>Outputs and Benefits</b>		Work program and reporting guidelines for monitoring and inspection system, monitoring and inspection reports, number of firms being monitored and inspected
<b>Action Area</b>	<b>A 1.4.1.</b>	Increasing the number of compost and biomethanisation plants
<b>Action</b>	<b>A 1.4.1.2.</b>	Conducting studies to generate renewable energy from all waste sources (i.e. domestic wastes and other municipal wastes) that have an energy value
<b>Outputs and Benefits</b>		Waste-to-energy potential analysis report. New employment opportunities, technological development
<b>Action</b>	<b>A 1.4.1.3.</b>	Ensuring that local governments benefit from incentives for implementation of waste management systems
<b>Outputs and Benefits</b>		Number of municipalities receiving incentives

Table 19 –Actions of National Climate Change Action Plan related with Smart Environment

<b>Action Area</b>	<b>Y 1.1.2.</b>	Strengthening cooperation in preparation of greenhouse gas emission inventory
<b>Action</b>	<b>Y 1.1.2.1.</b>	Establishing infrastructure for generating, collecting and registering measurable, verifiable and reportable data in a database, for monitoring and assessment of greenhouse gas emissions in all sectors
<b>Outputs and Benefits</b>		Greenhouse gas emission Database
<b>Action Area</b>	<b>Y 2.1.2.</b>	Developing mechanisms for monitoring and assessment to track indicators related to combating climate change
<b>Action</b>	<b>Y 2.1.2.2.</b>	Building a national system for monitoring, registering and evaluating the plans, programmes, strategies and projects for limitation of greenhouse gas emissions
<b>Outputs and Benefits</b>		Reporting and impact assessment guides. Information based decision making
<b>Action</b>	<b>Y 2.1.2.3.</b>	Monitoring and evaluating the effect of sectoral economic instruments on the limitation of greenhouse gas emissions
<b>Outputs and Benefits</b>		Periodical Monitoring and Evaluation reports. Information based decision making
<b>Action Area</b>	<b>Y 6.1.1.</b>	Developing the climate observation capacity
<b>Action</b>	<b>Y 6.1.1.2.</b>	Collecting data for creating continuous and periodic climatologic observation series, quality control and archiving in the database
<b>Outputs and Benefits</b>		Up-to-date, comprehensive database
<b>Action Area</b>	<b>Y 7.1.2.</b>	Supporting R&D studies on combating climate change
<b>Action</b>	<b>Y 7.1.2.5.</b>	Establishing an “Eco-efficiency Centre” to provide information, training and consulting services to producers and consumers
<b>Outputs and Benefits</b>		Eco-efficiency centre starting Operation. Efficient use of resources

#### 4.2.3. The 10th.Transportation and Communication Forum

Transportation and communication has a direct relation with economy. Economic performance of a city and efficiency of transportation and communication are correlated issues. The 10th. Transportation and Communication Forum that was held by Ministry of Transportation and Communication, focused on transportation and communication infrastructures, infrastructure interconnections, innovations, long term projects and solutions for the needs of transportation and communication sectors

In forum, there are 837 different project were listed for different sectors. From Smart City point of view, some project suggestions are listed below:

##### 4.2.3.1. Suggested Projects Related With Smart Economy Domain

*Integrated Ticketing Sub-Structure:* Transfers from one network to another or from one type of transport to another will be maintained. For achieving this goal, integrated ticketing systems beetwen different transportation modes (air- vehicles - ferry - public transport - parking) will be implemented.

#### **4.2.3.2. Suggested Projects Related With Smart Living Domain**

*Every home broadband access:* 100% of the households have to be connected via fiber and broadband wireless access networks.

*E-Learning / E-Commerce Project:* Broadband access infrastructure will be developed for distance learning, remote health care services, security, e-commerce applications and electricity, water, natural gas consumption measurement and billing for offices and residences.

*E-Patient History Project:* Health information for all citizens will be accessible from fixed or portable terminals.

#### **4.2.3.3. Suggested Projects Related With Smart Governance Domain**

*E-Government Project:* E-government and mobile-government services and applications should be spread nationwide.

*Establishment of a National E-mail Platform:* National E-mail Platform will be established for the distribution of electronic signature and providing an e-mail address to every citizen.

#### **4.2.3.4. Suggested Projects Related With Smart Mobility Domain**

*Establishment of Main Traffic Management Centers:* Especially in highways of large cities, traffic congestion has started to come up as a major problem. As a result of traffic accidents, congestion may become even more unbearable. For this reason, establishment of the main Traffic Management Systems is important.

*Expansion of Intelligent Transportation Systems:* Road safety, congestion management, weather pre-alarm systems, intelligent systems, such as OGS-KDS has to be expanded in roads. These systems have important cost reduction effects when they applied.

*Establishment of Digital Transportation System:* Transportation system should be convert in to digital completely and integrated with information technologies.

*Statistical Information Data Base:* Statistical database covering all aspects of the logistics industry must be established and updated continuously.

*Smart Transportation Solutions:* Smart transportation systems and related standards should be established in traffic management. The latest technologies and smart transportation systems should taken in to account during the planning phases for the efficiency and effectiveness for different modes of transport. Comfort of transport services should be increased by providing integration between different modes of transportation.

*Black-Box Applications:* In order to investigate the prevention of traffic accidents, making R & D studies for placement of the black box to vehicles have to be supported.

*Highway Statistics Database Project:* R & D activities for the creation of new statistical data systems will be supported.

*Traffic Data Collection and Analysis Studies:* Traffic composition, analysis and surveys for guiding the decisions and activities of highways improvement, expansion and operational controls will be supported.

*Railways Information Technology Integration:* Railway security system based on satellite technology will be established. With the help of ViMAx system, train information system will be available in everywhere and provide media and communications services. While travelling with trains along the route, automation and information system that serves historical and cultural information will be established.

With the Geo-coding, location specific historical and cultural information will be conveyed to passengers. The main stops on the route there will be animation centers, theme parks. The establishment of smart railway centers and fully integrated railway infrastructure must be provided.

*Train-Track Control System:* NDT solutions that enable the control of trains will be established. With the help of train-track control system, continuous follow-up, optimization of trip schedules and periodic maintenance of trains can be organized.

*Urban Access Information System:* In transportation network from slums to urban centers, there must be given online access speeds for each type of transport mode.

*Traffic Control and Management Centre:* Traffic control centers will be established in all cities. The usage electronics control systems will be promoted across the country. Traffic management system will be adapted for giving more priority to the public transportation. Differentiated pricing solutions that are sensitive to the traffic congestion will be implemented.

*Transportation Information System:* In commercial vehicles, automatic vehicle identification, routing, navigation safety and driving support systems will be installed. Dynamic passenger, driver and pedestrian information systems should be established in metropolitan urban transport networks

*Smart Transport Systems:* Establishment and expansion of smart transport systems and its standard will be maintained. By the integration of different transport modes, efficiency and effectiveness will be ensured. By the help of information technology, all details related to travel should reach to all passengers.

*Establishment of Urban Transportation Data Base:* Urban transportation database that covers all cities should be established. For this purpose, the dynamic database should be established in every city.

*Establishment of Mobility Database:* For all cities, "Mobility Database" should be established and continuously updated.

*IT and Integrated Transport Management System:* Communication infrastructure have to be installed for collaborative operation of smart transportation systems. These systems should be cover both wired or wireless technologies.

*Passenger Information and Warning System:* For the determination of start and end points of routes by passengers, choosing vehicle types, line numbers, the nearest stops, stop frequency and duration of next vehicle information and similar informative data should be provided to the passengers by telephone, internet or SMS.

*Integrated Transportation Solutions:* In 10 major cities, integrated public transport systems that are supported by intelligent transportation systems will be established.



#### 4.2.3.5. Suggested Projects Related With Smart Environment Domain

*Activation of Disaster Management Center:* Disaster management system has to be prepared as a proactive process for the existing key critical infrastructures in each city. In addition, in disaster situations, this system allows the least damage output.

#### 4.2.4. Other Strategic Actions and Plans in National Scale

##### 4.2.4.1. National Geographical Information System Portal

Smart city systems need realtime, multi-dimensional data for making quick and right decisions. Data evaluation process is also important. Because data have to be evaluated into knowledge with the help of systems and services.

Ministry of Environment and Urbanism is working on development of Geographical Information Systems. Until 2017, Regional Strategic Spatial Plans and National Geographical Information System Portal will be prepared and linked with INSPIRE European Spatial Data Infrastructure that will enable sharing urban spatial information among public authorities and public access across Turkey. A European Spatial Data Infrastructure will be completed in 2019.

##### 4.2.4.2. Energy ID Certificate

Smart cities are internalize and apply approaches like; sustainable use of natural resources, protection of ecological balance, preventing pollution, energy efficiency and eco-friendly.

Legislative and technical studies that aim to increase energy efficiency in buildings and industry continue throughout the country.

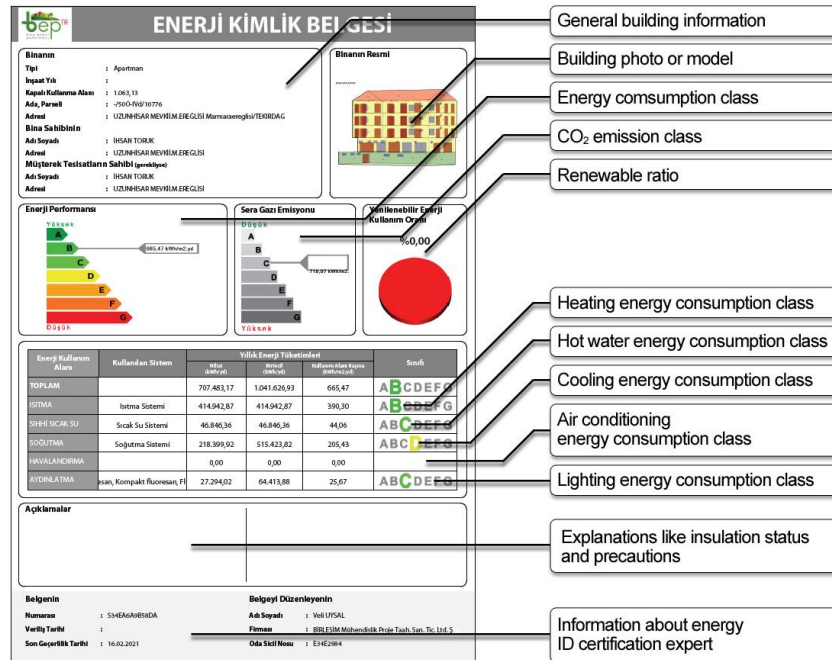


Figure 44 - Energy ID Certification

Increasing the share of renewable energy resources in total energy consumption up to 30% and using smart grid systems is the main goals of government.

Sub-goals for buildings can be listed as; preparation of energy efficiency and environmental regulation criterias, setting large scale central heating or co-generation infrastructures, extensive usage of alternative energy sources like geothermal, solar and wind.

After 2017, all buildings will mandatorily take an Energy ID Certificate. New buildings that are constructed since 2011 are taken Energy ID Certificate.

#### 4.2.4.3. National Transport Portal

Ministry of Transportation and Communication established a portal for collecting different transportation related services and applications in a single environment in 2012 called National Transport Portal (UUP – Ulusal Ulaştırma Portalı). Portal contains services ;

Travel planner that supports different modes of transportation,  
E-transport that collects e-government services related with transportation,  
Flight information like arrival and departure times of airplanes of different airlines,  
Query of cargo for different courier companies.  
Weather condition from interactive map  
Country and city guides.  
Educational materials like videos, animations and games for children to learn traffic rules.  
Mobile applications for different devices  
Road conditions

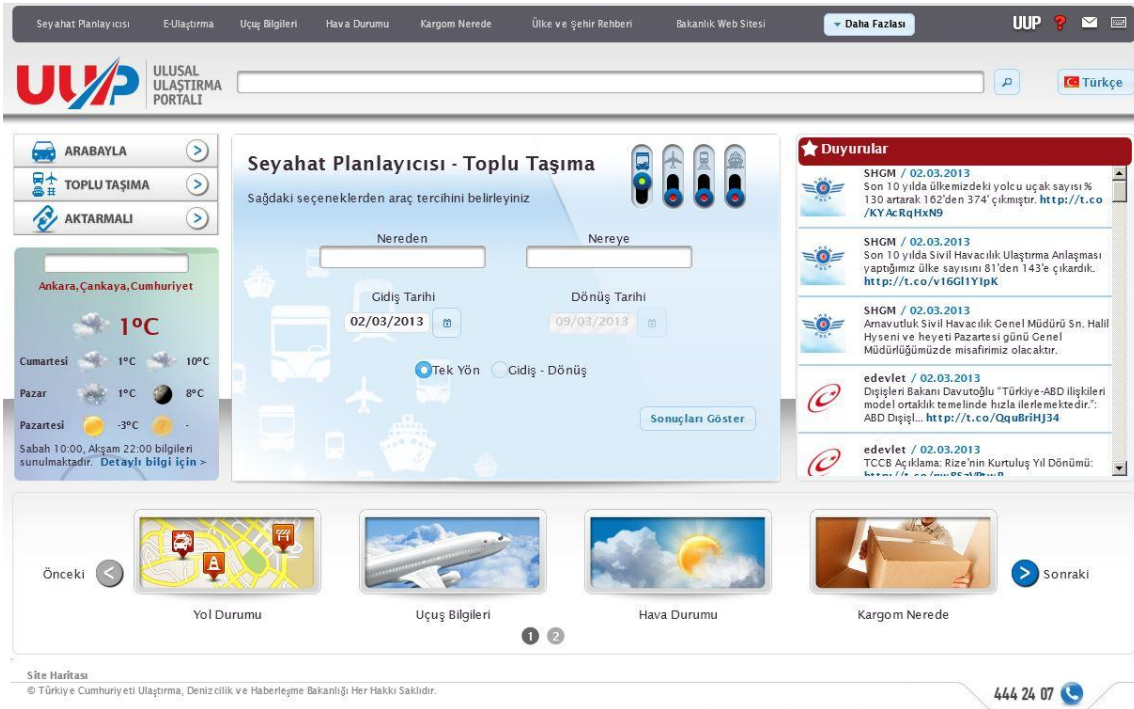


Figure 45 - National Transport Portal Interface

#### 4.2.4.4. Various Database Applications and Digital Assets

Today different governmental bodies invest to ICT systems and working on constitute a repository about thier related sectors. Some of them can be listed below.

- ENVANIS – Forest Inventory Information System Based on Development Plans (General Directorate of Forestry)
- Digitalized Basin Rehabilitation Studies (General Directorate of Forestry)
- Forestry Information System (General Directorate of Forestry)
- Locational ORBIS – KORBIS Geographical Information System
- Digital Maps for Biological Diversity Tracking
- Seed and Genealogy Bank
- Coordination of Information on the Environment-CORINE Project
- Digital Stance Maps and Other Statistical Data
- International Cooperation Program For Air Pollution And Its Effects on Forests (ICP Forests)
- Fire Management Information System
- Farmars Record System
- Agricultural Basin Data Base
- Earth Data Base
- Land Consolidation and Rural Infrastructure Database
- Water Data Base
- City Inventory And Decision Support System Project (ILEMOD)

#### 4.3. Case Studies in Local Scale

Spatial urban plans have to be correlated with technical infrastructure, transportation and other city systems. Administation, technical and economical aspects should be assessed with infrastructure master plans.

Continuously monitored urban infrastructure provides data and local governments have a chance to take smart decisions and manage priorities of labor ve financial source precisely.

Today in our metropolitan areas, local goverments and private companies try to invest in smart infrastructure systems and services.

In Mamak / Ankara, private company called ITC initiated investments that can be corelated with smart city operations. ITC started energy production from Biomass<sup>13</sup>. With the increased urbanization and population in Ankara, dump site in Mamak creates risks. With an increased landfill area of waste disposal carries risk of explosion and diseases, pollutes natural sources liki air and underground water.

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<sup>13</sup> Biomass is a biological substances in the from of living organisms that can be used as renewable energy source. Biomass can be turned in to energy by three alternative process: *thermal conversion*, *chemical conversion*, and *biochemical conversion*.



Figure 46 - Rehabilitation Of The Waste Disposal Area And Gas Utilization (ITC)

ITC drained leachate water from dump site and collect emitted methane gas for reducing explosion possibility and environmental pollution.

Collected gases are transferred to gas engines by piping system for energy production. From environmental protection point of view, methane is more dangerous than CO<sub>2</sub> in global warming. In 2009, with the collected methane gases 22.6 MW energy produced which is the highest capacity level reached from single landfill area in the world. There is a second power plant planned with 10 MW capacity.



Figure 47 - Anaerobic Digestion Systems (ITC)

Besides its environmental benefits, ITC's Integrated Solid Waste Management Systems and Anaerobic Digestion Systems help for reducing the volume of wastes and increase the capacity of waste land as an economic benefits.



Figure 48 – Utilization of Waste Heat in Greenhouses

Under the operation of Integrated Solid Waste Management Systems, while the energy producing from biogas, excess heat is using in greenhouses.

As another smart city project, Beyoğlu Municipality Services can be investigated. Beyoğlu Municipality established The Smart City Automation System. Information database constituted as a base of services for citizens, houses, streets. Municipality transferred all paperworks in to digital environment and previously issued informations and archives also digitalized.

Smart City Automation System contains 45 heighborhoods of Beyoglu with approximately 28.000 buildings, more than 130.000 houses, nearly 45.000 workplaces data and surveys collected. Under the Smart City Automation System, municipality initiated Management Data System Automation and Geographical Data System.

#### The Benefits of Smart City Otomation Systems (AKOS)

- Elasticity of data infrastructure system is achieved with an agile and efficient service maintained.
- Sub elements of municipal organization integrated.
- With the help of information, data and analysis, municipality prioritized its tasks.
- Effective resource management with a pricise data is implemented.
- For all the provisions brought by the new legislations, the required bases are prepared, the issue of Strategic Plan Making for instance. The applications which enables the questioning, detailing and analyzing with multiple dimensions are exposed to the use of the Municipality.
- With the effective resource management, optimization budged achieved.
- Information based management process is initiated.
- Municipality gained a capability of creating new values added services for residents
- With the help of trainings efficiency of competency of municipality's personel increased.
- The Municipality's bureacratc proceses become standard and transparent.
- Municipality's services are accessible from everywhere
- Citizen participation in the process of facilitating is implemented.
- Standardization of services for every citizen archieved..
- Wtith the effective knowledge anagement and coordination, bureaucracy reduced.

Another application implemented in Ankara as as a smart mobiliy service is Ankara EGO Public Transportation Information System. Metro, bus, minibus, bus stops and routes collected in a database and citizens can get information about distance, time and cost of their preferred trips in city.

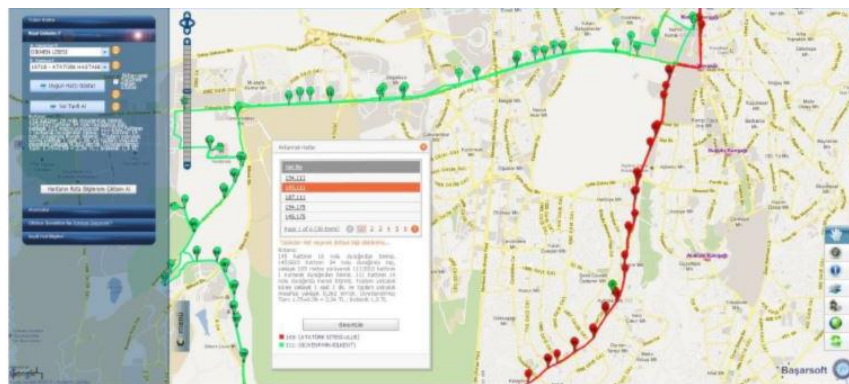


Figure 49 - Ankara EGO Public Transportation Information System Interface

Ministry of Transportation and Communication implemented another service as a Smart Living application called “GörenGöz” for the blind people. Blind people can use a special navigation software for mobile devices. This software gives information about location, messaging, emergency call functions by using an embossed screen

## CHAPTER 5

### CONCLUSION

Today cities are carrying more than half of the total world population. Cities are the places where social inclusion, accumulation points of social, financial and intellectual capitals and innovation centers. But cities also create different challenges. They emit three quarters of CO<sub>2</sub>, consume 70% of energy production and generate huge amount of waste. Demographically, in developing countries there are large number of young people face with unemployment. In developed countries population growing older. Capacity of transportation systems forcing their limits. Pollution and energy use are rising which causes increase in price of these services and effects quality of life.

Smarter cities have an opportunity to solve these differentiated challenges. They provide an eco friendly approach to climate change and creates process with an efficient resource management. Smart concept increase the quality of life of its inhabitants.

Smartness means the right use of data that are coming from different sources, like sensors, social networks and statistics etc. Also it means supporting people by providing better information and interfaces to invite them in to policy-making and service development progress. Another aspect of smart city is creating a benefit from collaboration of transport, energy, water and healthcare systems. Integrating these systems can create benefits and efficiency. This results delivering better service to citizens

In Turkish context, municipalities implement some limited projects for using ICT technologies to give certain services to their citizens. These efforts have to be supported by central government with a holistic approach.

As a strategic actions and plans in national scale, Ministry of Environment and Urbanism, Ministry of Internal Affairs and Ministry of Transport prepared strategic action plans. Also some municipalities and private companies initiated smart city services. Municipality messaging services, Natural resource management systems, financial management systems, project management systems and payment management systems are possible services that can be initiated as IT Based services.

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