Planlama 2016;26(2):130-146 | doi: 10.14744/planlama.2016.27247

ARTICLE / ARAŞTIRMA

Ultimate ICT Network in Turkey For Smart Cities

Akıllı Kentler İçin Türkiye'deki Son Bit (Bilgi ve İletişim Teknolojileri) Ağı

Özge Yalçıner Ercoşkun

Department of City and Regional Planning, Gazi University Faculty of Architecture, Ankara, Turkey

ABSTRACT

A smart city is a place where the traditional networks and services are made more efficient with the use of information and communication technologies (ICT), for the benefit of its citizens. This paper provides an overview of ultimate ICT network built in Turkish cities. It also makes comparison of telecommunication status and infrastructure between Turkish cities by thematic maps using Geographic Information System (GIS) in order to visualize the ultimate ICT network for paving the way for smart cities. The paper begins with smart city concept and focus on best practices in the world. The next part gives some statistics on Turkey's internet, mobile phone and social media usage. Then using the latest statistics, Turkish cities are compared according to some indicators such as the number of 3G, xDSL, mobile broadband and fiber subscribers, the length of fiber cable infrastructure. After making national analyses, some smart city initiatives and some governmental pilot projects on smart cities are explained to review the current situation for paving the way for smart cities in Turkey. The chapter concludes with some challenges and future options in city level.

Keywords: 3G and mobile broadband subscriptions; fiber cable infrastructure; smart cities; thematic maps of Turkish cities in GIS.

ÖZ

Akıllı kent, kentlinin yararına olacak şekilde, bilgi ve iletişim teknolojilerinin (BİT) kullanımıyla, klasik ağ ve hizmetlerin daha etkin hale getirildiği yerdir. Bu makale, Türk kentlerinde kurulmuş son teknoloji BİT ağlarının durumunu ortaya koymaktadır. Ayrıca, Türk kentlerinin telekomünikasyon durumu ve altyapısı konusunda bir karşılaştırma yapmakta, Coğrafi Bilgi Sistemleri (CBS) aracılığıyla hazırlanmış tematik haritalarla akıllı kent olma yolundaki son bilgi ve iletişim ağını görüntülemektedir. Makale, akıllı kent kavramı ile başlamakta ve dünyadaki en iyi uygulamalarla devam etmektedir. Dünyadaki akıllı kentler özetlenmekte, IBM'in daha akıllı kentler programından örnekler verilmektedir. Bu örnekler, İskandinav ülkelerinden, Uzak Doğu'dan ve Amerika'dan bazı kentler üzerinedir. Sonraki bölüm Türkiye'deki internet, cep telefonu ve sosyal medya kullanımı üzerine birtakım istatistikler vermektedir. Daha sonra en son istatistiklere göre, Türk kentleri bazı göstergelere göre karşılaştırılmaktadır, bu göstergeler, 3G, XDSL, mobil geniş bant, fiber abonelikler ve fiber kablo altyapısı uzunluğuna göre sıralanmaktadır. Ulusal analizler yaptıktan sonra, bazı akıllı kent girişimleri ve akıllı kentler üzerine pilot projeler anlatılmakta, sonuçta Türkiye'de akıllı kent kavramının önünü açmak için kent düzeyinde zorluklar ve gelecek seçenekler üzerinde durulmaktadır.

Anahtar sözcükler: 3G and mobil geniş bant abonelikleri; fiber kablo altyapısı; akıllı kentler; Türk kentlerinin CBS ortamında tematik haritaları.

Received: 18.02.2016 Accepted: 15.08.2016

Correspondence: Özge Yalçıner Ercoşkun.
e-mail: ozgeyal@gmail.com

TMMOB Şehir Plancıları Odası

Introduction

"From computers to data to information to communication to democracy" (Saco, 2002, p.xiii). New information and communication technology (ICT) platforms have evolved rapidly and transformed vastly during the last 30 years. Some of the concepts used to define the transformation in the Digital Age put forward by Castells (2009), show the cultural change in the globalized world. The popularization of the internet and the wireless systems have caused changes in today's communication platform. The internet was invented in 1969, but its commercialization expanded in the 1990s. Since then, users grew from 40 million in 1995 to 3.4 billion in 2016 (Castells, 2009, Global Digital Statistics, 2016). After the convergence of internet and wireless systems in the 2000s, the meaning of 'being connected' has shifted (Pinzon, 2013); as Castells points "the key feature of wireless communication is not mobility but perpetual connectivity" (2009, p.69).

Recent developments in geo-information technologies on wireless platforms to link spatial and relational data provide new and smart insights into patterns of urban life, such as traffic flows within cities, urban mobility and proximity of social relations. Mobile phones allow for large scale monitoring of people's movements and physical proximities over time, giving the possibility of understanding cognitive relationships and social ties. Popular social network sites (SNS), like Swarm-Foursquare, Facebook check-in and Quora, extend this real-time and location-based geo-information across highly connected networks of users. Globally, through rapid adoption of smart phone technologies and rise of geo-social networking, the number of active social media users is reached 2.3 billion by 2016 (Global Digital Statistics, 2016).

ICT utilize mobile devices that have changed our lives. They shape how we interact with each other and how we organize friends and family as well as broader networks. They have become the 'digital fabric of our lives'. The opening question for the usual telephone conversation has changed from "Whom?" to "Where?" since today we know who we are talking to before answering the phone. Mobile communication coordinates our daily mobility activities, for example, who is going to do the shopping, or who is going to pick up the children that day. These are not planned but talked and decided in real-time. Keeping in touch with social networks has its advantages, but interacting with real life environment is important while living in a smart community (Mobile Tech, 2013).

A smart community is a community where various next-generation technologies and advanced social systems are effectively integrated and utilize in a smart city. In smart cities, digital technologies translate into better public services for citizens and better use of resources. A smart city is a place where the traditional networks and services are made more efficient with the use of ICT, for the benefit of its inhabitants and businesses.

This paper provides an overview of ultimate ICT network built in Turkish cities. It also makes comparison of telecommunication status and infrastructure between Turkish cities by thematic maps using GIS in order to prove the ultimate ICT network for paving the way towards smart cities. Some of the concepts used to define smart cities such as eco-tech, livable, green and sustainable cities or smart growth can be considered beyond the scope of this paper since they relate to other spatial components and city planning visions.

The paper begins with smart city concept and continues with Top 10 Smart Cities and Smarter Cities Program in the world. They are explained as best practices from Scandinavia, Far East and America. The next part gives some statistics on Turkey's internet, mobile phone and social media usage. Then using the latest statistics, Turkish cities are compared according to some indicators such as the number of 3G, xDSL, mobile broadband and fiber subscribers, the length of fiber cable infrastructure. After making national analyses, some smart city initiatives and some national projects on smart cities are explained to review the current situation for smart cities in Turkey. The chapter concludes with some challenges and future options in city level.

Methodology

The work is based on a literature study which covered papers and reports on indicators, methodologies, rankings and evaluation tools related to ICT and cities. The literature study aimed to define the concept of smart city and to make an overview of smart city examples. National reports, Türk Telekom statistics, GSM operators' statistics and social media facts are found for the years of 2014 and the first quarter of 2015. Some facts and indicators are extracted from the research of ICT usage of Turkish people made by Turkish Statistics Institute. The city data was blended from publicly available annual province statistics of Information Technologies and Communications Authority (BTK) for Turkey. Then a geo-database was built in ArcGIS environment at city level concerning some indicators such as the number of 3G, xDSL, mobile broadband and fiber subscribers, the length of fiber cable infrastructure of BTK up-to-date statistics. Some thematic maps were produced to draw quantities using graduated colors to show values. In order to attract attention and to make comparison, five classes were used in the legend of the thematic maps for generating the difference in each indicator towards the ultimate ICT network for smart cities. From general to specific point of view, some e-municipality efforts in

Turkish cities were put in a summary table and some ultimate national smart city pilot projects were explained briefly in order to clarify the national vision of being a smart city.

Smart City Concept and Smart Cities in the World

The symbolic importance of labeling and branding cities with 'cyber', 'intelligent', 'digital' or 'smart' prefixes is stressed around the world (Graham & Marvin, 1999). Smart cities can be accepted as the demonstration areas of e-government applications. Smart city concept is integrated with the information based economy. Research and the use of new technologies accounted for the development in science, industry and commerce in a smart city. The impacts of ICTs can be observed in smart cities. The e-governance concept links the administrative institutions to these technologies. Public bodies using ICTs in management, commerce and communication across offer e-governance with multi-participation.

The financial services, information technologies and communication industry in a smart city bring economic development. Smart spaces are integrated with infrastructure in a smart city. Local governments should share their decisions, plans and projects with developing their internet networks for effective city management, should present some guidelines (Odendaal, 2003).

Smart cities own an advanced urban information systems where urban dwellers can use these systems even via their mobile devices. Urban information systems help automate analysis, share information, and encourage teamwork. By visually displaying information, GIS enhances evaluation and performs quickly. Real-time information and sensor updates in GIS support better decision making and improve city management. Creating an urban inventory, thematic maps, and queries also help to identify the gaps and scenarios help in planning measures (Yalçıner, 2002).

Moreover, a city can be defined as smart when investments in human capital, institutional systems, traditional transport and modern ICT communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources (Odendaal, 2003). Smart cities are all urban settlements which show strategic effort on the new ICTs in a way to achieve high quality of life, effectiveness and competitiveness on many levels (Angelidou, 2014). For the development of a smart city, instrumenting a city technically and investing in hard infrastructure also provides opportunities for innovation process. However, technology is not enough to guarantee the real smartness of cities, and it does not make urban dwellers themselves to think or act smart (Angelidou, 2015).

On the other hand, some smart city strategies consider specific districts and clusters (Komninos, 2011), such as business districts, R&D clusters, university technoparks, logistical clusters or neighborhoods. This is a spatial vision that gives character and functions at city level. It addresses some users, who benefit the district or neighborhood where they live in, work in or visit.

Smart city indicators are studied all around world. ITU Academy online notes provide some key performance indicators for the smart cities to understand how ICT performance can be measured (ITU website). When focused on the heading of Urban Sustainability, ICT appears under the connectivity topic. In the connectivity topic, the indicators are: access to internet is measured by the number of broadband and mobile broadband subscriptions; access to telephones is measured by the indicator of the number of mobile 3G subscriptions. Mobile broadband subscriptions are important and their number has a multiplicative effect on GDP, productivity and employment. OECD and the World Economic Forum also use these indicators for the goal of smart cities. So, this paper takes these indicators to visualize the ultimate ICT network built in Turkish cities and to make comparison of telecommunication status and infrastructure between them.

As the planet becomes more urban, cities need to get smarter. Large scale urbanization necessitates finding new and smart ways to manage complexity, reduce expenses and improve quality of life. This paper stressed the importance of better use of ICT. But a more comprehensive view of a smart city gives an integrated approach to improving the efficiency of city operations, the quality of life for its dwellers, and growing the local economy. Investments in human capital and modern ICT infrastructures fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement (Lombardi et al. 2012).

Canadian urban strategist Dr. Boyd Cohen developed a smart city wheel which allows a common language to develop amongst city stakeholders.

Smart cities can be identified along six main axes: A smart economy, smart mobility, a smart environment, smart people, smart living and smart government (Figure 1). These six axes are linked with traditional theories of urban growth and New Urbanism development and are based on theories of regional competitiveness, transport and ICT economies, human capital, quality of life, and participation of citizens in city governance (Fastcoexist website).

The Smart City Index is widely accepted and created by Cohen. Classified literature on the categories of a Smart City

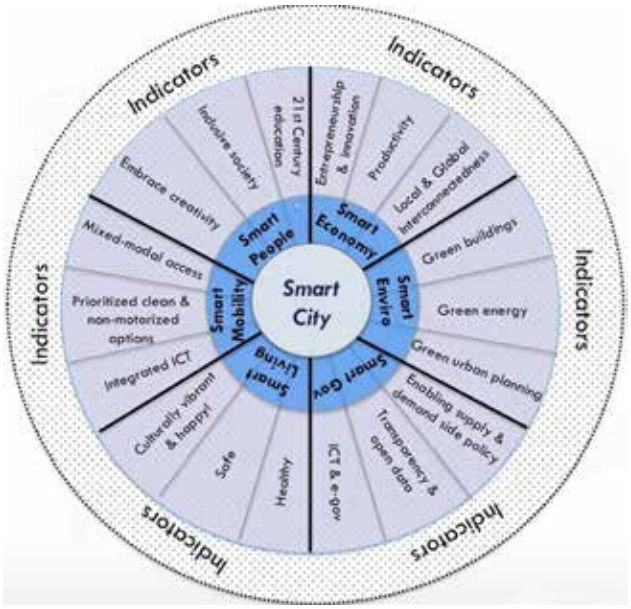

Figure 1. Smart city wheel.

is given in Table 1. Smart Environment can be created by green urban planning. Smart City is powered by "renewable energy," every function is "carbon free"; it shifts from central to "distributed" small scale power, water and waste systems; and "food production" will be part of the urban green infrastructure. Close-loop cities is emphasized in which the urban eco-cycle is balanced in support of a circular view of urban metabolism. Cities, designed on New Urbanism principles, nurture a special "sense of place" through a renewable and local economy, and they are "walkable" and transit-oriented using alternative fueled vehicles (Ercoskun, 2012). Moreover, ICTs may contribute economic development in a smart city, with smart spaces being integrated with smart infrastructure. The use of the Internet, virtual libraries, online forums, interactive talks and webinars makes life easier, and facilitates fuel savings as well as flexible and adaptable living and working conditions. Awareness is raised among the city residents in such matters of energy use as smart metering, car pooling and life safety systems (Ercoskun, 2010).

In Smart Government heading (Table 1), Wi-Fi and broadband coverage is one of the important indicators for smart cities (Fastcoexist website). Also under the Smart People heading, the number of internet-connected households and residents with smartphone access is the other indicator of smart cities which are used in this paper.

Smart city solutions have been evolved to more supply-driven rather than demand-driven in the cities (Komninos, 2011). Several conceptual models of smart cities have appeared under their impact of supply and demand. Some ideas for the smart city focus on ICTs which can make cities and their services act smart. Other smart city paradigms relate technology with innovation and human capital development to participate in society and solve problems. Nevertheless, smart city programs are being implemented in hundreds of cities in the world.

The Top 10 Smart Cities around the world are ranked by Cohen who considers the variables about innovation and sustainability. These cities are (Fastcoexist website):

1) Vienna: Vienna was the only city that ranked in the top 10 in every category such as: innovation city, regional green city, quality of life and digital governance. Vienna establishes smart-city targets with programs like the Smart Energy Vision 2050 and Roadmap 2020. Carbon reduction, transportation and land-use planning changes make the city number 1 in smart city technologies.

2) Toronto: The highest rated smart city in North America, Toronto is the second in ranking. IBM contributes its smartness more. Toronto is also an active in C40 megacities towards low-carbon economy.

3) Paris: Paris was highly rated in several categories including innovation, green cities in Europe, and digital governance. Paris is popular with its automobile and bike sharing programs.

4) New York: New York scored higher than most other cities in the ranking in all of the categories except quality of life. New York partnered with IBM in 2009. IBM helps the city prevent fires.

5) London: London is famous for some of its sustainability innovations such as congestion tax and its robust transit system. London built a partnership with O2 to launch the largest free Wi-Fi network in Europe.

6) Tokyo: Tokyo scores well in the innovation and digital city categories. Last year, the city announced plans to create a smart town in the suburbs. This eco-suburb will integrate solar panels and energy efficient appliances all connected to a smart grid. Tokyo also promotes smart mobility solutions.

7) Berlin: Berlin has good scores in innovation, greenness and quality of life. In collaboration with the firms, city works on vehicle-to-grid (V2G) technologies for creating a virtual power plant from electric vehicles.

8) Copenhagen: Copenhagen, as the European Green Capital in 2015, takes leadership role on sustainable clean-tech innovation. The city has committed to carbon neutrality by 2025 and 40% of its citizens regularly commute by bike.

Table 1. Classified literature on the categories of a smart city

Categories	Indicators	Description	References
Smart environment	Green urban planning	• Pollution control • Biodiversity-green area enhancement • Compact city • Mixed use, mixed income settlements • Walkable-cycleable environment • Strong urban identity • Climate friendly pattern • Urban metabolism for eco-efficiency • Buy local, eat local/self-sufficiency	Newman & Jennings (2008), Wheeler (2004), Holmgren (2007), Kazimee (2002), EU (2004), Resilientcity website, Vergunst (2002), Coaffee (2008), Saavendra & Budd (2009), Raven (2010), Godschalk (2003), Hopkins (2008), UNISDR (2010), Newman, Beatley & Boyer (2009), Hodson & Marvin (2009)
	Green buildings	• Green-certified buildings • Using building automation systems • Adapting/retrofitting for energy-saving	Accenture (2011), Steria (2011), The Climate Group et al. (2011), Think (2011), Washburn et al. (2010), Neirotti et al. (2014)
	Green energy	• Using renewables such as solar, wind power, geothermal etc., • Smart metering • Resilient smart grid • Wi-fi connected public lighting	Chourabi et al. (2012), Correia and Wunstel (2011) , Mahizhnan (1999) Steria (2011), Accenture (2011), Correia and Wunstel (2011), Dirks et al. (2009), Hughes et al. (2013), Nam and Pardo (2011), The Climate Group et al. (2011), Think (2011), Toppeta (2010), Neirotti et al. (2014)
Smart mobility	Mixed-modal access	• More public transport • Integrated fare systems	Hensher & Button (2003), Tolley, (2003), Ercoskun (2016), Neirotti et al. (2014)
	Prioritized clean&non-motorized options	• Bicycle paths-roads • Bicycle sharing systems • EV charging stations	Fastcoexist website, Wheeler, (2004), Kazimee (2002), EU (2004), Resilientcity website, Neirotti et al. (2014)
	Integrated ICT	• Optimize logistics for energy-saving • Energy-efficient fuels and engines • Smart card systems for public transit	Atzori et al. (2010), Caragliu et al. (2009), Correia and Wunstel (2011), Dirks et al. (2009), Giffinger et al. (2007), La Greca et al.(2011), Munuzuri et al. (2005), Nam and Pardo (2011), Steria (2011), The Climate Group et al. (2011), Think (2011), Toppeta (2010) Washburn et al. (2010), Neirotti et al. (2014) Ercoskun (2016)
Smart living	Safe	• Crime, terrorism • Smart protection • ICT for emergency	Neirotti et al. (2014), Fastcoexist website, Accenture (2011), Dirks et al. (2009), Nam and Pardo (2011) and Washburn et al. (2010)
	Healthy	• Life expectancy • Investment on health • Using ICT for healthcare services	Fastcoexist website Neirotti et al. (2014), Accenture (2011), Atzori et al. (2010), Correia and Wunstel (2011), Dirks et al. (2009); Nam and Pardo (2011), The Climate Group et al. (2011) and Washburn et al. (2010)
	Cultural&vibrant and happy	• Quality of life • Investment on culture • Equality • Participatory cultural and tourism events	Fastcoexist website, Accenture (2011), Dirks et al. (2009), Mahizhnan (1999), Nam and Pardo (2011) and Washburn et al. (2010), Neirotti et al. (2014)
Smart government	Enabling Supply-Demand Side Policy	• Using ICT to deliver energy and information exchange between providers and users	Neirotti et al. (2014), Fastcoexist website, Chourabi et al. (2012), Correia and Wunstel (2011) and Mahizhnan (1999) and Steria (2011)

Table 1. Classified literature on the categories of a smart city (Cont.)

Categories	Indicators	Description	References
Smart government	Transparency and open data	• Increasing reliability and transparency of energy supply systems • Enabling every citizen to access official documents in a simple way	Neirotti et al. (2014), Fastcoexist website, Chourabi et al. (2012), Correia and Wunstel (2011) and Mahizhnan (1999) and Steria (2011)
	ICT & e-Gov	• Wi-Fi and broadband coverage • ICT-based public participation • E-administration • E-ballots	Neirotti et al. (2014), Fastcoexist website, Accenture (2011), Bakıcı et al. (2013), Caragliu et al. (2009), Chourabi et al. (2012), Correia and Wunstel (2011), Dirks et al. (2009), Giffinger et al. (2007), Odendaal (2003), Steria (2011), Think (2011), Toppeta (2010) and Washburn et al. (2010)
Smart people	Inclusive society	• Raising the number of internet-connected households and residents with smartphone access • Improving the quality of life by stimulating social learning and participation especially for disadvantaged groups	Atzori et al. (2010), Bakıcı, Almirall, and Wareham (2013), Caragliu et al. (2009), Chourabi et al. (2012), Correia and Wunstel (2011), Giffinger et al. (2007), Mahizhnan (1999) and Toppeta (2010), Neirotti et al. (2014), Fastcoexist website
	Embrace creativity	• Technological platforms harnessing the collective intelligence and creativity of citizens	Neirotti et al. (2014), Fastcoexist website, Sasaki (2010), Lombardi et al. (2012)
	21st century education	• Creating more opportunities for students and teachers using ICT tools • Interplay between university and government for e-learning	Accenture (2011), Dirks et al. (2009), Mahizhnan (1999), Nam and Pardo (2011) and Washburn et al. (2010), Lombardi et al. (2012), Neirotti et al. (2014), Fastcoexist website
Smart economy	Local&global interconnec-tedness	• Integrating the city in national and global markets	Neirotti et al. (2014), Bakıcı et al. (2013), Caragliu et al. (2009), Chourabi et al.(2012), Correia and Wunstel (2011), Giffinger et al. (2007), Mahizhnan (1999) and Toppeta (2010), Fastcoexist website
	Productivity	• Improving productivity (i.e. output divided input) through automatic routine processes and by powering managers' decision-making, planning and control activities.	McKinsey Global Institute (2011), Neirotti et al. (2014), Fastcoexist website
	Enterpreneurship & Innovation	• Fostering the innovation systems and entrepreneurship in the urban ecosystem by local incubators	Bakıcı et al. (2013), Caragliu et al. (2009), Chourabi et al. (2012), Correia and Wunstel (2011), Giffinger et al. (2007), Mahizhnan (1999) and Toppeta (2010), Neirotti et al. (2014), Fastcoexist website

9) Hong Kong: Hong Kong is a leader in the use and adoption of smart cards, which are already used by millions of residents for services like public transit, library access, building access, shopping, and car parks.

10) Barcelona: Barcelona is a pioneer in smart city and low-carbon solutions. It was among the first in the world to introduce a solar thermal to promote the electric vehicles and charging infrastructure, and the city also launched a project to develop a living lab for smart-city innovation.

Moreover, IBM Smarter Cities Program gives some other smart city practices. For example, San Francisco, which has equipped with thousands of kilometers of sewer system pipes and treatment facilities that can give alarm against pump failure, broken pipes and overflowing storm drains in real time, with a smart maintenance. Singapore, with its smart traffic system created to lower congestion and carbon emissions

by recognizing traffic patterns on a city level. The engineers developed systems for leveraging road pricing, integrated fare management and deep analytics to help predict and mitigate traffic congestion (IBM, 2011). Technologies providing electronic tolling, advanced driver advisories, parking guidance, responsive traffic signaling, intelligent dispatch of cabs and contactless smart card-based fare transactions, have all helped to realize the utility and value of smart transportation systems in managing traffic in Singapore (Hin & Subramaniam, 2012). The City of Rio de Janeiro, which coordinates information flow from 20 city departments into one operations center for real-time visualization, monitoring and answering of response to incidents across the city. The system uses a smart weather-prediction technology to locate storms and hills vulnerable to landslides. And City of Madrid has an emergency coordination center. When authorities receive information about an emergency, they can recognize it as a unique or a duplicate incident with the improved of 25% response times (IBM, 2011).

Case Study: Turkish Cities

Turkey's Facts

Turkey's implementation of e-government is shaped by many factors including its size, centralized governance structure, e-government goals, Gross Domestic Product (GDP), population, etc. Table 2 illustrates some statistics about Turkey belonging to 2015. The number of mobile phone subscriptions is relatively high where the average annual income per capita is low. Mobile devices, smartphones and internet TVs attract Turkish citizens day-by-day.

TTNet, a subsidiary of Türk Telekom, launched broadband in the early 2000s, providing ADSL services. Mobile broadband over 3G started with three GSM operators: Turkcell, Vodafone and Avea. Also, broadband services provided fiber and cable-TV networks, in the 2000s. After significant growth in mobile telephony over the last decade, there are more than 70 million subscribers (around 70% of which have 3G), for a penetration rate of 91.5%. According to subscriber numbers, Turkcell, Vodafone, and Avea's market shares are 49.62%, 28.57%, and 21.87%, respectively. With 8.5 million fixed and 26.4 million mobile subscribers, total broadband subscription in Turkey has reached 35 million. Fixed broadband subscription is as follows: 79% xDSL, 15% fiber, and 6% cable. Currently, Türk Telekom owns 182,450 km of fiber infrastructure, around 123,000 km as backbone network and around 60,000 km that reaches subscribers. Alternative operators own a total of 51,244 km fiber infrastructure reaching subscribers. Ten years after its privatization and the opening of the competitive sector, Türk Telekom is still dominant provider in broadband services (Schkenkkann, 2014).

Table 2. Turkey's facts for e-government (TUIK, 2015)

Indicators-2015	Turkey
Population	77,695,904
Number of internet users	44,700,000
Household possession of mobile computers and tablets (% of population)	28.5%
Mobile telephone subscriptions	71,888,000
Number of TV with internet (% of population)	20.9%
The average annual income per capita	7714 $

According to the Vodafone report, with the introduction of the 3G networks in 2009, mobile broadband and smartphones are rapidly replacing older generation devices in the Turkish market. There are already 5.6 million Smartphone users in 2013 and the number of Facebook users stand at 32,408,540, the 7th largest usage base per country in the world (Mobile Tech, 2013). The Internet, and social media in particular, have become an important part of public life in Turkey. Turkish users spent the second most amount of time online per capita in Europe, after the UK. Facebook is the most popular social network with a penetration equal to 41.59% of the population. Around 90% of the country's internet users utilize Facebook actively. Turkey is ranking the 4th largest in global use of Facebook and 8th largest for Twitter with 31.1% penetration and 11,337,500 active Twitter users in 2014 (Tunç, 2014). Foursquare and Swarm has reached 7.2 million users in Turkey in 2015 (the second country after USA). Users check-in average is about 1.8 million daily. They frequently check-in cafes, restaurants and their homes, they generally prefer Turkish food, fastfood and seafood come next (Foursquare website).

Ultimate ICT Network in Turkey

There are 81 provinces in Turkey. Among the 81 provinces, 30 are designated metropolitan municipalities in 2014. The largest by far is İstanbul (23rd largest urban area in the world), followed by Ankara (87th) and İzmir (331rd in the world) (Demographia, 2015) (Figure 2).

Turkey welcomed 3G technology in 2009, and the investments spread its benefits in Turkey and get more people involved in this area. A recent report by the Information Technologies and Communications Authority (BTK) for the first quarter of 2015, which reported that there are were nearly 72 million mobile subscribers and 59.4 million 3G subscribers in Turkey in total (TT website). İstanbul, Ankara and İzmir were the top 3 cities in 2014. Bursa, Antalya, Konya was ranked number 4, 5 and 6, respectively. Mersin, Adana and Gaziantep followed as number 7, 8 and 9 in ranking. (Figure 3).

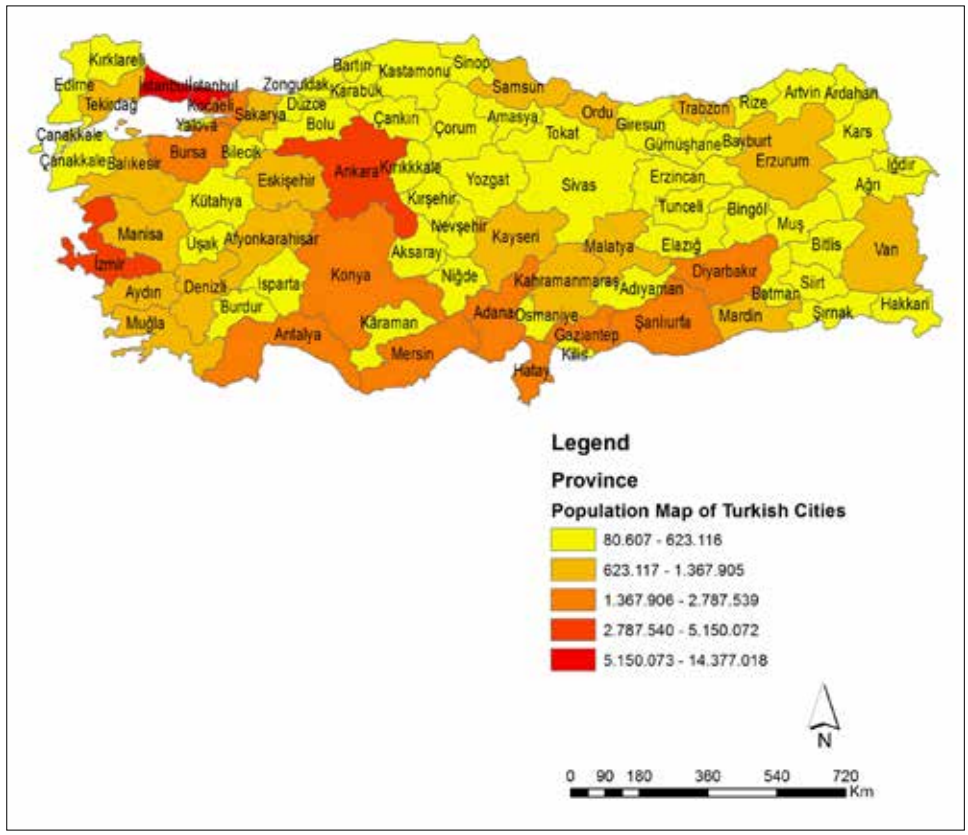

Figure 2. Population map of Turkish Cities-2014.

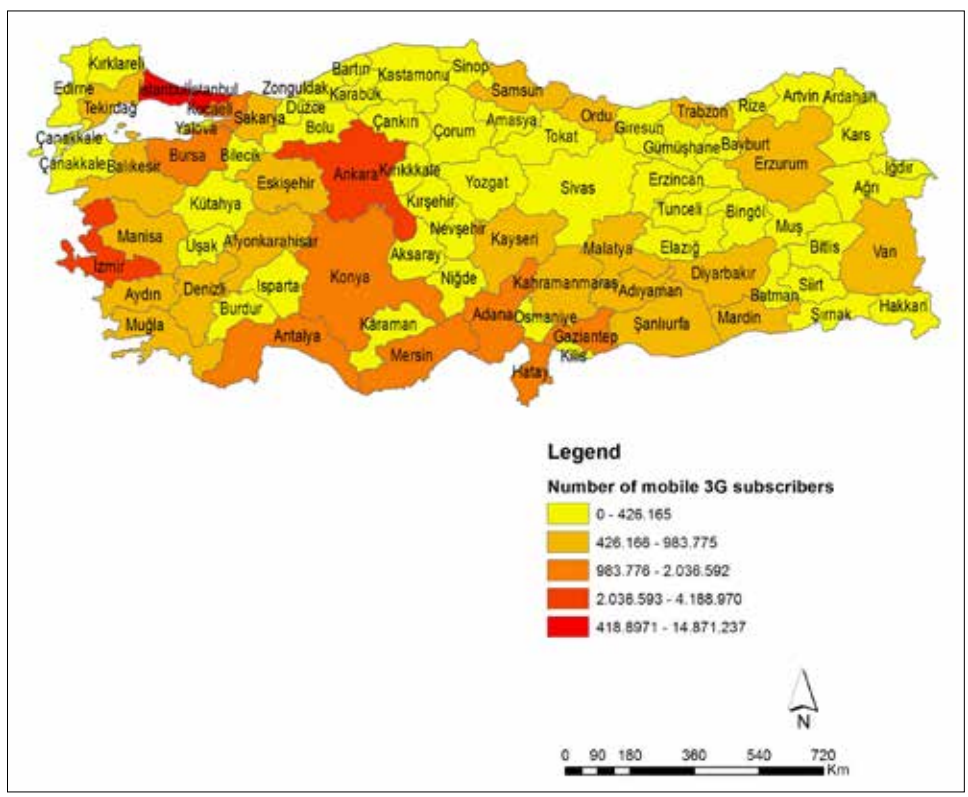

Figure 3. Number of mobile 3G subscribers in 2014.

Total broadband subscribers in Turkey approached to 42.9 million at the end of the first quarter (Q1) of 2015. Fixed broadband services were widely provided; the number of fixed broadband subscribers reached 9 million in Turkey (TT website). İstanbul became the undisputed leader in the rankings of the number total broadband subscribers. It is followed by Ankara which grabbed second place and İzmir in third. Rounding out the top 8, we see five other municipalities- Bursa, Antalya, Konya, Kocaeli and Adana (Figure 4).

XDSL is the main fixed broadband technology in the country with 6.8 million subscribers (TT website). After İstanbul, Ankara and İzmir, Bursa, Kocaeli and Antalya follow them according to the number of xDSL subscribers in the country in 2014 (Figure 5).

The total number of mobile broadband users was 33.9 million corresponding to 43.7% population penetration rate at the end of Q1 of 2015. Mobile broadband users via mobile phones reached to 32.4 million while mobile broadband users via non-phone mobile devices increased to 1.5 million. Compared to OECD average of 78.2% mobile broadband penetration rate, Turkey has an average growth potential in terms of mobile broadband penetration (TT website). After İstanbul, Ankara and İzmir, Bursa, Antalya, Konya, Mersin, Kocaeli, Adana, Gaziantep and Hatay follow them according to the number of mobile broadband subscribers in the country in 2014 (Figure 6). Number of mobile broadband subscribers via mobile phones in 2014 shows the distribution of same cities (Figure 7).

Additionally, share of fiber subscribers exceeded 1.5 million subscribers and there were also 575,000 cable subscribers at the end of Q1 of 2015. Compared to OECD average of

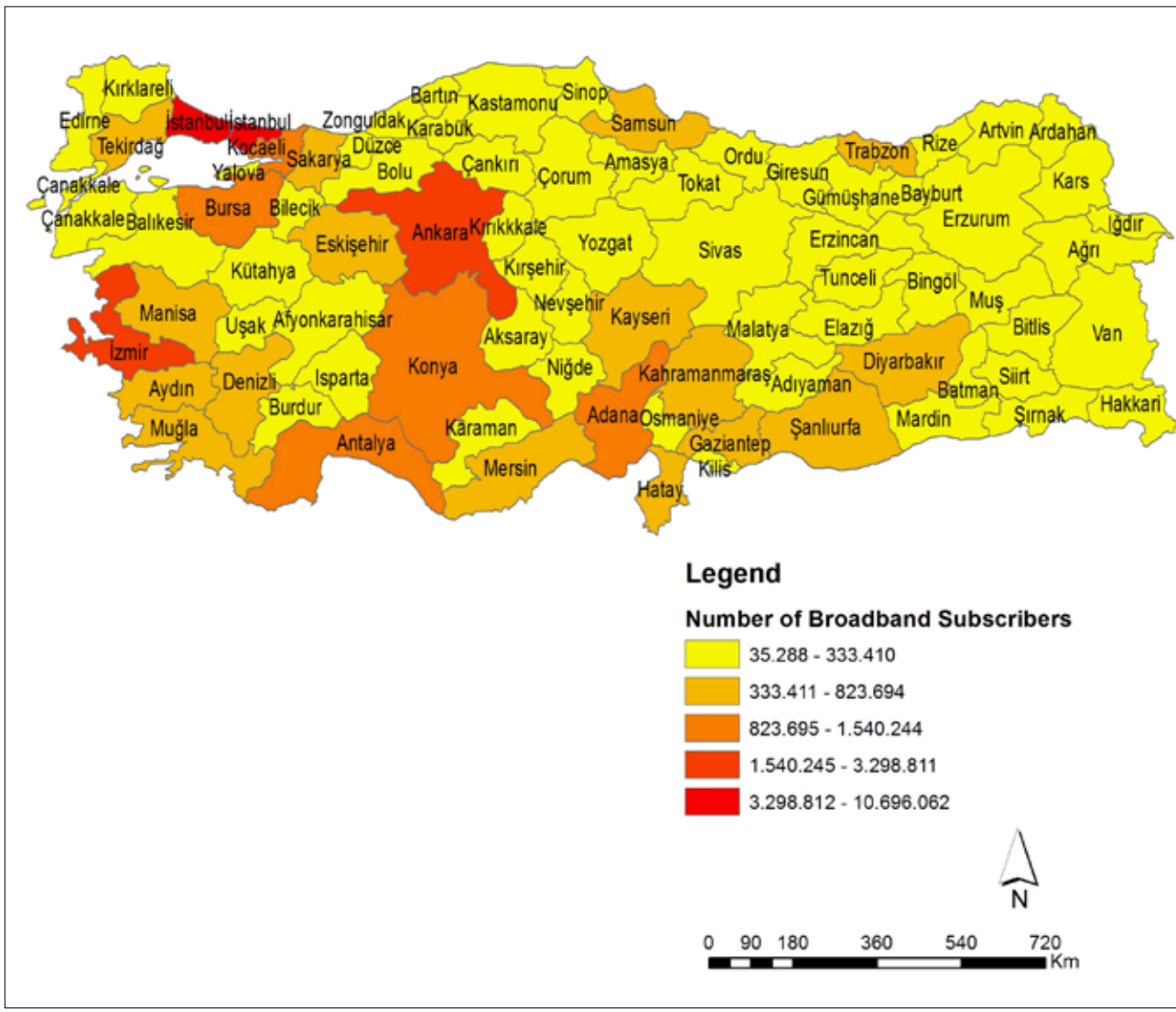

Figure 4. Number of Broadband Subscribers in 2014.

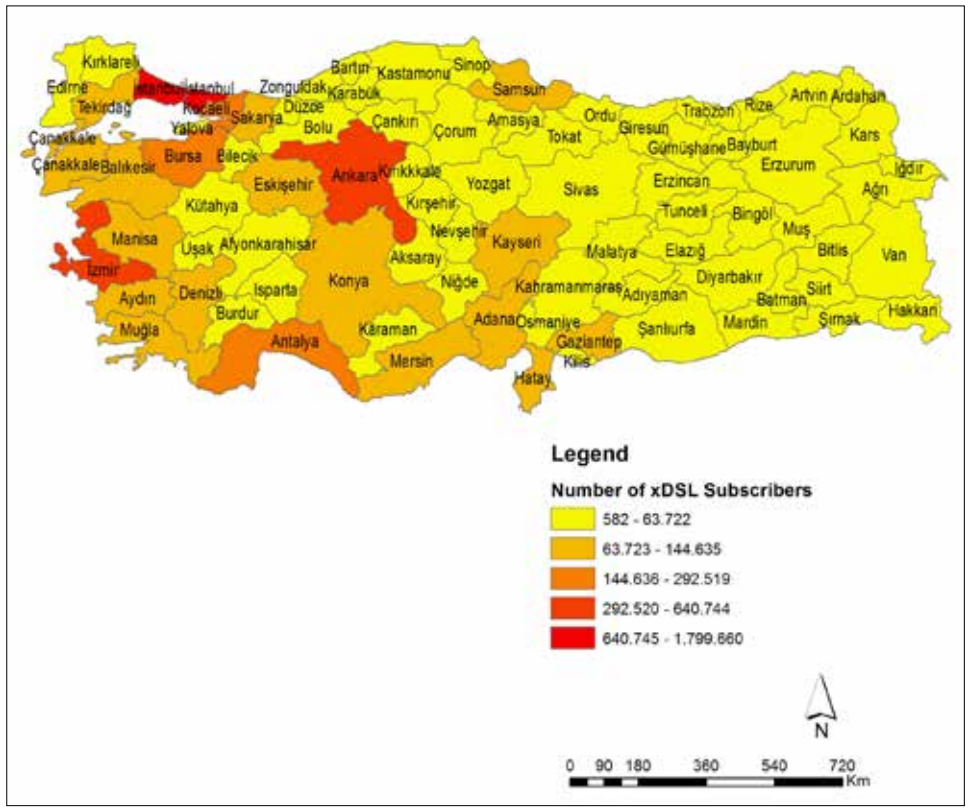

Figure 5. Number of xDSL Subscribers in 2014.

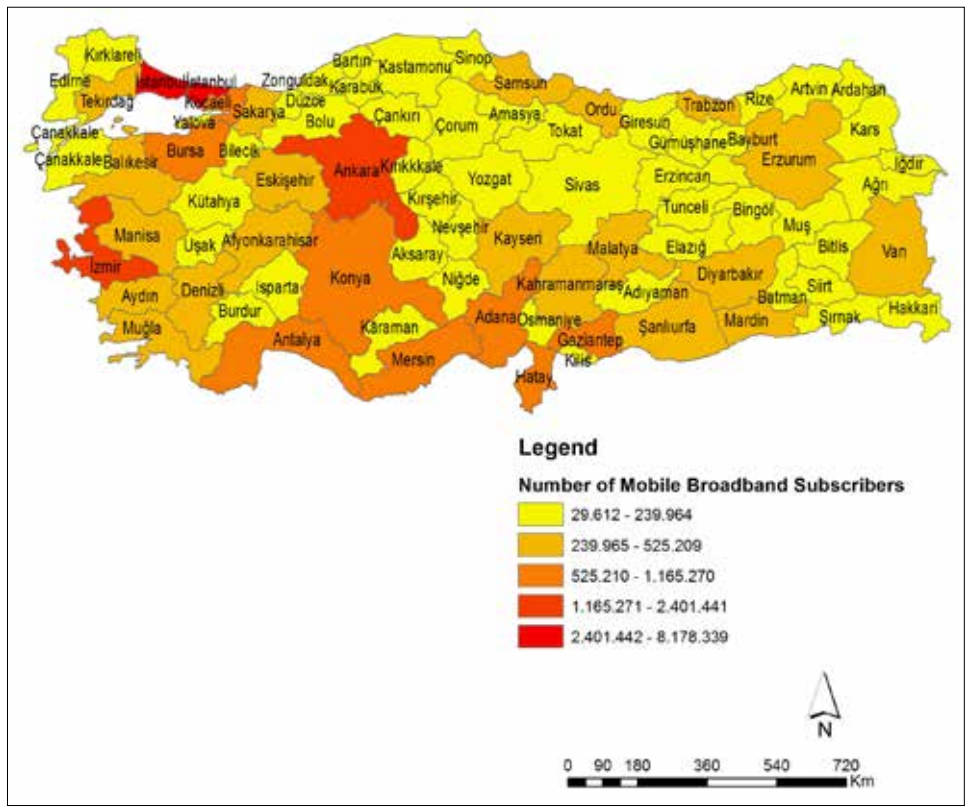

Figure 6. Number of mobile broadband subscribers in 2014.

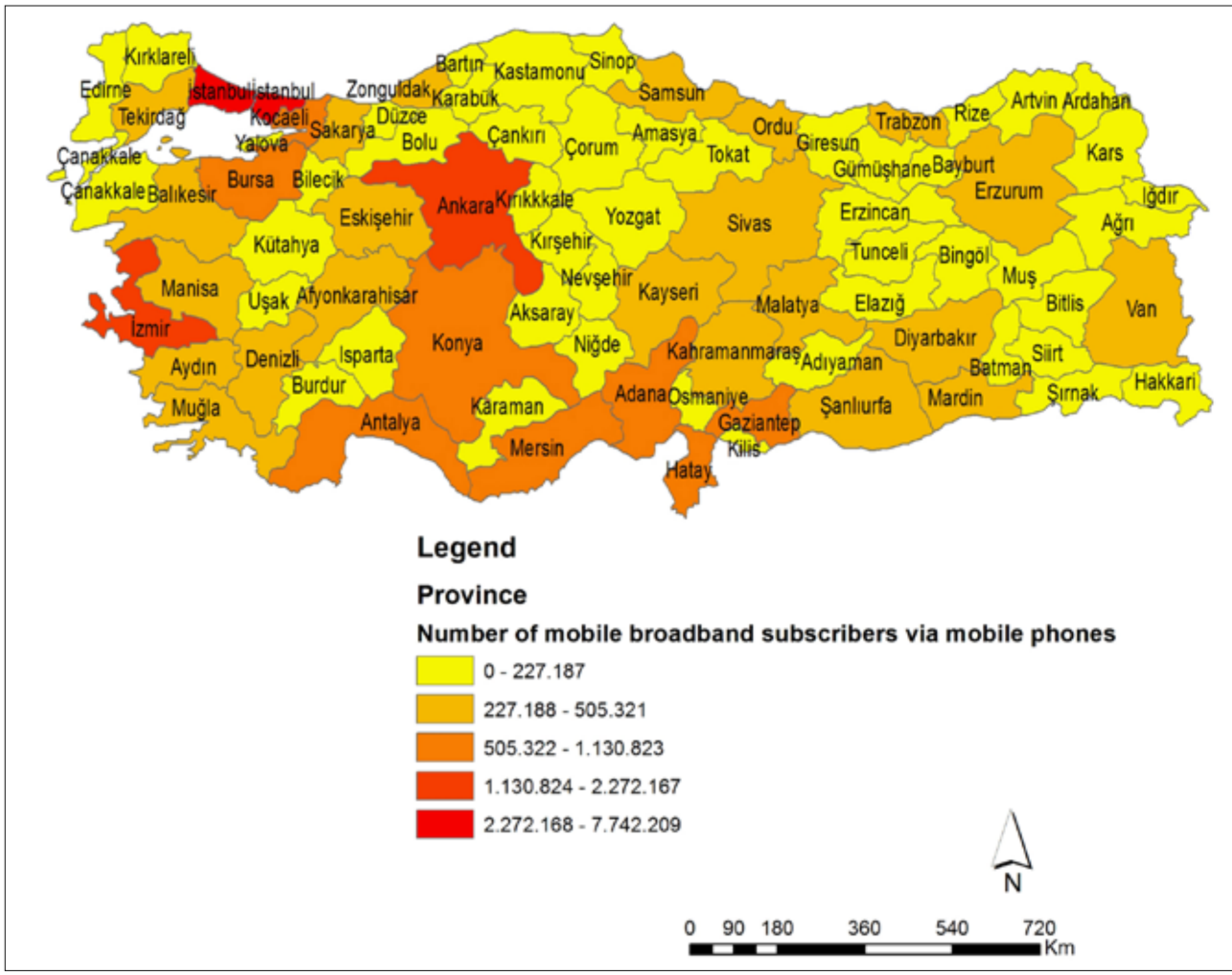

Figure 7. Number of mobile broadband subscribers via mobile phones in 2014.

27.4% fixed broadband population penetration rate, Turkey has an average growth potential with its 11.6% penetration rate (TT website). Turk Telekom with its approximately 197 thousand kilometer fiber network has the biggest fiber infrastructure in Turkey. Alternative operators' fiber length was 53 thousand at the end of Q1 of 2015 (TT website). İstanbul is the leader in the rankings of the length of fiber cable in kilometers. It is followed by Ankara which grabbed second place and İzmir in third. Rounding out the top 9, we see six other municipalities- Bursa, Antalya, Mersin, Adana, Kayseri and Konya (Figure 8).

The fiber network structure is imperative for 4G and 4.5G technologies, and telecommunications companies widely criticize Türk Telekom, which dominates Turkish fiber infrastructure ownership. Under an executive order from 2011, the Ministry is supposed to encourage Türk Telekom to reach an agreement with alternative providers for right-of-way concessions. Also, some municipalities put barriers to the operators for digging the roads for this infrastructure.

In summary, we can compare the number of mobile telephony and broadband subscriptions and the length of fiber cable in top 5 cities. İstanbul is the leader and doubles the percentage of Ankara; Antalya needs more investment as a smart city (Table 3).

Smart City Pilot Projects in Turkey

Grounding the national-level ICT policies such as e-Turkey to the urban level is a major challenge that needs to be tackled. Within the frame of e-Turkey, City of Yalova is selected as a pilot city for the initiative of ICT Valley Project in the beginning of 2000s. Yalova is selected as Turkish Telecom's pilot city for the provision of a natural-disaster-resistant internet infrastructure after Great Marmara Earthquake. ICT projects of Yalova were presented as best practices in various national and international conferences, meetings, and platforms (Velibeyoğlu & Yiğitcanlar, 2009). After Yalova, Bursa, Kocaeli, Ankara and the other cities were put into agenda of ICT Valley Project. Initiatives supporting e-municipality and

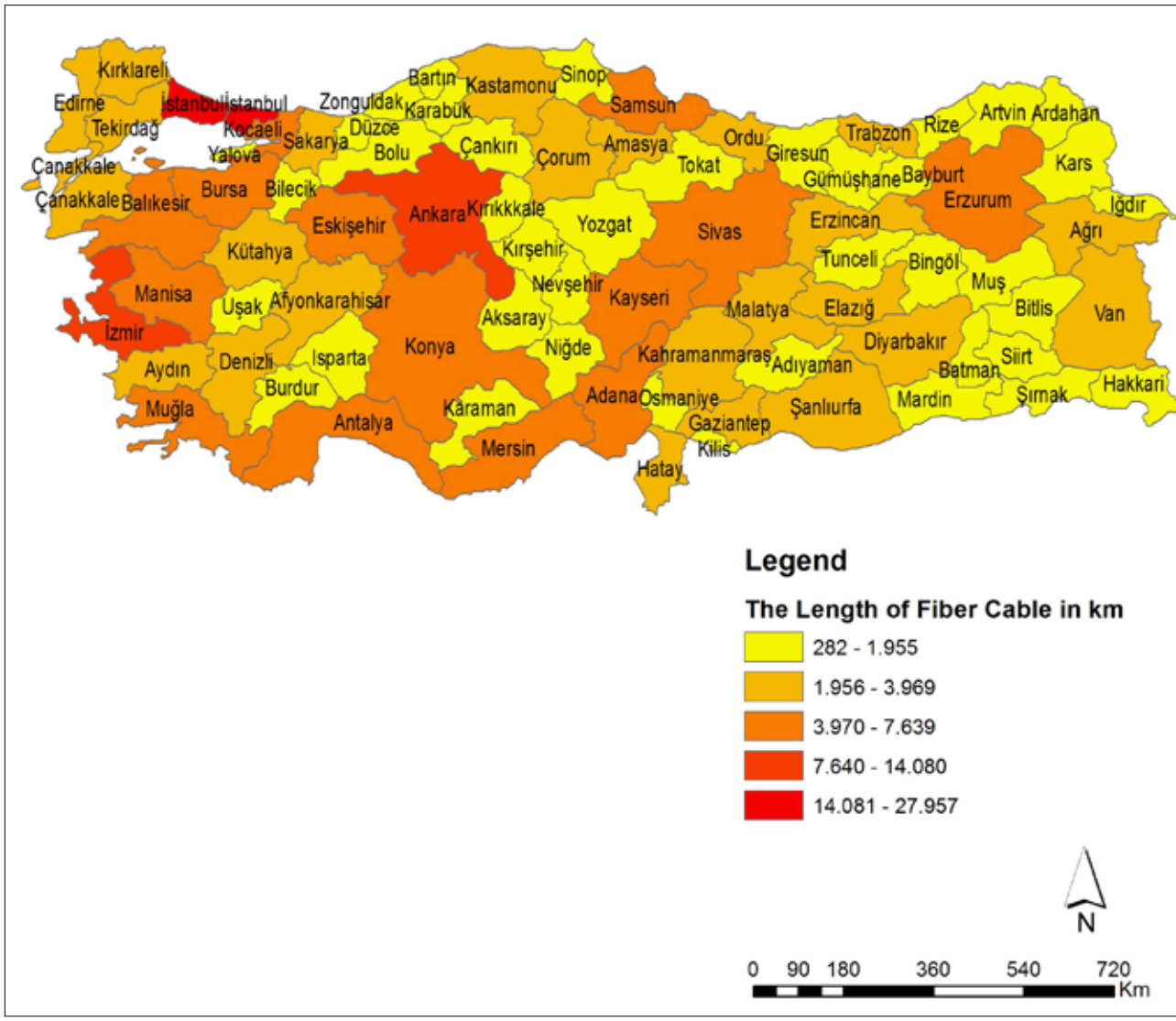

Figure 8. The length of fiber cable in km in 2014.

Table 3. Ratio of city amount to the country level amount: City amounts of subscriptions/length of fiber are divided by country level equivalent amounts of subscriptions/length of fiber. (Top 5 cities according to population) (BTK, 2014)

	Number of mobile telephony subscriptions - total	Number of broadband subscriptions - total	The length of fiber-km
İstanbul	24,87%	25,94%	11,42%
Ankara	7,43%	8,00%	5,75%
İzmir	5,46%	5,90%	4,86%
Bursa	3,51%	3,74%	3,12%
Antalya	3,13%	3,13%	2,83%

Table 4. Smart city projects in Turkey

Name of the municipality	Status
Yalova	ICT Valley Project continues.
Fatih-İstanbul	GIS digital inventory has been completed; Smart City Project team has been built.
Kadıköy-İstanbul	GIS digital inventory has been completed; system has been integrated with e-municipality applications.
Beyoğlu-İstanbul	GIS digital inventory has been completed; system has been integrated with e-municipality applications.
İzmir	UIS has been completed; 3D applications are integrated with the system.
Ankara	GIS digital inventory has been completed; public transportation system has been built and integrated with Android and IOS.
Bursa	UIS has been completed. Web-based 3D city guide is on use.

e-government, and transition from government to e-governance raised the importance of transparency, communication, public accountability, and participation issues. In this sense, the concept of Urban Information Systems (UIS) began to be popular among the local governments (Velibeyoğlu & Yiğitcanlar, 2009). Some district municipalities of İstanbul such as Beyoğlu and Fatih display 3D street views integrated to Google Earth in their UIS. Fatih Municipality applies augmented reality in their smart city projects. Every single building which has been photographed with mobile phones of 3G-4G technology, the information about the building can be sent to the user. Some smart city projects are listed in Table 4.

In year 2015, two major smart city projects named as Akilli KenTT are launched by Ministry of the Turkish Transport, Maritime Affairs and Communications and Türk Telekom. One of them is city of Karaman in the South of Anatolia. Karaman is one of the fastest growing cities in Turkey. According to 2013 data, the young make up a large proportion of its 180,000 residents, making the city open to many different technological and social developments. Türk Telekom chose Karaman, which is also the hometown of the Minister, to launch the country's first smart city project, creating a model for other cities in the country. Karaman's Akilli KenTT project differs from other smart city initiatives as all the smart applications operating in the city are managed by a single platform and one operations centre.

Throughout the project, Innova (software developer and integrator company) created overall management of all the systems and applications implemented in the project, including setting up the systems architecture, developing an Internet platform, installing the necessary management and screens, establishing an operation centre, and providing kiosk and digital signage applications. Akilli KenTT applications to be built in Karaman are given and categorized in Table 5.

Minister of the Turkish Transport, Maritime Affairs and Communications, Lütfi Elvan, in a conference held in Karaman,

Table 5. Akilli KenTT applications (Innova website, 2015)

Internet and monitoring systems	Management Platform	The nerve centre enabling the end-to-end management of system.
	Wi-Fi Management System	Designed to offer free and secure Internet to all citizens across the city.
	Security Cam in the Cloud	Cameras placed in public areas, records can also be viewed by citizens.
	Aerometer in the Cloud	Designed to measure humidity, temperature and noise levels in the city.
Transportation and Emergency	Smart Stations for buses and trains	Designed to reduce waiting times and to optimize the public transport system.
	Smart Intersection System	Designed to reduce waiting time at junctions, to lower carbon emissions and fuel consumption, to give priority to emergency response vehicles.
	Intelligent Parking System	Optimized parking services by reducing time spent searching parking lots.
	Traffic Management System (TEDES)	Identification of drivers breaking traffic laws and regulations, to improve traffic safety on roads.
	Panic Button	Calling an ambulance by pressing a single button.

Table 5. Akilli KenTT applications (Innova website, 2015) (Cont.)

Social issues	Smart Home and Office Management System	Remote security solutions for offices and homes.
	Bulk SMS System	Used to send warning and reminder messages to all urban dwellers.
	Patient Tracking System	Designed to enable the detection of health problems among urban dwellers.
	Disabled Amenities	Smart technologies for disabled people in the public spaces.
	Missing and Unidentified Persons System	Designed to find missing people and lost animals by helping to trace back their movements.
Technical and Telecommunication infrastructure	City Lighting System	Centralized lighting management in public areas to make energy saving.
	Remote Irrigation System	Remote management to agricultural operations such as irrigation and fertilization to lead energy efficient solutions.
	Multimedia Payphones	Next generation payphone system with video calls and Internet access to public areas.
	Information Kiosks	Kiosks installed to display public information relating to city matters through a broadcast management system.
	Touchdesk Kiosks	Self-service kiosks with a convenient platform to access various public services.
	Recycling Machine	Application to recycle waste instantly allowing remote monitoring of the remaining capacity of waste sites.
	Intelligent Waste Collection System	Optimized disposal operations for efficient use of resources.
	Meter Reading System	Facilitating centralized readings of electricity and water meters to track illegal usage and other losses of resources.
	City Operations Center	Designed to enable instant monitoring of all solutions applied on all sites and to give early response.

said: "We launch an integrated smart city application for the first time in Turkey, in Karaman. We build a smart city that will bring savings and lead to all public institutions, including the municipal authority, to conduct more effective and efficient operations. This project will give us the opportunity to offer better public services at a lower cost" (Innova, 2015).
The second Akilli KenTT project was launched in Antalya in May, 2015. The similar applications given Table 4 will be installed in Antalya in near future. Among the most popular solutions - installation of smart traffic lights at intersections will regulate the movement with the busy streets, and organize the movement of vehicles of emergency services. Passengers will be able to track the location of buses, recognize arrival at the desired station, using mobile phone. Pensioners and patients will have regular contact with the doctor and emergency ambulance. Smart Technologies will bring 60% of the decline in traffic accidents, while 25% of the reduction in the waiting time in traffic, and 30-35% of the reduction in carbon emissions.

Many of the improvements will affect the tourism sector positively in Antalya. Wi-Fi zones in the center and on the beaches will be created in these areas: Cumhuriyet Meydanı, Kapalı Yol, Yavuz Özcan Parkı, Konyaaltı Sahili, Sarısu, Kale Kapısı, Kadınlar Plajı ve Beach Park. Akilli KenTT Project will provide free Wi-Fi zones in 22 km wide which will cover public transport vehicles as well. Such projects have been implemented in London, Dubai and Barcelona before Antalya (Öztuzsuz, 2015).

Conclusion

This paper overviewed smart cities by seeing them as spaces that make better use of ICT. However, smart city concept has a broader approach to improving the efficiency of city operations, the quality of life for city dwellers, and growing the local economy. So, many studies can be made on this concept. Table 1 gives the accepted categorization such as environment, mobility, living, government, people and economy. The Top 10 Smart Cities around the world, given in this paper, improve all these categories, national governments make attempts in the economy, energy, ICT infrastructure and social dimensions. The municipalities of these Smart Cities make collaborative work with NGOs, private sector and universities to improve Smart Growth plans, smart mobility programs and ICT- controlled energy and infrastructure systems.

Based on these categories, ICT sector has become an essential part of the Smart Economy, in particular Smart People, since it directly affects the ever-changing cities. Turkey has great potential for growth in telecommunications and the Internet sector with its young population and high technology adoption rates. The Internet and social media have become an important part of public life in Turkey. Turkish users spent the second-most amount of time online per capita in Europe, after the UK. More than 90% of the population ages 15-64 have a Facebook account, and more than 70% are on Twitter. Nearly, all of the population owns mobile phones and most of them are the latest technology smart phones. The aggregate attention on digital media is immense. The key explosions are in e-commerce. The e-commerce companies in Turkey already have millions of dollars in monthly revenues.

The BTK has the legal instruments, financial resources, and institutional capabilities to encourage this growth. However, this potential has not sufficiently translated into the expansion of the sector. The statistics of Turkey on the number of 3G, xDSL, mobile broadband and fiber subscribers, the length of fiber cable infrastructure is still low or average in OECD countries.

Turkey's rapid urbanization has transformed the country demographically and economically. Urban population has grown from 25% (1950s) to 75% (today). Urban growth has shifted from Turkey's primate cities to its secondary cities over the last ten years with the impact of the Metropolitan Municipality Law. The thematic maps produced in this paper show that changes in demographic growth patterns and usage of internet broadband, xDSL and mobile 3G technology, Anatolian Tigers such as Konya, Adana, Mersin and Gaziantep are catching up İstanbul, Ankara and İzmir's statistics. We see Kayseri in the thematic maps in addition to these cities in the rankings of the length of fiber cable in kilometers. As another Anatolian city, Karaman near Konya launched the country's first smart city project, all the smart applications operating in the city are managed by a single platform and one operation center.

However, Turkish cities have lots to do in Smart Environment and Smart Mobility categories. Green urban planning, green buildings and green energy issues, clean and non-motorized options need to be prioritized and action plans need to set a clear goal to become Smartest City in the world. Turkish cities would also make use of the ultimate technology to acquire citizen involvement which offers a range of software and mobile tools for cities to communicate and engage citizens in a dialog about city projects. Turkish citizens know and contribute very little about city projects. Furthermore, ICT-based safety systems in public spaces save many lives with smart protection against natural and human-made disasters and crime events in Turkish cities. In Smart Mobility category, the journey to becoming a smart city will stall without a major commitment to supporting efficient, multi-modal transit. Electric vehicles and the appropriate infrastructure should be placed in many smart-city strategies.

For paving the way towards smart cities, clear strategies should be put with the stakeholders. The first one should be the creation of a vision for the city and citizen engagement. Utilizing ICT and social media can be the way to build active participation. Each city has its own needs depending on density, topography, existing infrastructure etc. Cities should develop their own smart and sustainable targets and choose indicators on common baselines. Once a city has established clear goals and the indicators to measure their progress, it needs to build plans for longer-term. Starting with a pilot project can test the feasibility of its planned program.

For Smart People category, building a smart community today involves education and trainings at all levels. The subsidies will continue at national level and also the EU is trying to ensure that smart solutions for cities can be explored, implemented and replicated. Many projects for smart cities and communities were funded under Horizon 2020 in the environment which can be an opportunity for the Turkish cities in emerging economies.

REFERENCES

Accenture (2011). Building and managing an intelligent city. Retrieved February 13, 2016 from http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Building-Managing-Intelligent-City.pdf.

Angelidou, M. (2015). Smart cities: A conjuncture of four forces. Cities, 47, 95-106.

Angelidou, M. (2014). Smart city policies: A spatial approach. Cities, 41, S3-S11.

Atzori, L., Iera, A., & Morabito, G. (2010). The internet of things: A survey. Computer Networks, 54(15), 2787–2805.

Bakıcı, T., Almirall, E., & Wareham, J. (2013). A Smart City initiative: The case of Barcelona. Journal of Knowledge Economy, 4(2), 135–148.

BTK (2014). The Bulletin of the Yearly Statistics at Provincial Level for Turkish Electronic Communications Market. Retrieved July 29, 2015 from http://btk.gov.tr/en-US/Pages/Statistics

Caragliu, A., Del Bo, C., & Nijkamp, P. (2009). Smart Cities in Europe. In 3rd Central European conference in regional science – CERS 2009, 7–9 October Kosice, Slovak Republic.

Castells, M. (2009). Communication power: Oxford University Press.

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S. & Nahon, K. (2012) Understanding Smart City initiatives: An integrative framework. In 45th Hawaii international conference on system sciences (pp. 2289–2297), 4–7 January Maui, HI.

Coaffee, J. (2008). Risk, resilience, and environmentally sustainable cities. Energy Policy, 36, 4633-4638.

Correia, L. M., & Wunstel, K. (2011). Smart Cities applications and requirements. White Paper of the Experts Working Group, Net!Works European Technology Platform. Retrieved February 13, 2016 from http://www.scribd.com/doc/87944173/White-Paper-Smart-Cities-Applications

Demographia World Urban Areas (2015). 11th Annual Edition, Retrieved August 27, 2015 from http://www.demographia.com/db-worldua.pdf.

Dirks, S., Keeling, M., & Dencik J. (2009). How smart is your city. IBM Institute for Business Value. Retrieved August 27, 2015 from http://www-03.ibm.com/press/attachments/IBV_Smarter_Cities_-_Final.pdf

EU. (2004). Urban design for sustainability, Final Report of the Working Group on Urban Design for Sustainability to the European Union Expert Group on the Urban Environment, Austria

Ercoskun, O.Y. (2016). "Smart Technologies for Sustainable Mobility". In E.V. Ocalir-Akunal (Ed.), Using Decision Support Systems for Transportation Planning Efficiency (pp.288-310). Hershey, PA: Information Science Publishing.

Ercoskun, O.Y. (2012). "A Paradigm Shift towards Urban Resilience". In O.Y.Ercoskun (Ed.), Green and Ecological Technologies for Urban Planning: Creating Smart Cities (pp.1-16). Hershey, PA: Information Science Publishing.

Ercoskun, O.Y. (2010). "Green Urban Planning and Design for Smarter Communities". In A.Hallin & T.K.Gustavsson (Eds.), Organizational Communication and Sustainable Development (pp.41-59). Hershey, PA: Information Science Publishing.

Fastcoexist website, Retrieved February 13, 2016 from http://www.fastcoexist.com/3038818/the-smartest-cities-in-the-world-2015-methodology, http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet

Foursquare website, Retrieved June 24, 2015 from http://webrazzi.com/2015/04/16/fousquare-turkiye-kullanici-infografik/.

Godschalk, D.R. (2003). Urban hazard mitigation: Creating resilient cities. Natural Hazards Review ASCE, 4(3): 136-143.

Global Digital Statistics, 2016, Retrieved February 15, 2016 from http://wearesocial.com/uk/special-reports/digital-in-2016.

Graham, S., & Marvin, S. (1999). Planning cybercities: Integrating telecommunications into urban planning. Town Planning Review, 70(1), 89-114.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic , N., & Meijers, E. (2007). Smart Cities: Ranking of European medium-sized cities. Vienna, Austria: Centre of Regional Science (SRF), Vienna University of Technology. Retrieved February 15, 2016 from http:// www.smart-cities.eu/download/smart_cities_final_report.pdf

Hensher, D.A., & Button, K.J, (2003). Handbook of Transport and the Environment, Elsevier Science, USA.

Hin, L. T. W., & Subramaniam, R. (2012). Creating Smart Cities with Intelligent Transportation Solutions: Experiences from Singapore. In Ö.Y. Ercoşkun (Ed.), Green and Ecological Technologies for Urban Planning: Creating Smart Cities (pp.174-190). Hershey, PA: Information Science Publishing.

Hodson, M., & Marvin, S. (2009). Urban ecological security: A new urban paradigm?. Int. Journal of Urban and Regional Research, 33(1): 193-215.

Holmgren, D. (2007). Permaculture: Principles & pathways beyond sustainability, Australia: Holmgren Design Services.

Hopkins, R. (2008). The Transition Handbook, Devon, UK: Green Books

Hughes, S., Pincetl, S., & Boone, C. (2013). Triple exposure: Regulatory, climatic, and political drivers of water management in Los Angeles. Cities, 32, 51–69.

IBM (2011). Smarter lessons from our smarter cities, Building a Smarter Planet: 9 in a Series, Retrieved August 28, 2015 from https://www.ibm.com/smarterplanet/global/files/us__en_us__smarter_cities__wsj_op_ad_final.pdf.

Innova website, Türk Telekom and Innova launch Turkey's first smart city project. Retrieved August 24, 2015 from https://www.innova.com.tr/en/news-detail.asp?haber=781A225F-C412-4132-EAC2-BBA-001CA111C.

ITU website, Key Performance Indicators (KPIs) and Standards for Smart Sustainable Cities Smart Sustainable Cities Training Programme, Module SSC-3, Retrieved February 15, 2016 from https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Module%203%20Smart%20Sustainable%20Cities%20KPIs%20Draft%20H.pdf

Kazimee, B.A. (2002). Sustainable urban design paradigm: Twenty five simple things to do to make an urban neighborhood sustainable. In: C.A. Brebbia, C. Martin-Duque, L.C. Wasdhwa (Eds.), The Sustainable City II, (pp. 31-41). London: Witpress.

Komninos, N. (2011). Intelligent cities: Variable geometries of spatial intelligence. Intelligent Buildings International, 3(3), 172–188.

La Greca, P., Barbarossa, L., Ignaccolo, M., Inturri, G., & Martinico, F. (2011). The density dilemma. A proposal for introducing smart growth principles in a sprawling settlement within Catania Metropolitan Area. Cities, 28(6), 527–535.

Lombardi, P., Giordano, S., Caragliu, A., Del Bo, F. C., Deakin, M., Nijkamp, P., Kourtit, K. , Farouh, H. (2012). "An advanced Triple-Helix network model for smart cities performance", In Ö.Y. Ercoşkun (Ed.), Green and Ecological Technologies for Urban Planning: Creating Smart Cities (pp.59-73). Hershey, PA: Information Science Publishing.

TUIK (2015). Hanehalkı Bilişim Teknolojileri Kullanım Araştırması, 2015. Retrieved August 20, 2015 from http://www.tuik.gov.tr/PreHaberBultenleri.do?id=18660.

TT (Turk Telekom) website, Retrieved August 24, 2015 from http://www.ttinvestorrelations.com/turk-telekom-group/investing-in-turk-telekom/turkey-telecom-sector.aspx.

Mahizhnan, A. (1999). Smart cities. The Singapore case. Cities, 16(1), 13–18.

McKinsey Global Institute (2011). Big Data: The next frontier for innovation, competition and productivity. Retrieved February 15, 2016 from http://www.mckinsey.com/insights/ business_technology/big_data_the_next_frontier_for_innovation.

Mobile Tech. (2013). Mobile technologies – The digital fabric of our lives. Vodafone Institute for Society and Communications, Retrieved August 5, 2014 from http://www.vodafoneinstitut.de/uploads/media/Studies_komplett_FINAL_von_250913.pdf.

Munuzuri, J., Larraneta, J., Onieva, L., & Cortes, P. (2005). Solutions applicable by local administrations for urban logistics improvement. Cities, 22(1), 15–28.

Nam, T., & Pardo, T. A. (2011). Conceptualizing Smart City with dimensions

of technology, people, and institutions. In 12th Annual international conference on digital government research, 12–15 June 12–15 College Park, MD.

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. Cities, 38, 25-36.

Newman, P., Beatley, T., Boyer, H. (2009). Resilient cities responding to peak oil and climate change. Washington DC: Island Press.

Newman, P., & Jennings, I. (2008). Cities as sustainable ecosystems principles and practices. Washington DC: Island Press.

Odendaal, N. (2003). Information and communication technology and local governance: understanding the difference between cities in developed and emerging economies. Computers, Environment and Urban Systems, 27(6), 585-607.

Öztuzsuz, T. (2015, May 5). Akıllanan Dördüncü Büyük Kent Antalya. Sabah Akdeniz Haberleri, Retrieved from http://www.sabah.com.tr/akdeniz/2015/05/28/akillanan-dorduncu-buyuk-kent-antalya.

Pinzon, L. (2013). Beyond connectivity: The impacts of social media in urban development in Puerto Ayora, Ecuador. (DPU Working Paper No. 160). London: The Bartlett Development Planning Unit.

Raven, J. (2010, May). Cooling the public realm climate-resilient urban design. Paper presented at the meeting of 1st World Congress on Cities and Adaptation to Climate Change Resilient Cities 2010, Bonn, Germany.

Resilientcity website, Retrieved August 8, 2010 from http://www.resilientcity.org/index.cfm?pagePath=RESILIENCE&id=11449.

Saco, D. (2002). Cybering democracy: Public space and the Internet (Vol. 7). University of Minnesota Press.

Saavendra, C., Budd, W. W. (2009). Climate change and environmental planning: Working to build community resilience and adaptive capacity in Washington State, USA. Habitat International, 33, 246-252.

Sasaki, M. (2010). Urban regeneration through cultural creativity and social inclusion: Rethinking creative city theory through a Japanese case study. Cities, 27, S3–S9.

Schenkkann, N. (2014).Turkey as a battleground state for regulating the internet, the struggle for Turkey's internet. A Freedom House Special Report, New York.

Steria-Smart City (2011). Smart Cities will be enabled by Smart IT. Retrieved February 15, 2016 from http:// www.steria.com/uk/fileadmin/assets/media/STE3899Smart_Cities_brochure_08_APP.PDF

The Climate Group, ARUP, Accenture, & The University of Nottingham (2011). Information marketplaces the new economics of cities. Retrieved June 15, from http://www. theclimategroup.org/_assets/files/information_marketplaces_05_12_11.pdf

Think (2011). Smart Cities initiative: How to foster a quick transition towards local sustainable energy systems. Retrieved June 15, from http://www.symple.tm.fr/uploaded/pdf/ THINK_smart_cities.pdf

Tolley, R. (Ed.) (2003). Sustainable Transport: Planning for Walking and Cycling in Urban Environments, CRC Press, USA.

Toppeta, D. (2010). The Smart City vision: How Innovation and ICT can build smart, liveable, sustainable cities. The Innovation Knowledge Foundation. Think!Report, 005/2010.

Tunç, A. (2014). Can pomegranates replace penguins? Social media and the rise of citizen journalism in Turkey, the struggle for Turkey's internet. A Freedom House Special Report, New York.

Washburn, D., Sindhu, U., Balaouras, S., Dines, R. A., Hayes, N. M., & Nelson, L. E. (2010). Helping CIOs understand "Smart City" initiatives: Defining the Smart City, its drivers, and the role of the CIO. Cambridge, MA: Forrester Research, Inc. Retrieved June 15, from http://public.dhe.ibm.com/partnerworld/pub/smb/smarterplanet/forr_help_cios_und_smart_city_initiatives.pdf

Wheeler, S., (2003). "Planning Sustainable And Livable Cities", The City Reader, 3rd Edition, (eds.) LeGates, R.T. ve Stout, F., Routledge Urban Reader Series, New York, 487-496.

UNISDR, United Nations International Strategy for Disaster Reduction. (2010). Making cities resilient: My city is getting ready. 2010-2011 world disaster reduction campaign report. Geneva: UN.

Vergunst, P. J. B. (2002). The potentials and limitations of self-reliance and self-sufficiency at the local level: views from southern Sweden. Local Environment, 7(2), 149-161.

Velibeyoğlu, K. & Yiğitcanlar, T.(2009). Information and communication technology for E-regions. In M. Khosrow-Pour (Ed.), Encyclopedia of Information, Science and Technology (pp. 1944-1949). Hershey, PA: Information Science Publishing.

Yalciner, O. (2002). Urban Information Systems for Earthquake-Resistant Cities. ArcUser magazine of ESRI, 4, 24-25.