Smart City: A Case of Seoul

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ABSTRACT

Smart City is a city that efficiently and effectively solves its challenges in advancing the quality of life and work of its citizens by adequately making use of the best available technologies, which are mainly infrastructure technology in the early stages of urbanization and information technology for everyday use. In addition, it is also argued that a city requires not only technology but also new regulations to become a smart city. With new technology and rules Smart City successfully achieves prosperity and sustainability. This paper briefly reviews what defines a smart city and discusses the case of Seoul.

This paper discusses two exemplary cases showing how to build a smart city by using new technology and rules to reform public transportation and by adopting OPEN (Online Procedures ENhancement for civil applications). The first example shows how Seoul diverted her mobility from a car-dependent city, which causes congestion, pollution, inefficiency and social cost, to transit-oriented city which improves sustainability, efficiency, productivity, and quality of life . These examples confirm that new technology and rules can increase the efficiency of public services and create a bi-lateral governance system.

Keywords: Seoul, smart city

INTRODUCTION: TECHNOLOGY FOR PROSPERITY AND SUSTAINABILITY AND AN IMPROVED QUALITY OF LIFE

As more than half of the world's population lives in urban areas, building or transforming a city to be smarter than before has become prevalent world-wide in order to respond to the emerging challenges caused by rapid urban population growth and climate change. However, literature is limited on what constitutes a smart city or how to build one. To close that gap and in response to the increasing popularity of the concept, this paper will briefly review the working concepts of a smart city from various sources and will use Seoul as a case study. A smart city does not refer to a specific and fixed end. Instead, it is one that efficiently and effectively solves its challenges in advancing the quality of life and work of its citizens by making use of the best available technologies; infrastructure technology at the early stage of urbanization, and information technology. In addition, the paper also argues that a city requires not only technology but also new rules to become a smart city.

Although a smart city has been the talk of urban planning as of late, it has not been clearly defined. For example, Amsterdam Smart City, Smart City Wien, Smart City Expo, Smart Cities Summit, and Smart City Council have recently surfaced. Further, IBM, Cisco, Siemens and other global corporations have also adapted the term of smart cities. India and China have announced that they will build hundreds of smart cities and such prospects are also likely for

South American, European[1] and North American countries alike. Yet, the word 'smart' is used with various connotations, which can be associated with 'intelligent,' 'ingenious,' 'fashionable' and 'stylish'. The term smart city also often overlaps with 'smart growth', 'intelligent city', 'creative city', 'innovative city', 'eco city', 'sustainable city', 'ubiquitous city', 'digital city', 'wireless city',' future city', and smart grid. Since such vague definitions could mean too many things, this broad definition could lose particular significance.

The definition of a smart city varies as it is sometimes defined as an end-result or a goal, and other times defined as a process. For example, a smart city could refer to a city that makes good use of information and communication technology and has a high sustainability. Other times it could refer to a city that resolves the tasks it faces most efficiently and effectively. The followings are some working definitions.

- "The vision of 'Smart Cities' is the urban center of the future, made safe, secure, environmentally green, and efficient because all structures, whether for power, water, transportation, are designed, constructed, and maintained by making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerized systems comprised of databases, tracking, and decision-making algorithms." (Hall 2000)

- A smart city is a city performing well in a forward-looking way in six characteristics; smart economy, smart people, smart governance, smart mobility, environment, and living. these are built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens (Giffinger, et al. 2007),

- Smart city is "combining ICT and Web 2.0 technology with other organizational, design and planning efforts to dematerialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability." (Toppeta 2010; recited from ITU 2014)

- "The use of Smart Computing technologies to make the critical infrastructure components and services of a city, which includes city administration, education ,healthcare, public safety, real estate, transportation, and utilities–more intelligent, interconnected, and efficient." (Washburn2010)

- "IBM defines a smarter city as one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources." (IBM 2011)

- "In Smart Cities, digital technologies translate into *better public services for citizens, better use of resources and less impact on the environment*.…The smart city concept goes beyond the use of ICT for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities, and more efficient ways to light and heat buildings. And it also encompasses a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population." (European Commission, https://ec.europa.eu/; italic added by author)

The above working definitions show changes in the concept over time. It began with a possibility of newly emerging information technology which can be utilized for efficient urban management. Later, corporations such as IBM, Cisco, and Siemens emphasize the technological component as the key component to their concepts of smart city. Scholars have criticized this senseless and placeless approach neglecting how cities really function and how citizens live and work in their cities. Recently the concept of a smart city returns to the original focus of the betterment of city and quality of life and livelyhood of citizens.

In this sense, information technology may be necessary, but it is not sufficient for a city to be smart. In other words, introduction of high technology in urban planning and administration itself is not sufficient to become a smart city. Instead, improvements in quality of life and work should be presented to be a smart city although utilizing advanced technology is inevitable in order to make our cities smarter.

[1] In Europe, the term 'intelligent city' is interchangeable with 'smart city'.

As seen with the above definitions, the most fundamental concept of the smart city is a city that actively makes use of information and communication technology to provide solutions for the problems it faces. Information communication technology helps to make the city's infrastructure more efficient, effective and provides better public service.

When it comes to a city's governance, citizens make use of the traditional representative democracy to elect leaders, and under such a system it takes some time for the citizen's demands to be reflected by the government. But with today's information and communication technology, the voices of citizens are more easily heard, and the time it takes for their opinions to be reflected is significantly reduced. As more citizens take part in deciding how the city is run, using information and communication technology, today's cities are changing from a government system to a governance system. This two-way governance boosts the city's efficiency, improves the lives and jobs of its citizens and makes the city more sustainable.

Smart City: Developed vs. Developing World

From the above working concepts of a smart city in the developed world, it can be deduce that the foremost tasks of the cities are the improvement of service efficiency, governance, and the environmental sustainability. The problem of natural resources and energy costs must be addressed adequately and the carbon emission levels must be lowered to prevent global warming. Today's information and communication technology can assist in finding solutions to such problems. For example, smart grid integrates information communication technology with the city's energy supply system for increased efficiency and reduced energy wastes. It allows for a decentralized power supply system and increased consumption of renewable energy. Such integration of the existing infrastructures with information communication technologies and environmental-friendly technologies can reduce the consumption of natural resources and greenhouse gases to prevent global warming. Information communication technology can also be integrated with transport and sewerage systems for increased efficiency. The concepts of smart city from the developed world tend to focus on efficiency of existing systems and sustainability of natural environments.

The focus of developing countries shows subtle differences from developed countries. The smart cities of the developing world have yet another task that must be taken care of: the rapid growth of population and urbanization. If the city is not ready for a rapid growth in its urban population, its citizens will be riddled with poverty that deteriorates the quality of their lives and will suffer from excessive environmental degradation that ultimately endangers the city's sustainability.

Cities also play a key role in national economic development. With properly planned cities, developing countries can actualize its economic potential, consume energy more efficiently and reduce inequalities to provide a sustainable livelihood for its citizens. Urbanization is not just a result of growth but can be a driver of that progress and that is why urban development is in need to eradicate poverty. However, growing cities come to face many problems; increased slum population, spread and proliferation of informal sectors, lacking infrastructure, expanding sprawls, damaging the natural environment, social and political conflicts and natural disasters. For a city to play its role in bringing about economic and social development, the aforementioned problems must be addressed with effective urban planning and governance. For such successful urbanization, India and China define smart city as follows.

- India: A smart city should provide the city's public services (sewage, sanitation, health, etc.), attract investments, have fair administration, and make citizens feel happy and safe. (Indian Department of Urban Development. 2014)

- China: Smart city projects have been declared to combat the following: rapidly growing cities, pollution, disrupted public order, slow administrative systems, and increasingly dissatisfied citizens. They should also; promote a domestic business boom, intelligently manage the city with information communication technology, and manage basic infrastructure facilities. This would include a network for various services provided for the citizens such as; traffic, energy, waste disposal, environmental watch and healthcare. (China 2012)

As seen above, while developed countries are more concerned with the environment and its resources, the smart cities of the developing world are centered

on founding infrastructure, business revitalization that encompasses both investment and business, the fair and efficient administration, safety and public order. All of which are problems that rapidly growing cities come to face.

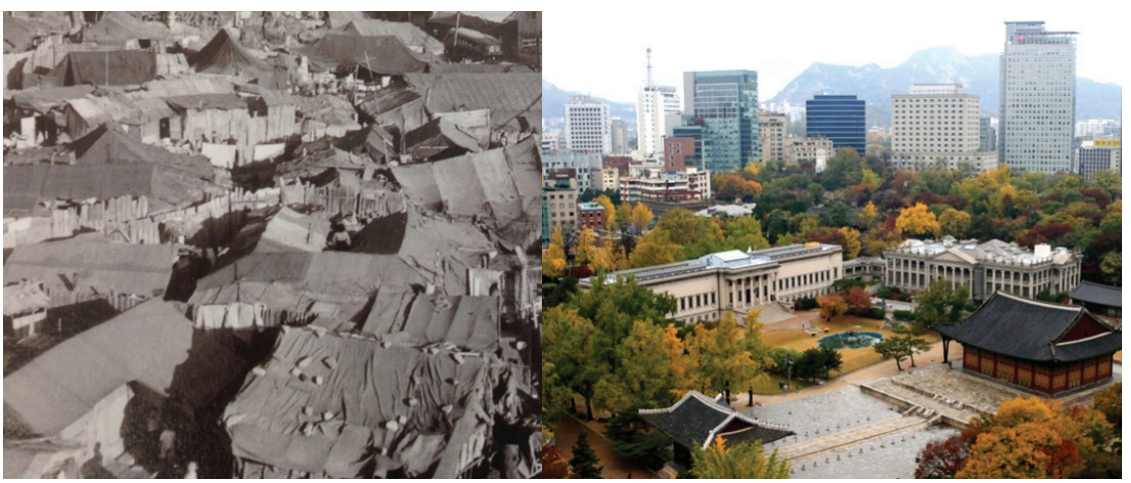
Information communication technology is vital in providing a 'smart' solution to the aforementioned tasks, but the use of such technology is not what defines a 'smart city'. A more important definition is how it provides solutions to become a highly efficient, immaculate, attractive and an economically vital future-oriented city. Achieving such tasks successfully can make a city 'smart'.

Half a century ago Seoul has been a city that was stricken with poverty, poor economy, sprawl, slums, congestion, unsanitary conditions, sewerage problems and lacking drinking water. These conditions became worse due to an explosive urban population growth. Today, Seoul is a clean and economically active city with efficient public services that include: sewerage, water, traffic, internet, and e-government. Seoul has been successfully transformed into one of best livable and sustainable cities in the world by solving these urban problems which a rapidly growing city faces and developing the city's economy.[2]

Furthermore, Seoul's energy consumption and greenhouse gas emission per capita is lower than other cities of similar population and economic scale. The city has high energy efficiency, protects its natural areas, uses less land for building cities and minimizes the effects urban expansion has on the environment. In comparison, Seoul is a city that produces more with fewer resources.

Information technology has also assisted in digitalizing the government to assist in establishing a governance system. Seoul's digital governance began in the year 2000 by disclosing the administrative information and processes to the public through the Internet to prevent corruption and to gain the trust of the citizens. E-governance made administration more efficient, more customer-oriented and more transparent. Seoul's e-governance has continued to develop itself and now has become the bi-lateral governance system that works for its citizens.

How was this outcome achieved? Seoul is a 'smart city' in two ways– infrastructure technology in the early stages, 1960s to 1990s, of urban development and information technology since 2000. Two specific examples, innovative transportation and governance with information technology, will be discussed in the following.[3]

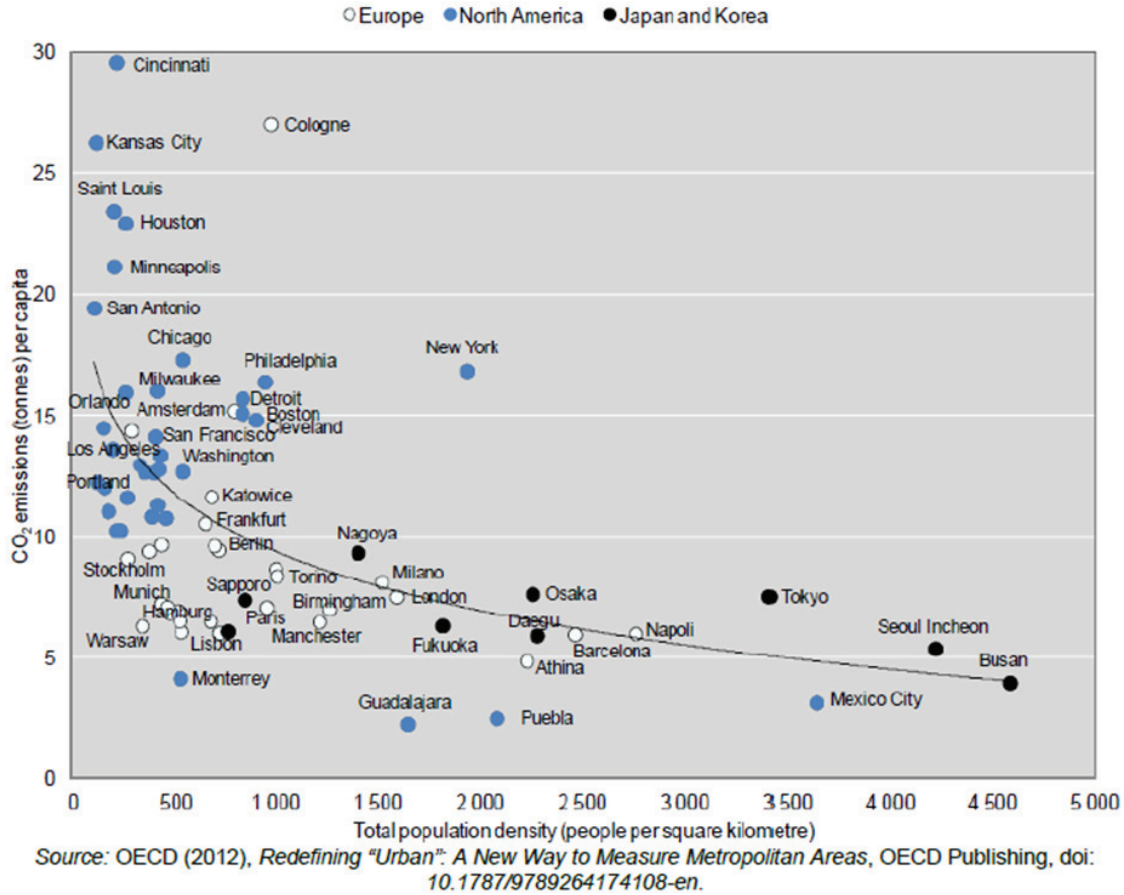


(a) 1960's (b) 2000's

Figure 1:
Successful Transformation of Seoul from 1960's to 2000's

[2] For more on development of Seoul, refer to the last issue's (World & Cities Iss.8, 2015 Winter) 'Why Seoul?'

[3] There are variety of examples that can be found at http://seoulsolution.kr/



Source: OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, OECD Publishing, doi: *10.1787/9789264174108-en.*

Figure 2:
Population Density and Carbon Emissions per Capita by Metropolitan Area

Public Transportation Reform with Information Technology and New Regulations

Until 2002, Seoul's general traffic condition, despite continuous construction of roads and subways, had continued to worsen due to increasing population and number of vehicles (especially, single occupancy vehicles), parking problems, and unregulated bus service. Before the reform, private cars were pointed out as a major cause of traffic congestion since they occupied 72% of the road and 79% of them had a single driver. The social cost for severe traffic congestion was huge, reaching 5 trillion won per year and energy consumption for car operation reaching 4.1 trillion won.

Public transportation in Seoul had many problems such as poor operating systems and limited financial status. Due to the poor bus service, people stretched their budget to buy their own cars. In turn, automobile ownership continuously increased, which caused serious traffic congestion. Road congestion further lowered the bus service quality since buses could not arrive on time due to reduced speeds. Citizens gradually became reluctant to use buses. The bus share of transport numbers tended to decrease year by year, dropping from 37% in 1995 to 27% in 2002. This contributed to a vicious circle, of bus companies' financial difficulties leading to repetitive fare increases and poorer service.

The fact that bus services were private businesses with little public regulation caused a vicious circle. Individual bus companies tried to maximize their profits, so they tended to run only profitable routes. Bus services were over duplicated along more profitable routes and disregarded in non-profitable areas. Therefore the congestion was worsened and

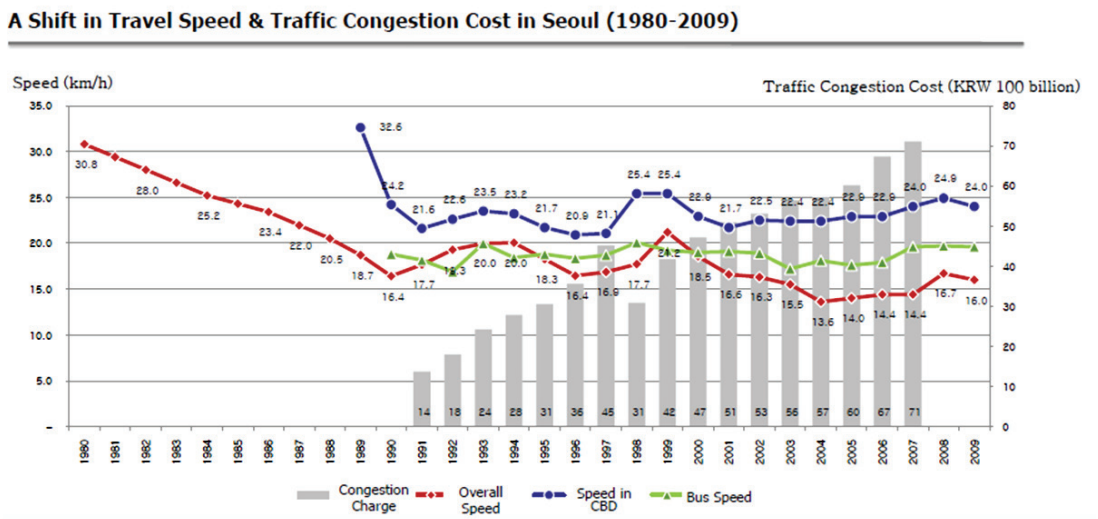


Figure 3:
Degradation of Transportation and its Social Cost
Source: Seoul Metropolitan Government (circa 2009)

bus service coverage was limited. Moreover, there was little integration among transportation modes of buses, subways, bikes and walkways, thus discouraging citizens' use of public transportation. Seoul public transportation needed a readjustment and an integration of public transportation services with new regulations and technology.

Bus Reform from Private to Quasi-public System

Previously, each bus route was exclusively operated by private bus companies on the basis of a licensing system. Privatization of bus routes made it difficult to adjust bus lines, which resulted in an imbalance of service stability between profitable and unprofitable routes. In addition, excessive competition in the overlapping profitable lines led to irregular bus operations to secure more passengers, resulting in poor service levels. Since bus companies exclusively operated the secured route, competition among them for management rationalization was absent, which resulted in lax management and low operation efficiency. Due to the bus industry's financial difficulties, the financial burden of the Seoul municipality also increased gradually

The core concept of the quasi-public bus system was to transform bus routes and operational systems to serve public interests. The Seoul city government took the right to adjust bus lines away from private companies, pursued public welfare of bus services as well as improved service levels. By jointly managing revenue and redistributing it based on operational performance, bus operation and revenue management was separated. The revenue pool management system collected all the fares of bus operation, regardless of profitable or unprofitable routes, and redistributed them. In the process, bus companies whose expenses exceeded their income were reimbursed for their shortfalls, others returned their surplus. In other words, surplus in profitable routes was used to compensate deficits in unprofitable lines.

The quasi-public bus system was composed of three major components: public management, private operation and operational infrastructure. First, public management meant that the Seoul municipality would decide and adjust bus routes to properly accommodate people's traffic demands. Evaluation systems were also established to examine operational performance, service levels, and contract fulfillment. Second, private operation meant that the consortium of existing and new bus companies took control of the actual operations by settling expenses and managing vehicles, facilities and employees. The last component of operational infrastructure is composed of two major elements:

bus-related infrastructure such as public garage, median bus lane system, central control center, bus signal priority system, and the financial system through which income was redistributed and bus companies were guaranteed a reasonable profit. For that purpose, the Seoul city government established the fare settlement center and other organizations.

Joint revenue management was an essential prerequisite for the public transportation system. For this, standard bus operation costs had to be settled, based on which revenue could be redistributed. In the beginning, the Seoul city government and the Seoul Bus Association estimated bus operation cost separately and tried to reach agreement through negotiation, which turned out to be difficult. Eventually, the subcommittee of the Bus Reform Citizens Committee determined the standard operation cost.

The revenue pool management enabled bus companies to provided stable bus operation regardless of passenger demands. In addition, bus companies no longer had to stick to the profitable routes. For the revenue pool management, subsidies had to be paid, but it was impossible without a revision of 'Passenger Transport Service Act,' the legal basis of bus operation, because it limited financial support to 'operations in unprofitable routes.' The revision required agreements from the central government. But their early position was that it was difficult to allow exceptions for Seoul's special situation, even though they understood the purpose of the reform. In response, the city officials in Seoul persuaded the central government through persistent meetings and visits, and eventually revised the law and ordinances to prepare for the legal foundation of the quasi-public system.

Improvement of Bus Routes

The previous bus routes were often too long or circuitous, which brought about excessive traveling time and traffic congestion, thus decreasing the overall service quality of Seoul's public transport. In addition, heavy overlapping of bus routes in limited areas decreased operation efficiency, while other areas were abandoned. Discrepancies between passenger's service demand and the bus operation resulted in the poor service level. Bus speeds were low and time of arrival was irregular and untrustworthy. In addition, intense competition with the subway system and lack of connections to the subway negated a comprehensive public transportation service.

The Seoul city government divided bus routes into trunk lines for inter-regional, middle to long distances, and feeder lines for short rides within each region. The priorities in designing inter-regional and trunk lines were to improve operation efficiency by straightening and shortening lines, while avoiding overlap. The feeder and circular lines focused on improving accessibility by satisfying traffic demands within the region and making it easy to transfer to the trunk lines

Depending on the function, buses were divided into interregional (red), trunk (blue), feeder (green) and circular (yellow) lines, and the systematization of each line enhanced mobility, accessibility and convenience of bus services. The Seoul municipality also devised measures to enhance operation efficiency. Transfer terminals were installed in major points like Cheongnyangni to make it easy to transfer from bus to bus and from bus to subway.

Information Technology for Public Transportation Improvement

For the new public transportation system, an information system base was necessary. To integrate and process the information collected from related organizations, TOPIS (Seoul Transport Operation and Information Service) as well as BMS (Bus Management System) and BIS (Bus Information System) were established.

Before the reform, the bus fare system charged a flat rate regardless of travelling distance, and each route had an independent fare system. Through the reform, the fare system changed to distance-based with free transfers. The subway system also adopted a distance scale rate system in the metropolitan area, and it was integrated with the bus fare system. For a single bus trip, a flat rate is charged as before. When transferring from bus to bus, the transfer is free, transfers from bus to subway or vice versa a discounted fare is collected. Through these changes, the citizens' public transportation fee decreased by 30% on average. Information technology made this improvement possible

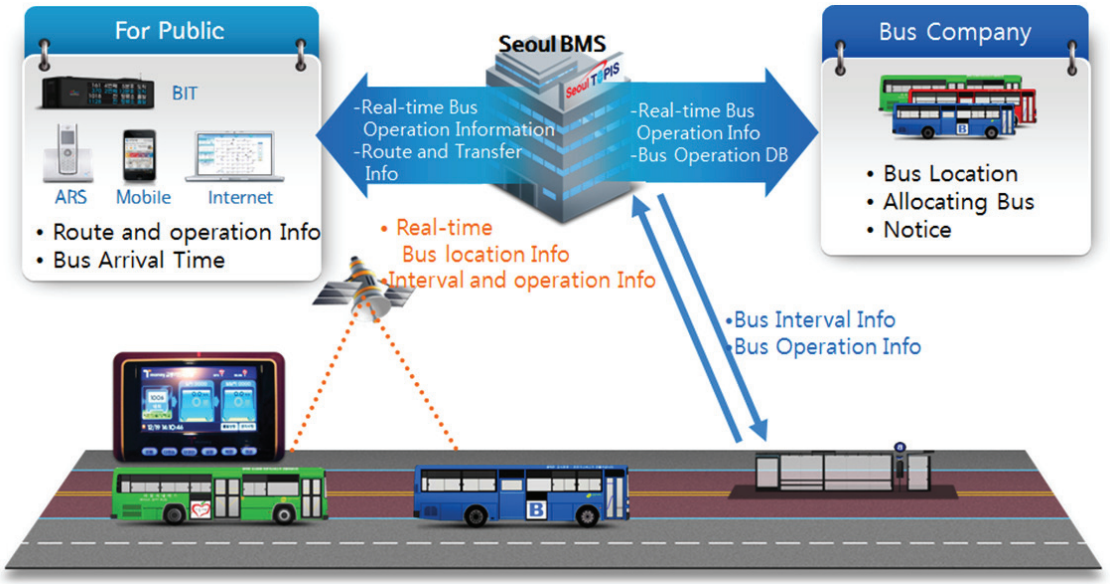


Figure 4:
IT System for Public Transportation
Source: Seoul Metropolitan Government (circa 2009)

Method of fare calculation (bus / subway)	Before	After
5km (by bus) + 4km (by bus)	900 + 900 = 1,800 won	900 won (Basic rate within 10km)
5km (by bus) + 7km (by subway)	900 + 900 = 1,800 won	Basic rate +100 won (additional fares for 10km to 15km) 1,000 won
6km (by bus) + 8km (by subway) + 4km (by bus)	900 + 900+ 900 = 2,700 won	Basic rate +200 won (additional fares for 10km to 20km) 1,100 won

Figure 5:
Cost Reduction after Reform with Distance-based Fare System

Betterment in Livability and Sustainability

The bus reform has increased the speed of buses during peak times by 30% on average, 10 to 80%, depending on the section. In addition, punctuality of bus services improved thanks to the information technology that includes scientific bus management with BMS, and quasi-public collaborative operation among buses.

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After the reform, citizen's satisfaction for public transport significantly improved. According to research conducted by the Seoul Development

Institute in June 2005, the satisfaction rate increased from 14.2% to 36.9% after the reform. Major factors for the satisfaction were 'discounted transfer fare' and 'connection between subway and bus.

The integration between buses and subway systems brought about increases in ridership of both. Public transit ridership showed a decline by 2.1% in the first half of 2004, but it was converted to an increase by 5.5% during the period of July 2004 to June 2005. Bus ridership increased by 6% and town bus passengers particularly increased by 26.4%. Such an explosion of town bus ridership occurred because the integrated fare system (free transfer fare) motivated people to use town buses, rather than walking, when they accessed nearby subway stations or bus stops. Increased ridership resulted in the increase in revenue by 10.3%. The transfer rate of public transport increased in response to the reform, and transfer rate of the buses soared in particular. Since the burden of transfer between different transport modes was relieved by the integrated fare system, people now seem to have more freedom to choose more reasonable modes of transportation.

Transportation reform contributed Seoul's PM10 decrease from over 75$\mu g/m^3$ in 2002 to 44$\mu g/m^3$ in 2013, which became lower than the Korean air quality standard (50$\mu g/m^3$). NO_2 has also been decreasing from 0.037ppm in 2001 to 0.033ppm in 2013, yet it needs more improvement to meet the Korean air quality standard of NO_2 of 0.02ppm.

OPEN: e-Government for Transparency and Efficiency

In July 1998, Mayor Kun Goh began his term in the mayoral office. The city of Seoul then launched an anti-corruption campaign to ensure a transparent administration. Despite such an endeavor, on 19th January 1999, the newly-appointed chief of the Administrative Bureau, a position that was supposed to play the key role in the anti-corruption campaign, was arrested for taking bribes. Mayor Goh was tremendously shocked by this scandal and wanted stronger measures to be taken. On 25th January 1999, Mayor Goh proposed, as the second step of anti-corruption campaign, that the city government develop an e-Government system that can ensure transparency. Seoul started to develop an open online civil petition system, which began the e-governance system of Seoul.

OPEN (Online Procedures ENhancement for civil applications)

Just like the sunlight kills the germs, the OPEN aimed to prevent corruption through the transparency, which enabled citizens to monitor the procedures of civil applications and petitions over the Internet. Seoul made the procedure visible from petition reception to final decision, so that the filers could follow the procedure on a real-time basis on line. For example, a citizen who submitted a request

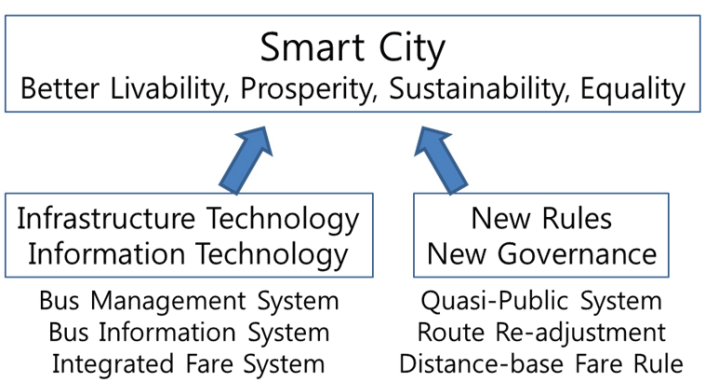

Figure 6:
Smart City with New Technology and Rules: Case of Bus Reform in Seoul

for construction permission could easily check the current status of her/his request online, even from home without meeting or calling the city hall.

By disclosing the procedures on a real-time basis, Seoul sought to prevent irregularities in the administration. Seoul also intended to enhance the credibility of the administration. This bi-lateral governance system helped restore the credibility of the administration. Seoul aimed to create a system that can satisfy both citizens and the city government by ensuring citizens' participation. By making the administrative service easier and more affordable for the citizens, the city laid the groundwork for better communication between the citizens and the city government to create a highly participatory governance. (Seoul Metropolitan Government, 2001b, p.50)

Seoul built OPEN within less than three months and launched on 15th April 1999. OPEN started with disclosing the procedure of corruption-vulnerable petitions: petitions that are complex, exposed to interest of various stakeholders, and prone to bribe. Twenty six civil application procedures were disclosed at first. Later, Fifty-four civil application procedures in 10 sectors were disclosed. As of 2005, a total of 111 procedures in 11 sector (including 71 procedures in 10 sector and 40 procedures of petition-related committees) were being disclosed through the OPEN system (Choi 2006)

The Information Disclosure Act of that time stipulated that the government didn't need to disclose the information unless disclosure request is submitted by the people. However, the OPEN system of Seoul enabled a step-by-step disclosure of administrative process even without any request from the people, innovatively enhancing the transparency.

The OPEN system also displayed a flow chart to let citizens, who are not familiar with the administrative process, anticipate the process going forward. Disclosing the whole process of dealing with petitions played the important role in deterring irregularities and corruptions, because it enabled everyone to know who made what decision at which point. It also enhanced efficiency of internal audit and monitoring to uncover and control irregularities and corruptions. The OPEN system was synched to the electronic document approval system later.

Information Technology for OPEN

In order to ensure an efficient automation of administration, the Seoul Metropolitan Government came up with a broadband network establishment plan and installed ATM exchangers at the main and annex buildings of city hall, the Information Management Office, and the 25 district offices, which were connected to the central Information Management Office on E1-grade speed (2Mbps). The network started operation in 1997. In January 2001, the city devised a framework plan to build a "data highway" that would allow STM-4 grade speed (622Mbps) instead of the previous level at E1 (2Mbps), by routing fiber-optic cables in the common ducts of the subway routes in Seoul.

The Data Highway project was a three-year project (2000-2002) aimed at establishing a data infrastructure that would connect 30 agencies under the city government. Fiber-optic cables dedicated for this project were to be routed in the common ducts, taking advantage of both the old and new subway routes. Also, underground duct lines were to be created to connect the government offices and the mechanical room of the nearest subway station via fiber-optic cables. Six selected key points were connected to one another with a speed of 2.5Gbps, while the remaining 24 offices were connected via 622-Mbps branch networks.

Each node was tied in the form of a ring, in order to duplicate the circuit for backup, ensure the credibility, and enable a one-stop management of the network. At the same time, factors such as network extensibility, economic feasibility and adaptability of future technologies, compatibility with other standard networks were taken into consideration for an efficient system management.

Better Governance

The OPEN system made practical contributions to eradicate corruption of the public officials in the course of dealing with petitions. People no longer needed to mobilize an acquaintance in the city hall or asked to pay an "express charge." The process of dealing with petitions was accelerated, with no more delays due to unclear reasons. Overall, the system effectively enhanced efficiency and quality of civil service.

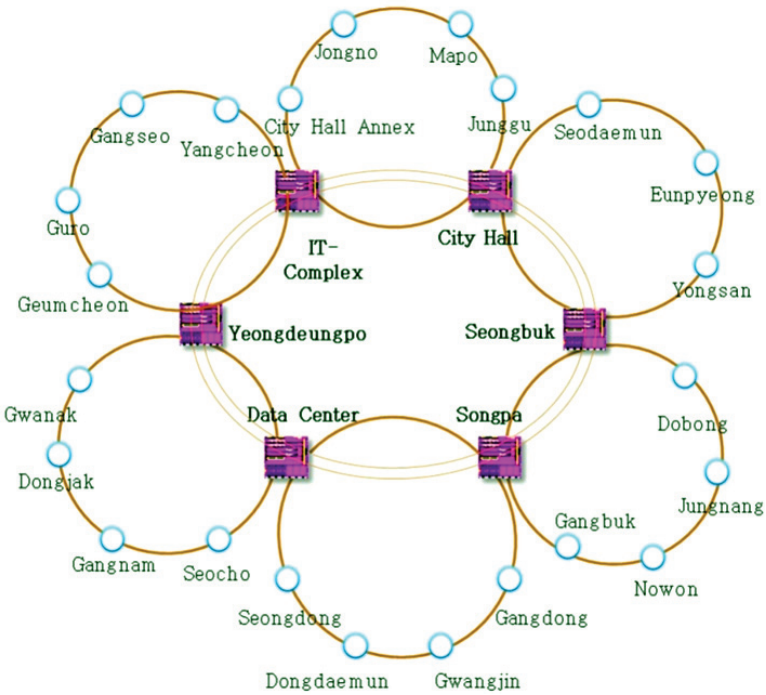

Figure 7:
Map of the Ring-shaped Data Highway

Eradication of corruptions and reduction of administrative irregularities were the most important purpose of introducing the OPEN system. In conclusion, the system effectively works. Since 1999 when the OPEN system was introduced, the number of public officials involved in corruption or irregularities dropped by a significant margin. The audit team of the Seoul Metropolitan Government uncovered an average of 79.1 corrupted officials after the introduction of the OPEN system, down 30.9% from the previous average of 114.5 officials. The number of bribery cases detected halved while dereliction of duties decreased by 72.2%. In terms of sector, corruptions committed by officials in charge of housing and construction projects accounted for 17.8% of the total after the OPEN system introduction, a sharp drop from 42.9% prior to the system introduction.[4]

68.7% of citizen respondents said that corruption had decreased since the introduction of the OPEN system. 45.1% of public officials responded in the same way: a little bit lower than the rate of positive response among the citizen respondents. Overall, the system was received widely in a positive way that it helped decrease corruption.

To the question, what benefit will the OPEN system have in the petition process and administrative organization, the following results were given: 22% of public officials pointed out confidence-building between the government and the citizens, while 17.5% pointed a reduction of irregularities by enhanced transparency. For the same question, citizen respondents selected enhanced efficiency (36.5%) and reduction of irregularities (25.3%).

[4] This result could be a combined effect of various anti-corruption measures. It is almost impossible to separate the sole effect of OPEN.

Before the introduction of the OPEN system, it took an average of 7.7 days to complete the treatment of a 10-day due petition. The duration decreased to 7 days after the introduction of the system, speeding up the time on an average of 10%.

59% or more than half of public officials responded that they have the opportunity of understanding the works of their colleagues, subordinates or bosses via the OPEN system. Also, 75% of them said that the OPEN system helped them better understand the work of their colleagues. In conclusion, most of citizens viewed that the OPEN system helped enhance the administrative efficiency while the public officials mostly appreciated the effect of confidence and transparency building.

CONCLUSION

There are advantages and challenges of urban agglomeration. As many people live and work in a small area, the city and its citizens can enjoy the benefit from division of labor, economies of scale, agglomeration economies, diversity, and value added from trade. However, as many people live and work in a small area, the city and its citizens may suffer from congestion, pollution, and shortages of public services. Smart city is a city that maximizes the utility of agglomeration and minimizes the disutility of congestion with advanced technology and new rules.

Although cities in the developed world focus on information technology for efficiency and sustainability, those cities in the developing countries have to adopt both infrastructure technology (IT1) and information technology (IT2) for livability, prosperity, and sustainability.

Smart City is a city that successfully solves the tasks it faces and develops itself as a future-oriented city using the best available technology. Today, the cities of the world are looking to increase the efficiency of their public services and create a bi-lateral governance system that works for its citizens and an eco-friendly city that adapts to the change in climate. Furthermore, in the developing countries, it is a city that adequately makes use of the available lands, protects the natural areas, promotes economic growth and fights poverty. A 'smart city' ultimately is a city that resolves all of the above given tasks effectively and efficiently using advanced technology and knowledge.

Seoul has successfully increased the effectiveness and efficiency of its infrastructure and public services in all fields and also created a governance system that works for its citizens. Buses in Seoul were operated by many individual private companies. Government had little control of routes and schedules, but it set fares and provided subsidies. Bus routes were winding and not integrated with the subway. Bus companies were only interested in profit maximization, with little attention to safety and comfort of citizens. Quality of bus service was not safe, uncomfortable, and unreliable. As a consequence, transit ridership decreased and pollution increased. With information technology Seoul's public transportation system was innovatively reformed. It coordinated buses' routes and schedules, and integrated buses with the subway. Information technology and new regulations drove the successful reforms.

As shown in the results of surveys and audits conducted by the city, the OPEN system contributed greatly to enhancing the transparency of Seoul administration, thereby reducing corruption and building confidence of the citizens. Even though it would be difficult to strictly verify the real effectiveness of the system in corruption eradication, the system did successfully ensure transparency and deter corruptions caused in the past by the information asymmetry between the public officials and the citizens.

It was remarkable that such a new system as the OPEN was launched within two and a half months. The mayor's strong leadership played the crucial part in realizing the idea into specific programs, at the same time, overcoming difficulties such as resistance from the public officials. When it wasn't even legally stipulated that active disclosure of data was necessary, the mayoral leadership was indispensable to such the innovative approach of disclosing each step of the petition procedure on the Internet.

The city of Seoul continued moving toward e-Government even after the launch of the OPEN system. Since 2000, the Seoul Metropolitan Government reinforced its electronic drive to integrate information services and encourage citizens' participation. The SMG worked on the capitalize as "Policy to Link and Integrate Information Services and Resources" in 2003-2004, the "Sophistication of Integrated Data Resources and Encouragement of Citizens' e-Government Service Use" in 2005-2006, and the "Ubiquitous City Plan"

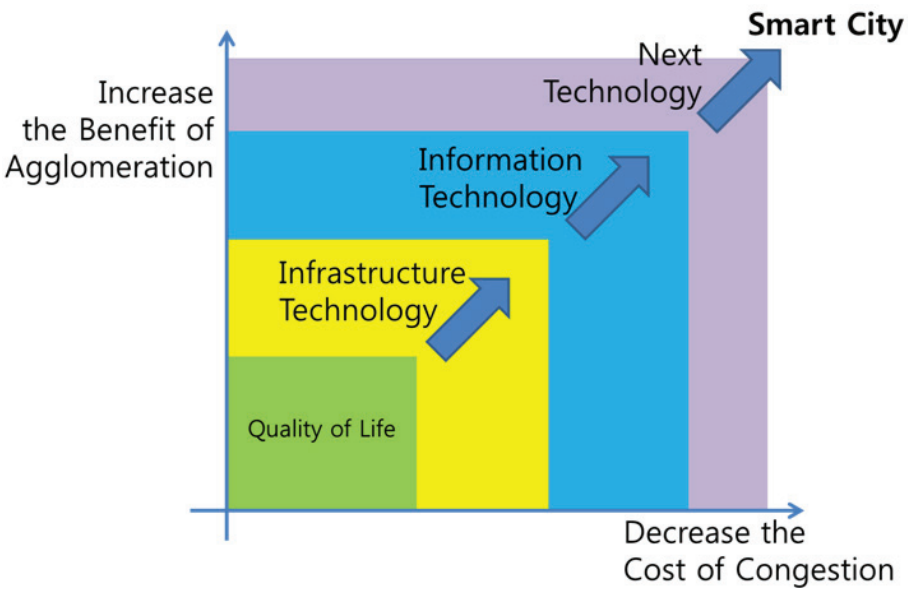

Figure 8:
Smart City and Technology

in 2006-2010. Since 2011, it launched the "Smart Seoul" campaign and continued to work to create a smart-technology-based city government that utilize the development of ICT technologies. It is becoming a leading e-Government city by forging ties with global cities and advancing the city's brand as a cutting-edge ICT city. Thanks to such an effort, the city of Seoul ranked first in the World City e-Government Survey for four consecutive years since 2003, hosted the inaugural general meeting of the WeGO (World e-Government Organization), and won the second prize in the UN Public Services Awards with its "Oasis of 10 Million's Imaginations" project.

Should a new technology develop in the future that can further improve the lives and work of its citizens, the city will be called a 'smart city.' Smart city is a future-oriented city that makes use of the latest technology and knowledge in successfully solving its tasks to develop and transform itself in order to maintain a high quality of life, prosperity, sustainability, and equality.

REFERENCES

Albino, Vito, Umberto Berardi and Rosa Maria Dangelico. (2015). Smart Cities: Definitions, Dimensions, Performance, and Initiatives. Journal of Urban Technology.

Choi, Jin-wook. (2006). The Impact of the OPEN system of Seoul on the corruption. 2006 Spring Joint Seminar by Korean Association for Public Administration & Korean Association for Local Government Studies. [Korean]

Kehoe, Michael, Michael Cosgrove, Steven De Gennaro, Colin Harrison, Wim Harthoorn, John Hogan, John Meegan, Pam Nesbitt, and Christina Peters. (2011). Smarter Cities Series: A Foundation for Understanding IBM Smarter Cities. IBM.

Kang, Myounggu. (2015). Brief Overview on Urban Planning Experience of Seoul. World and Cities, 8. Seoul Institute. [Korean]

Department for Business, Innovation, and Skills (UK government). (2013). Smart Cities: Background Paper.

European Commission. https://ec.europa.eu/digital-agenda/en/smart-cities Accessed on March 3, 2015.

Hall, Robert. (2000). The Vision of a Smart City. Presented at the 2nd International Life Extension Technology Workship in Paris, France.

Indian Government. (2014), Draft Concept Note on Smart City Scheme.

International Telecommunication Union(ITU). (2014). Smart sustainable cities: An analysis of definitions.

Giffinger, et al. (2007). Smart Cities: Ranking of European Medium-Sized Cities.

Seoul Metropolitan Government, (2001a), White paper of new Seoul on administrative reform. 2001, Business administration, open administration, transparent administration, Seoul: Administrative Reform Division, Seoul Metropolitan Government. [Korean]

Seoul Metropolitan Government, (2001b), Evaluation study on the effect of the anti-corruption policy of Seoul: Focusing on the OPEN system, Seoul: Administrative Reform Division, Seoul Metropolitan Government. [Korean]

Washburn, Doug and Usman Sindhu. (2010). Helping CIOs Understand“Smart City” Initiatives. Forrester Research Inc.