Welcome to Module 1 of the eLearning Course “Smart City”

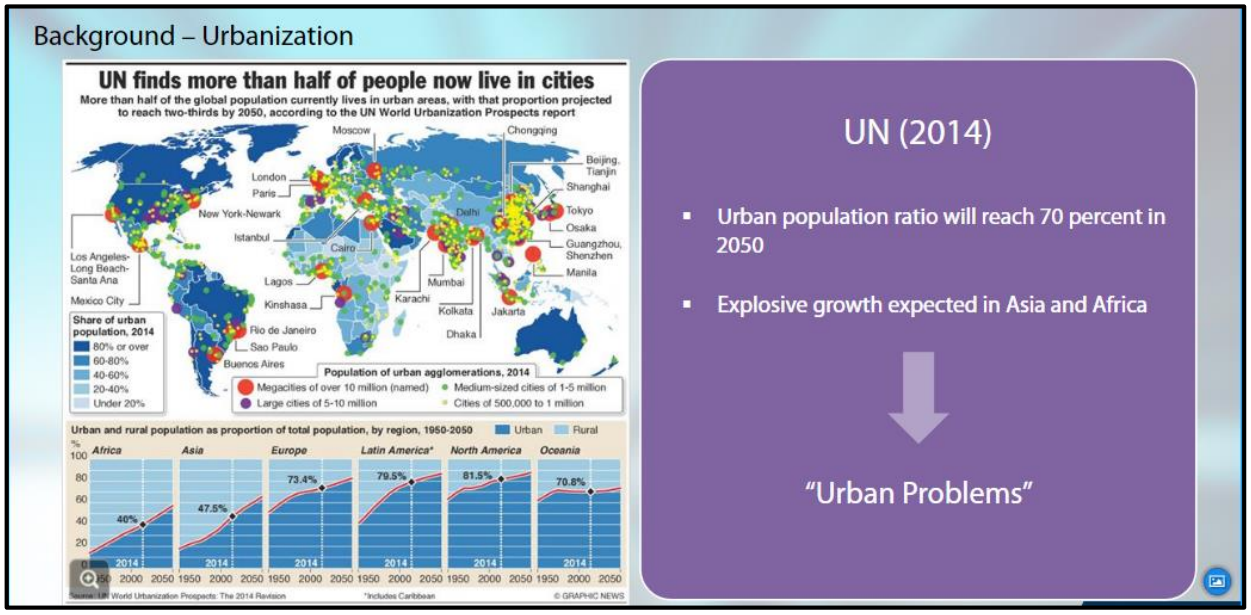
This module will introduce the definition, idea, and components of Smart City. It will also look most closely at the recent global standards of smart city with an aspect of smart technologies and as a solution to complex contemporary urban problems.

Background – Urbanization

In 2014, the United Nations put forward a forecast on urbanization. According to that, the urban population ratio will reach 70 percent in 2050, and an explosive urban population growth is expected in Asia and Africa

In the picture, red points represent megacities with over 10 million population. Also, the graphs below describe that, Africa and Asia are not the areas with the biggest population, but the ratio of their population growth is the most radical. You can see this by looking at the steep red curves.

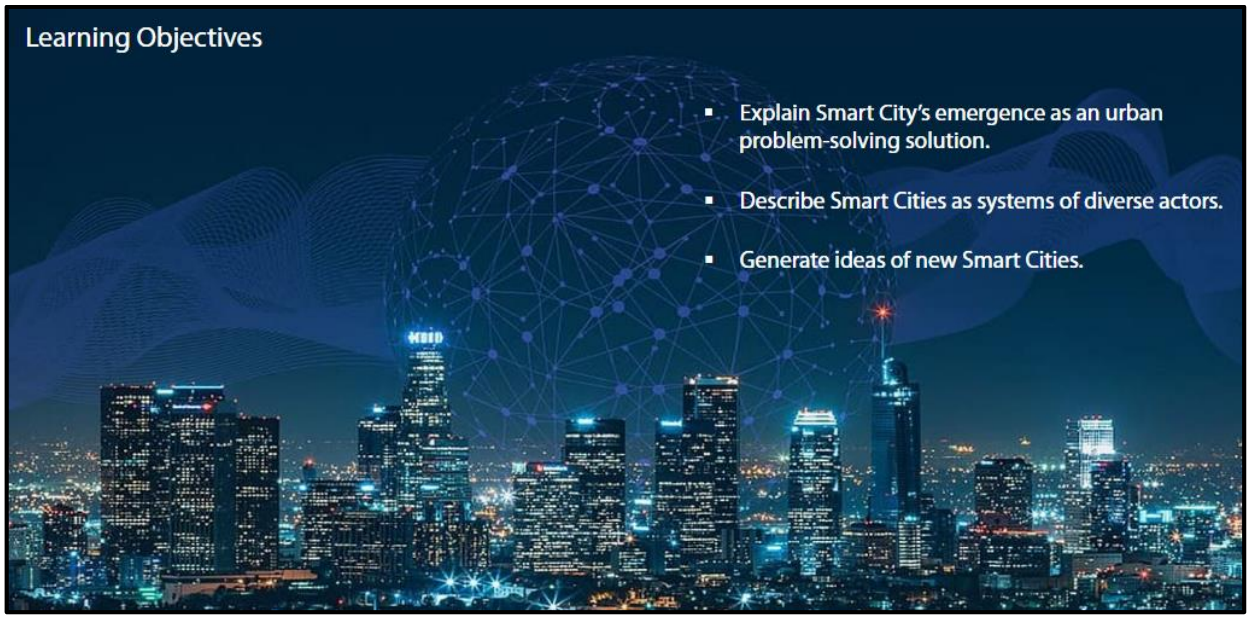
In this context, a radical urbanization is expected to cause a number of diverse urban problems.



Learning objectives

By the end of this module, participants will be able to:

- Explain the background of Smart City's emergence as an urban problem-solving solution.
- Describe Smart Cities as a system of diverse actors: citizens, businesses, technologies, infrastructures, and government.
- Generate ideas for new Smart Cities applicable to each country.



Background – Urbanization

There are many types of urban problems. Water problems (supply or sewerage), traffic problems (traffic jam or parking), environmental problems (pollution or energy-related problems), and people-related problems like education, housing, and crime are the most representative urban problems.

Every major city is unique in its own way, but each deals with the same, if not very similar problems.

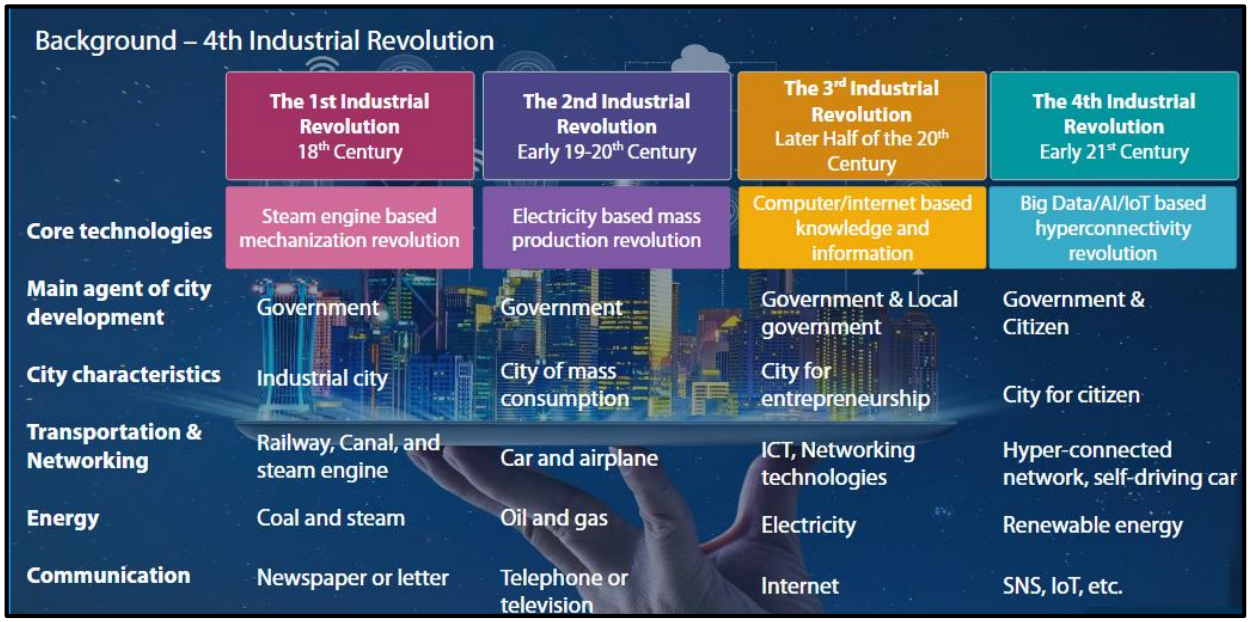
Background – 4t^{h} Industrial Revolution

Most experts in urban problems believe that the technology can provide solutions to most of urban problems.

As we are living in the 4th Industrial Revolution era, technologies can provide good opportunities to a number of diverse areas of the city. This table shows the characteristics of city developments from the 1st industrial revolution to the 4IR.

Government was the only main agent of city developments from the 1st to the 2nd industrial revolution era. On the other hand, local governments emerged as main agents of city developments since the 3IR era, and citizens intervened as main agents of smart city developments during the 4IR. As a result, city characteristics have changed evolved towards “Cities for citizens,” which means that the goal of every services or application in cities is to enhance the quality of life of local citizens.

Also, the main emerging technologies in the 4IR are Big data, IoT, AI, and Blockchain. Therefore, most applications in a city are operated by analyzing big data using hyper connected networks. Also, energy sources are becoming more eco-friendly.



Digital Transformation and Smart City

In other words, the technologies in the 4IR, such as smartphone, IoT, AI, Big data, Cloud, Blockchain, and 5G networks support the connection of things and people, data collection and analysis, and the Intelligence of city services. This leads to changes in the way we create value in cities, and the relations among participants in these cities. We can explain these changes by digital transformations.

So the city can be described as a platform that connects people, space, and things in the city.
Cities in the 4IR not only support infrastructures and services for people, but also data collections, analysis, visualizations, and predictions. Smart city is hence a platform for data and the 4IR.

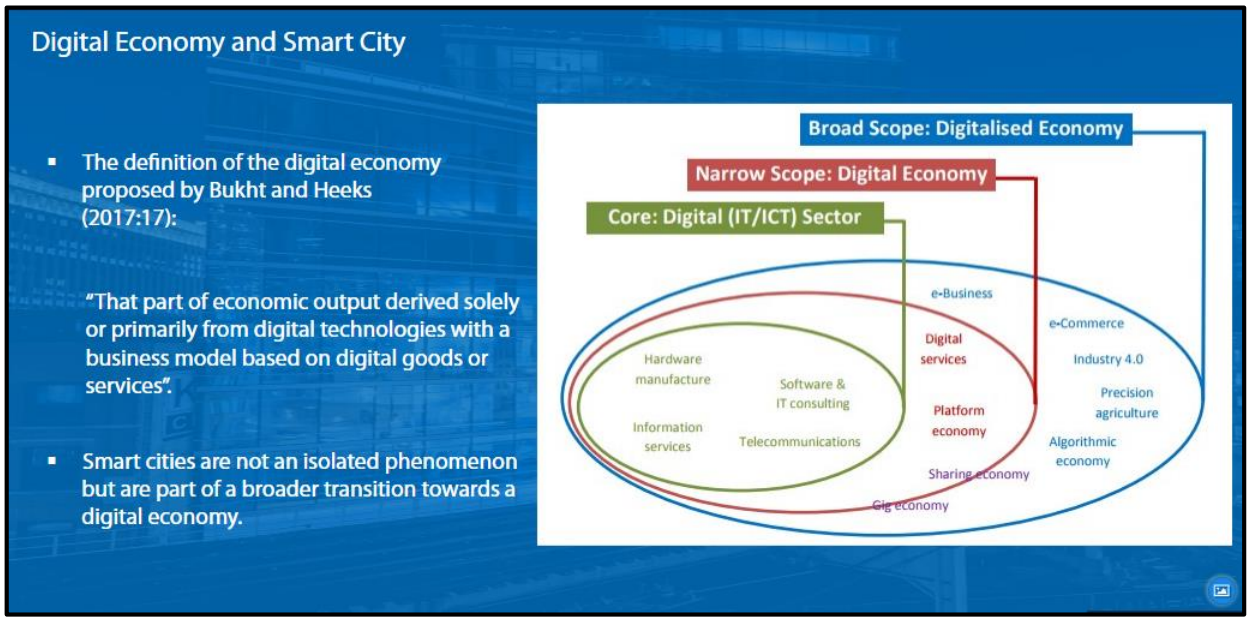
Digital Economy and Smart City

Smart city can be described as part of a digital economy.

According to the definition of the digital economy proposed by Bukht and Heeks, “That part of economic output derived solely or primarily from digital technologies with a business model based on digital goods or services”.

In the broad scope of the digital economy, characteristics of smart cities share a similar tone. Smart Cities are not an isolated phenomenon but are part of a broader transition towards the digital economy.

If you want to learn more about the smart city in the era of 4th industrial revolution and digital transformation, it would be helpful if you read the reading material “World Economic Forum (2018). Agile Cities: Preparing for the Fourth Industrial Revolution, Global Future Council on Cities and Urbanization,”



UN SDGs and Smart City

The UN Sustainable Development Goals consider diverse streams of smart cities. SDG 11 was established with the aim of making cities and human settlements inclusive, safe, resilient, and sustainable.

In this sense, it is essential to consider SDGs when developing and building Smart Cities master plans.

Global Definitions of Smart City

From now on, global definitions of smart city will be introduced. According to the International Telecommunication Union (ITU) 's 2014 survey, there are 116 definitions of smart cities globally. Which means there is no specific definition for smart city.

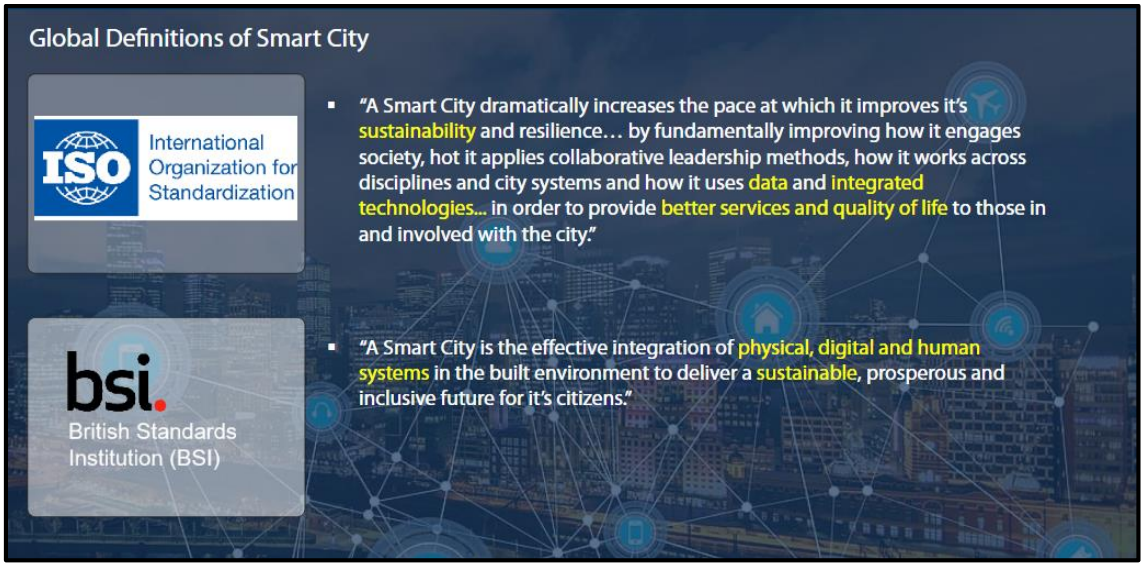
However, there are essential keywords that most of the definitions comprise; ICT, environment and sustainability, Infrastructures and services.

Also, the diagram shows the concept of Smart Cities, and its classifications. A smart city should have a goal and an implementation plan. Major goals of a smart city can be for the city itself, or for the citizens. The implementation of smart city can be the service, or the structure of it.

Global Definitions of Smart City

These are example definitions of a smart city.

ISO and BSI are the institutions of global standardization of technologies. They described Smart Cities with some keywords, including: sustainability, technologies like data, digital systems, citizens, services and quality of life.



Global Definitions of Smart City

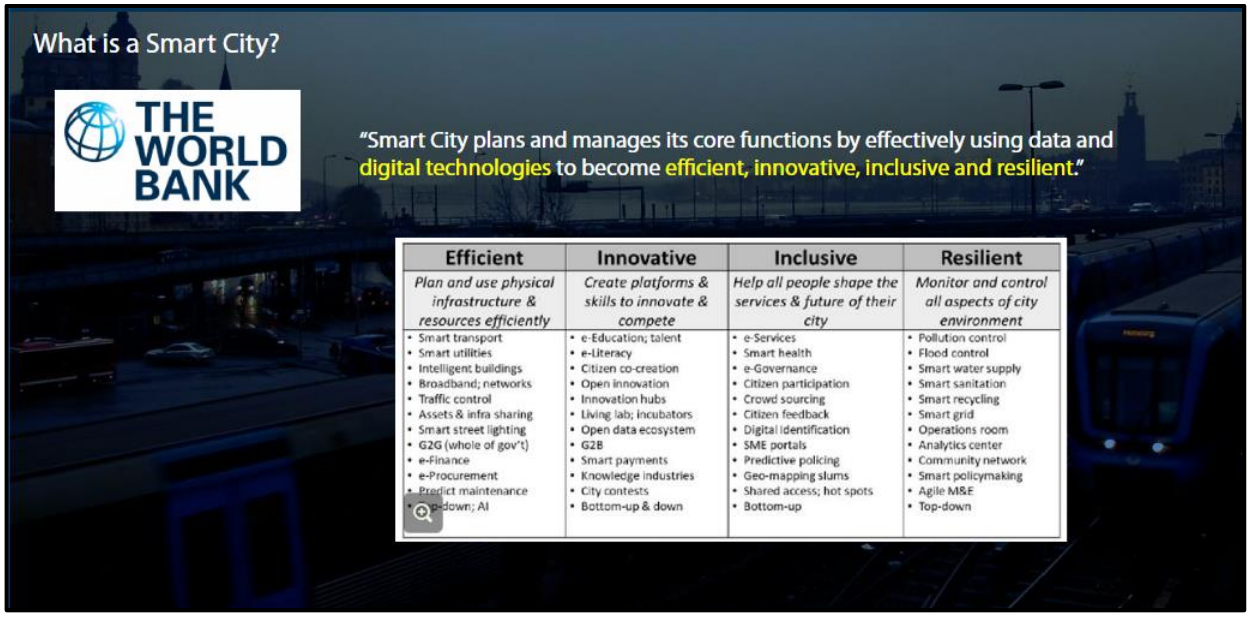
ITU focused on the keywords such as sustainability, ICT, and quality of life.

EU also focused on digital and telecommunication technologies, services and citizens.

What is a Smart City?

Lastly, The World Bank Group defines a Smart City with digital technologies, including effectiveness, innovativeness, inclusiveness, and resilience.

Smart city services and applications should seek to achieve the following values: Efficiency, innovativeness, inclusiveness, resilience.
Similarly, smart city components can be categorized by these four sections.

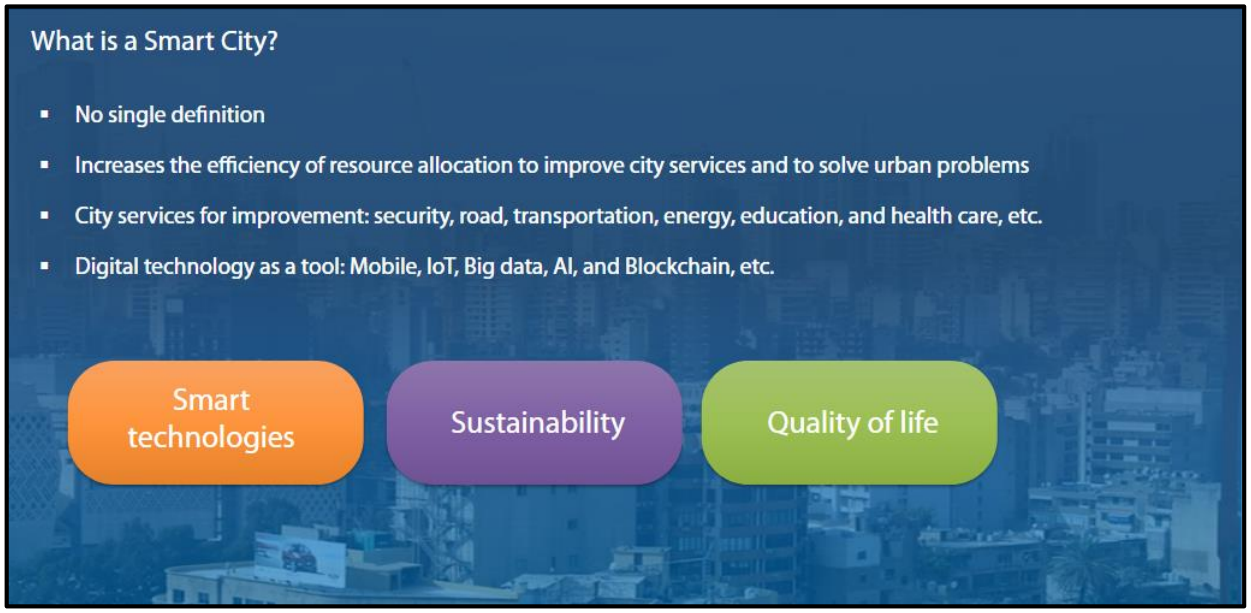


What is a Smart City?

To conclude, there is no single definition of Smart Cities.

However, a number of definitions share common features by describing smart cities' services in the sector of security, road, transportation, energy, education, or healthcare to increase the efficiency of resource allocations and contribute in solving urban problems. And those services use digital technologies such as mobiles, IoT, Big data, AI, Blockchain, etc., as implementing tools of Smart Cities.

I would like to describe Smart Cities with three keywords: Smart technologies, Sustainability, and (Increasing) Quality of life.

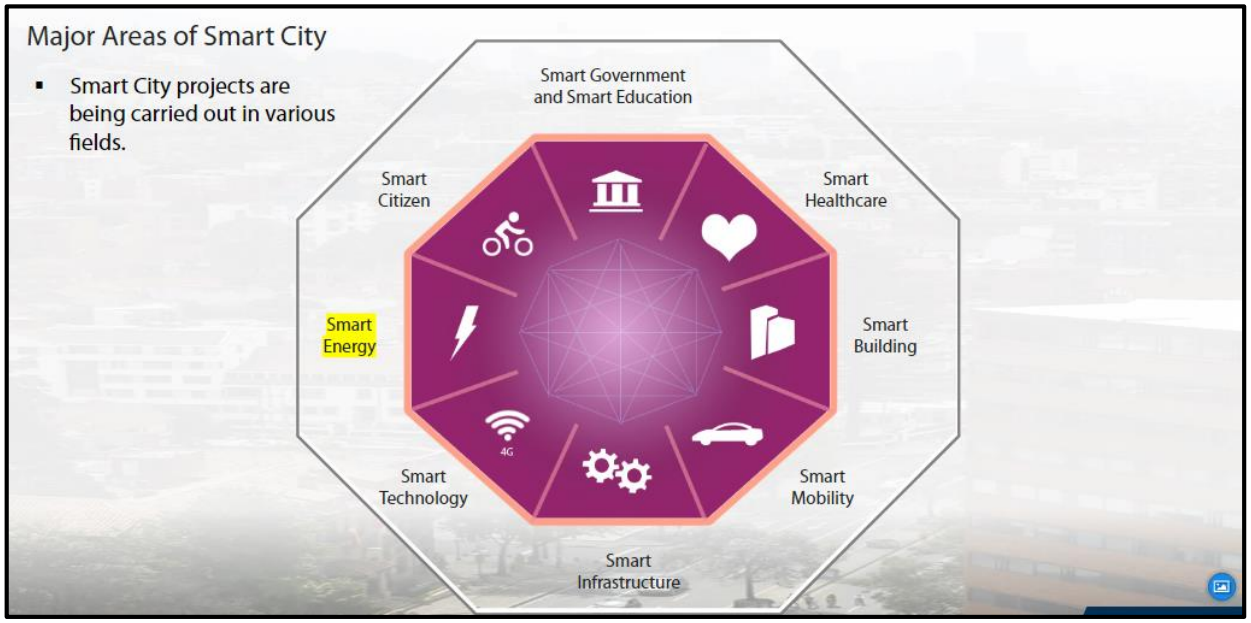


Major Areas of Smart City

Smart Cities are the confluent results of various fields. Smart City projects are hence being carried out in various sectors such as transportation, energy and environment, safety, medical care, and education.

About 70% of the global smart city projects are focused on three key areas: energy, transportation and safety.

Also, smart citizens, smart governments, education, smart healthcare, building, mobility, Infrastructure, technology, and energy are the smart city areas suggested by Frost & Sullivan.



Major Areas of Smart City

In addition, Smart City projects are distinguished into three major aspects: (i) city development, (ii) operation, and (iii) regeneration.

First, the city development aspect of Smart Cities focuses on building new infrastructures permitting to accommodate the incoming population.

The second area is city regeneration. It mainly focuses on regenerating the city to revive the underdeveloped area and improve the residential environment.
Finally, the last area is city operation. This consists of urban applications that enhance the quality of life for citizens.

Major Areas of Smart City

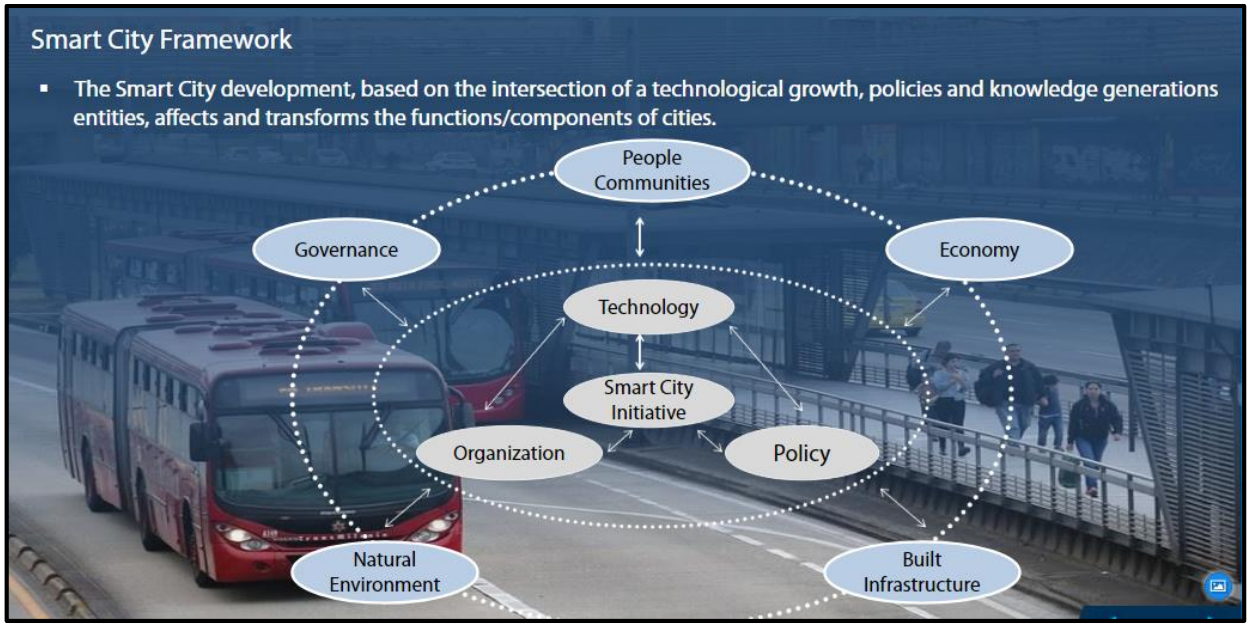
Smart cities are comprised of diverse areas. Each one of theses can be developed if needed by the city, which permits to enhance a balanced smart city system.

When developing a smart city master plan, the priority of each cities' main areas should be considered. Strategic methods of planning a smart city will be covered in module 4.

Smart City Framework

From now on, I would like to introduce the components of a smart city, which are described by the diagram framework of smart city.

Many literatures suggest that the smart city development, established based on the intersection of a technological growth, policies and knowledge generations entities, affects and transforms the functions/components of a city.



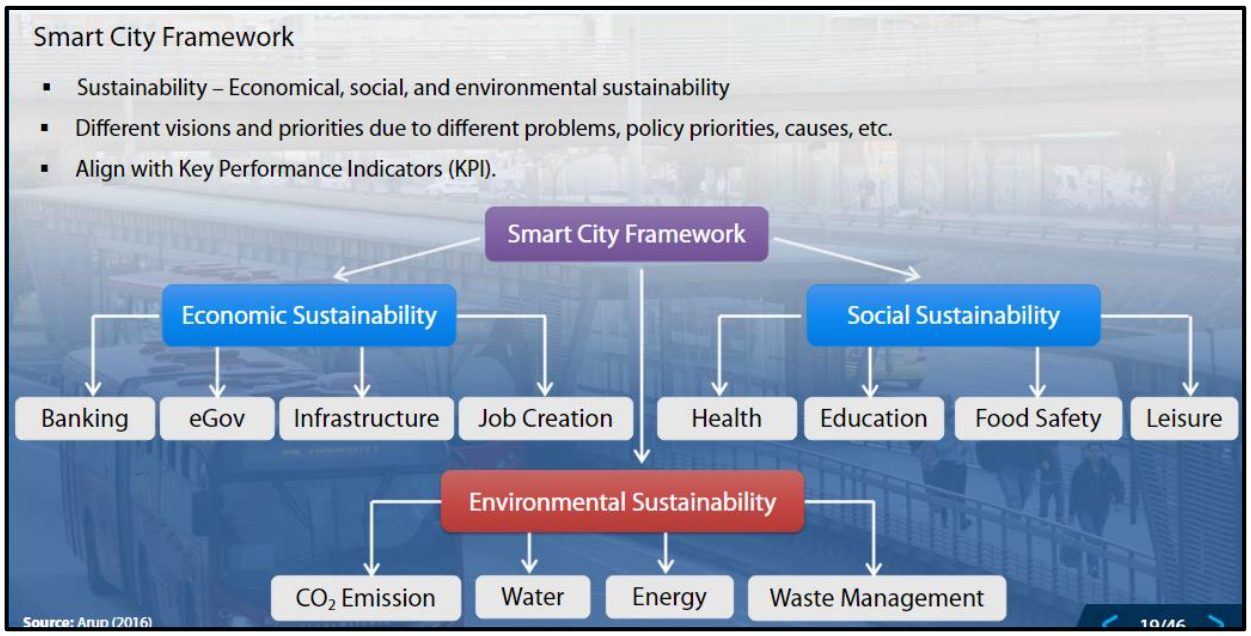
Smart City Framework

Also, in from the aspects of sustainability, the smart city comprises economic, environmental, and

social factors of sustainability.

Every city has its own lacking points, so city developers should focus on the most challenging issues of each respective city. What are the most challenging issues in your city?

Also, the addressed issues should be aligned with the Key Performance Indicators.

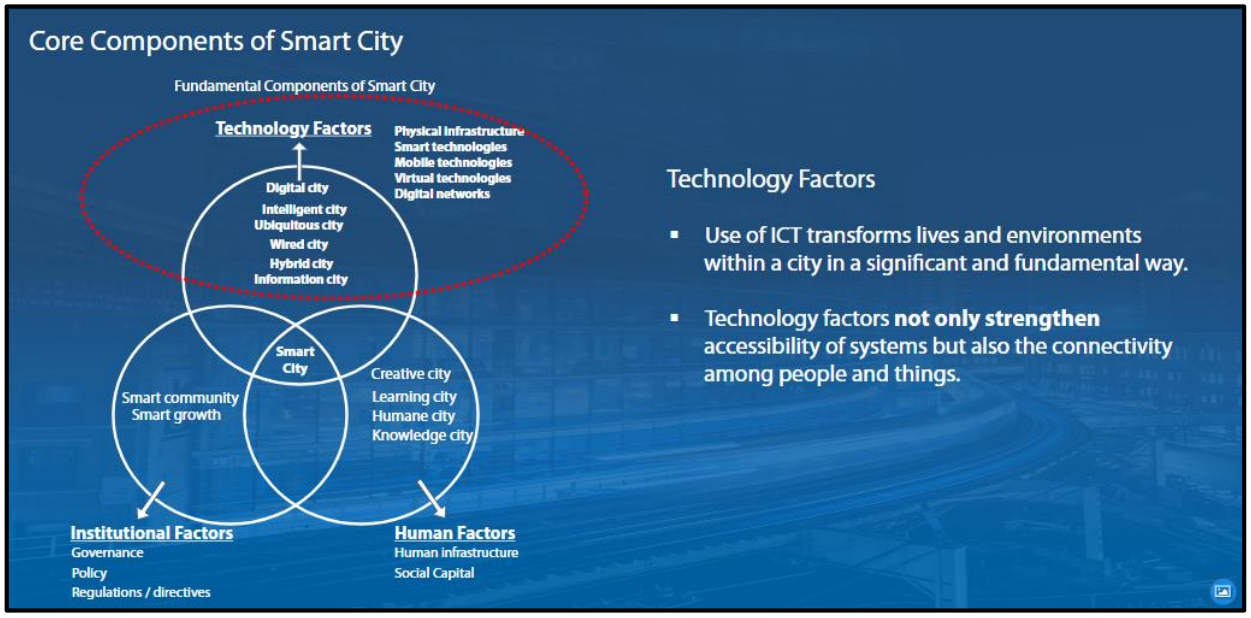


Core Components of Smart City
From now on, I would like to introduce the three core components of a Smart City.

The first core component is technology factors. It contains physical infrastructures, smart technologies, mobile technologies, virtual technologies, and digital networks.

Technology is key to being a smart city, since the use of ICT transforms life and works within a city in a significant and fundamental way.

Especially, technology factors not only strengthen the accessibility and availability of systems but also provide the connectivity among people and things found in the city.

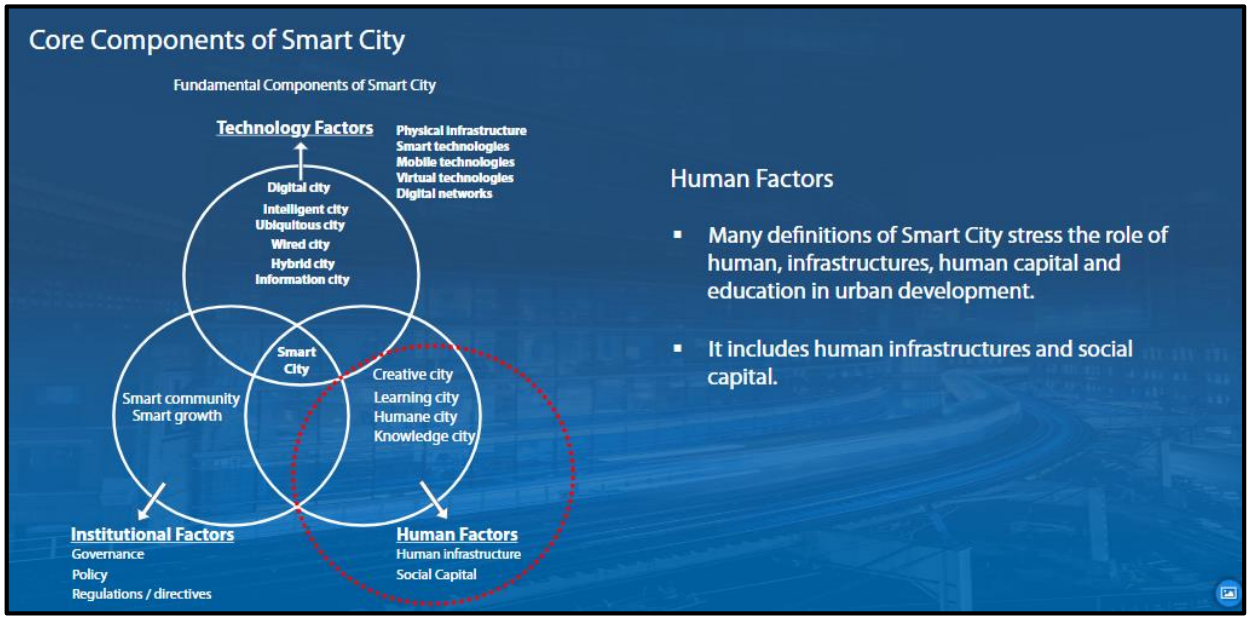


Core Components of Smart City

The second core component is human factors. It contains human infrastructures and social capitals.

In the era of the 4IR, not only the government but also the citizens act as main city developers. Also, small businesses like startups which are considered as human capitals are one of the most important components constituting Smart Cities, which are also the sources of innovation. In this context, the human factors have been emerged as a key component of smart cities nowadays.

Human factors especially include social inclusion of various urban residents in public services, soft infrastructures (knowledge networks, voluntary organizations), urban diversity and cultural mix, social/human/relational capital, and knowledge base such as educational institutions and R&D capacities.



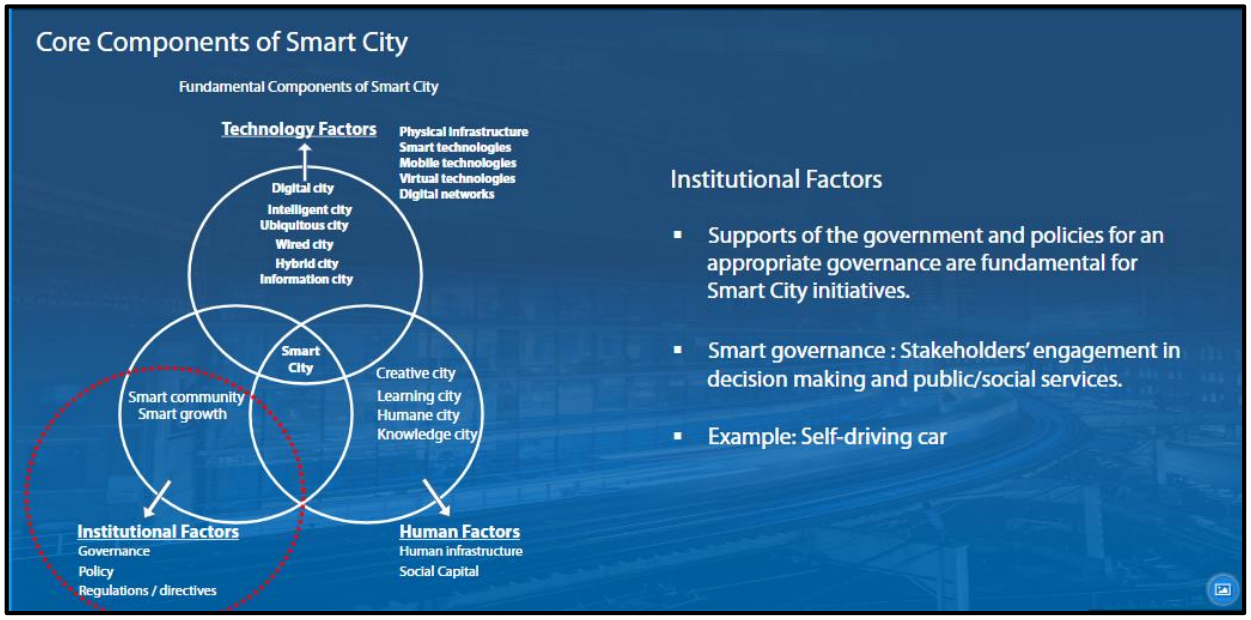
Core Components of Smart City

The last core component in smart city is institutional factors. It covers governance, policies, regulations, or directives. (Governance encapsulates collaboration, cooperation, partnership, citizen engagement, and participation.)

The supports of the government and policies for an appropriate governance are fundamental to the design and implementation of smart city initiatives.
In addition, the transformation towards smart cities entails interactions of technological components with political, institutional and transitional components.

Also, governancewise, smart governance in smart cities promotes engagement of diverse businesses and citizens in decision making processes of city services.

In the era of the 4IR, new business models which apply smart technologies like selfdriving car will require political supports. In smart cities, a regulatory sandbox is needed for encouraging new businesses. As a result, institutional factors are becoming more important nowadays for promoting innovations in smart cities.

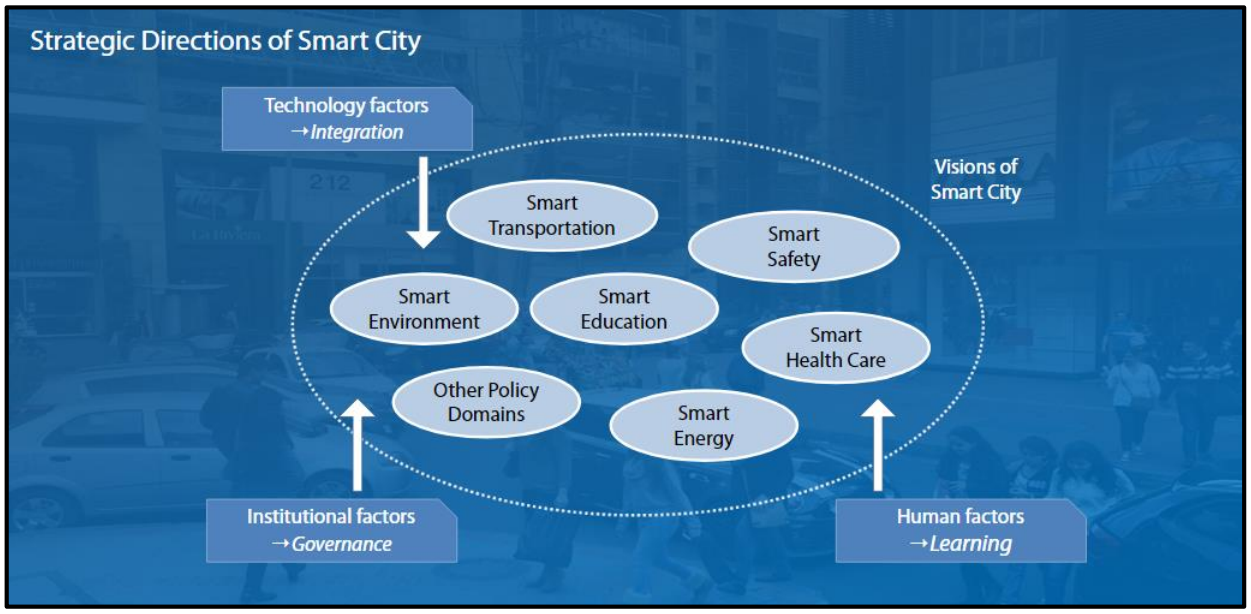


Strategic Directions of Smart City

To sum-up, visions of smart city could be dealt with those three core components: technology, institutional, and human factors.

In other words, those factors could be managed to enhance smart cities strategies aligned with their main visions.

Usually, the integration of technology factors (convergence of technology), governance, and learning for human factors have been the common strategies of smart cities.



Evolution of Smart City

From now on, we will see the evolution of smart cities.

Smart Cities were first developed in the mid-1990s. The first implemented case of Smart City in Korea was the “Digital City”, followed by the “U-city” which applies the digital city definition in the Korean context. With the development of the related technologies, demands for urban developments overlapped with a rapid diffusion of those implemented technologies.

Evolution of Smart City

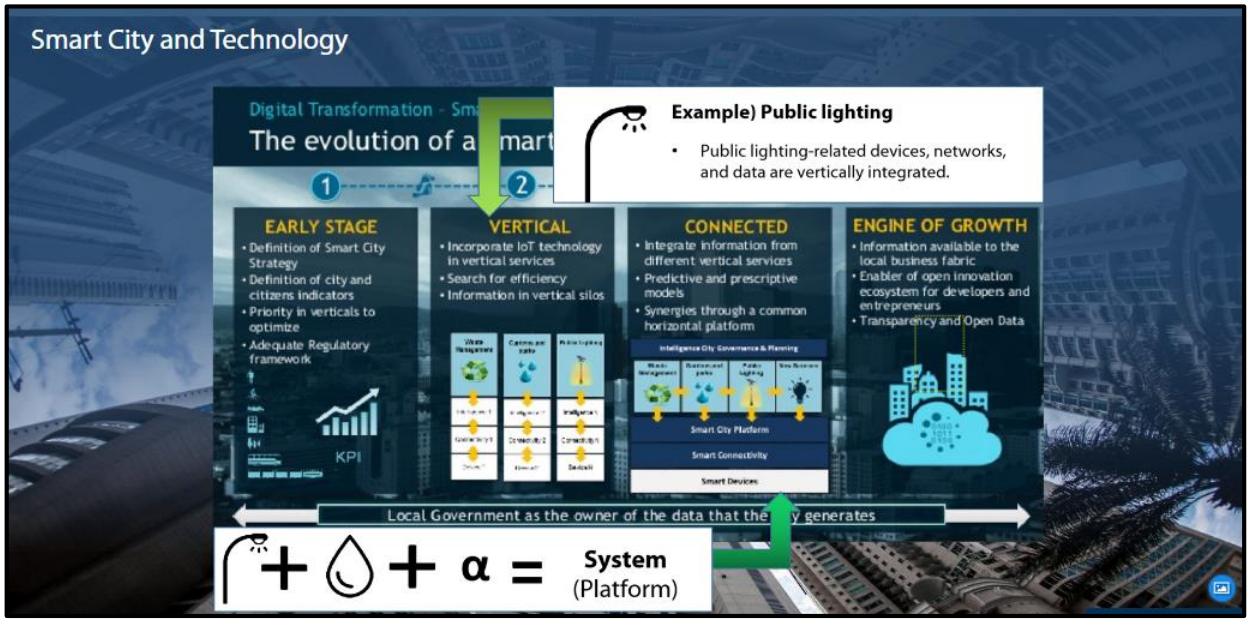
This is a diagram that shows the evolution of smart cities with each distinctive stage.

In the early stage, the definition, strategies, and components of smart cities were established based on the KPIs.

In the second stage, a vertical integration among services using IoT has been implemented. In other words, every device, network, and data for the public lighting services in smart cities are vertically integrated in this stage. During this stage, each service works separately from other services. For instance, the water management service is separately operated from the public lightings service.

Then, a horizontal integration of those services is formed, which formulates a smart city platform with smart connectivity.

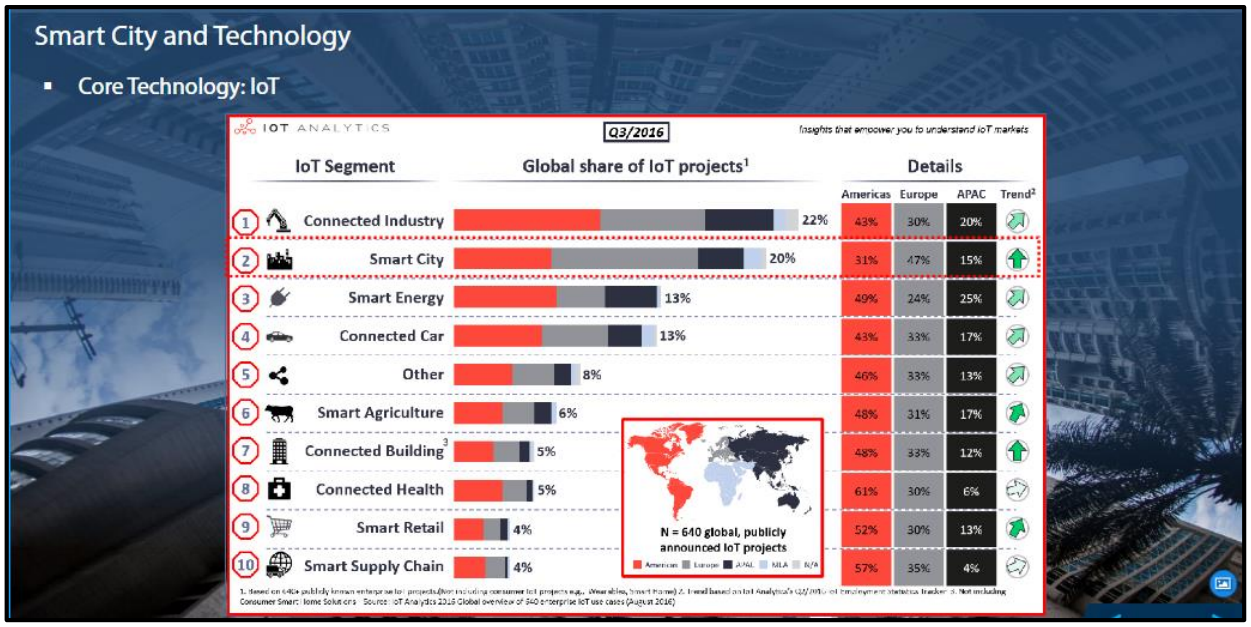
Finally, the system of a smart city comprised of platforms of technologies and data is expected to be the engine of growth.



Smart City and Technology

From now on, I would like to introduce shortly about smart cities and technologies. Module 2 will provide further information on this.

The most representative and essential technology of a smart city is the Internet of Things. The 2016 global overview diagram describing 640 million enterprise IoT use cases, shows that smart city was the 2nd area which applies IoT in many of the implemented projects.



Smart City and Technology

IoT uses sensors, and sensors are able to capture all environments in a smart city.

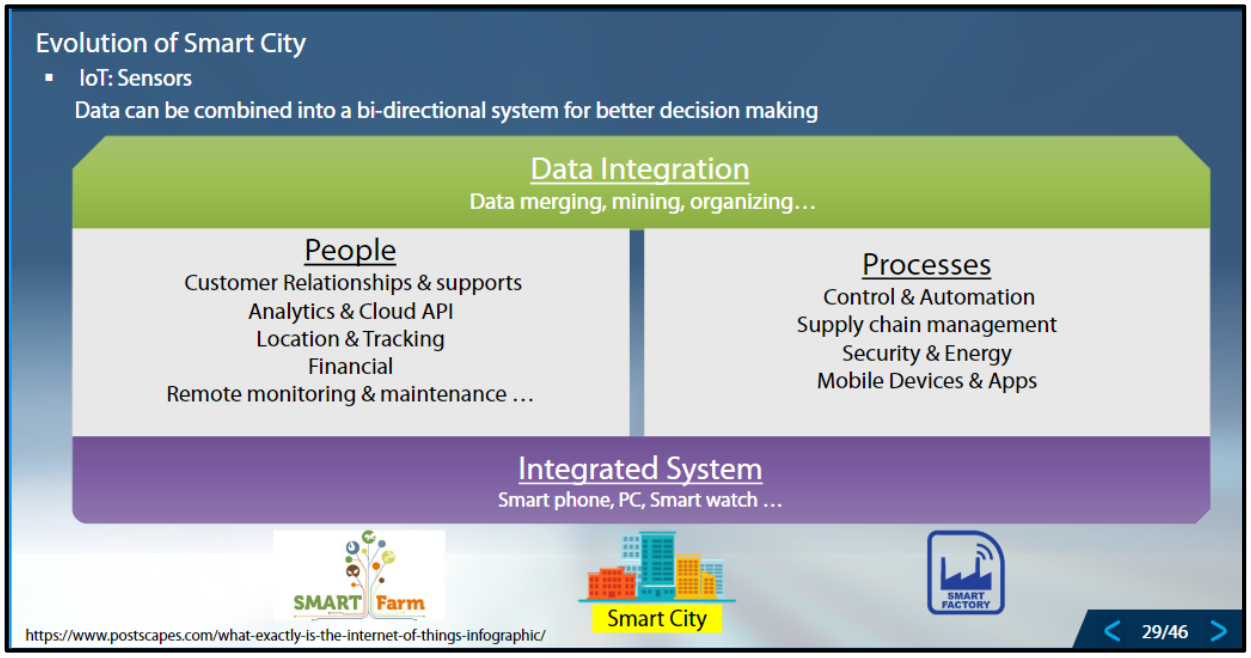
These sensors gather the data from a number of surrounding environments in a smart city.

Smart City and Technology

Also, the data which is gathered from the sensors could be combined into a hyper-connected system for better decision making.

The data from smart cities, smart farms, and smart factories are organized and analyzed in an integrated system. And the result of analysis is used for people and processes for the development of infrastructures and services in smart cities.

And again, data from those people and processes are integrated.

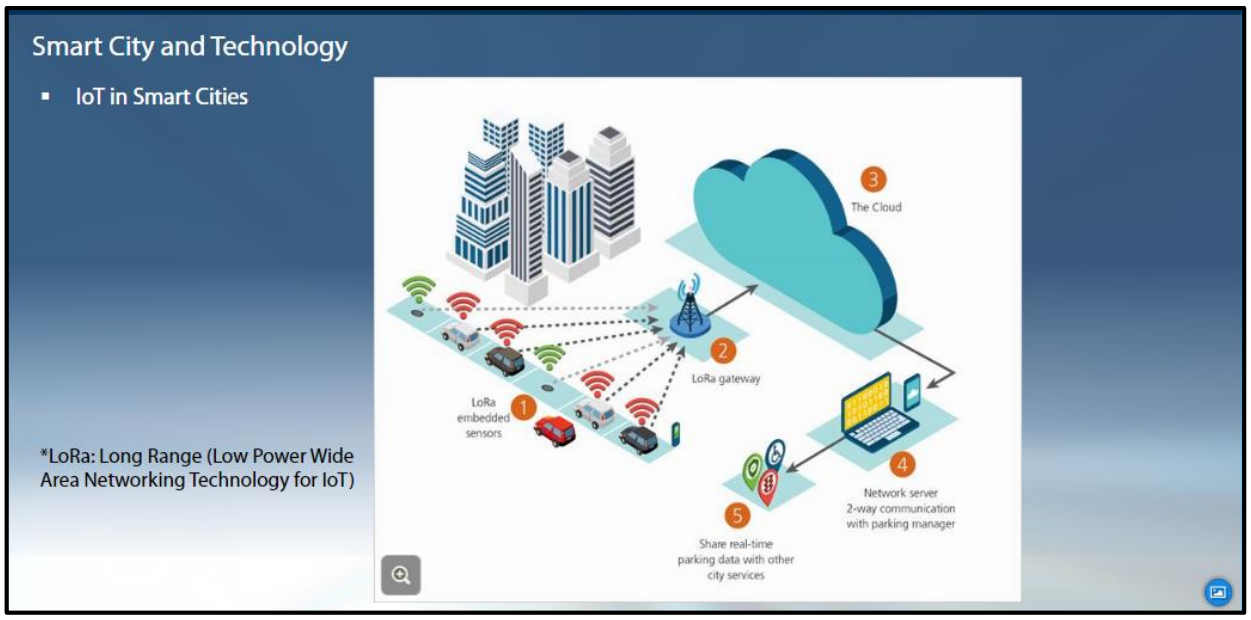


Smart City and Technology

This is an example of IoTs in Smart Cities. IoT sensors gather the data of the traffics in the city. And the gateway of IoT sends the data to the cloud of a city, which monitors and analyze the data.

Then, the result of analysis is sent to the network servers of a parking manager.

And these information is shared through diverse application in real-time.



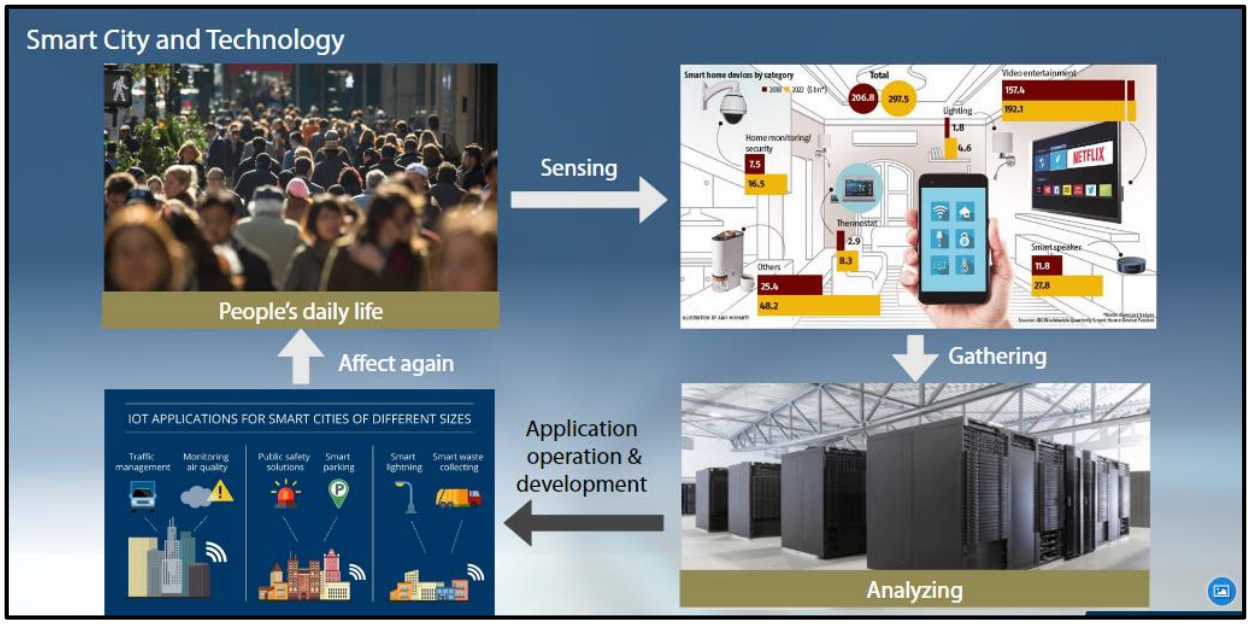
Smart City and Technology

In people's daily life, diverse sensors and devices gather tons of data from people and things. And the data storage system like cloud or data center monitors and analyzes the data.

These data and the result of analysis are used for diverse city applications, operations and developments. It can be used in diverse IoT applications in different sizes.

Hence, technologies implemented in Smart Cities vis-à-vis affects people's daily life in a number of ways.

This mechanism formulates an organic system.

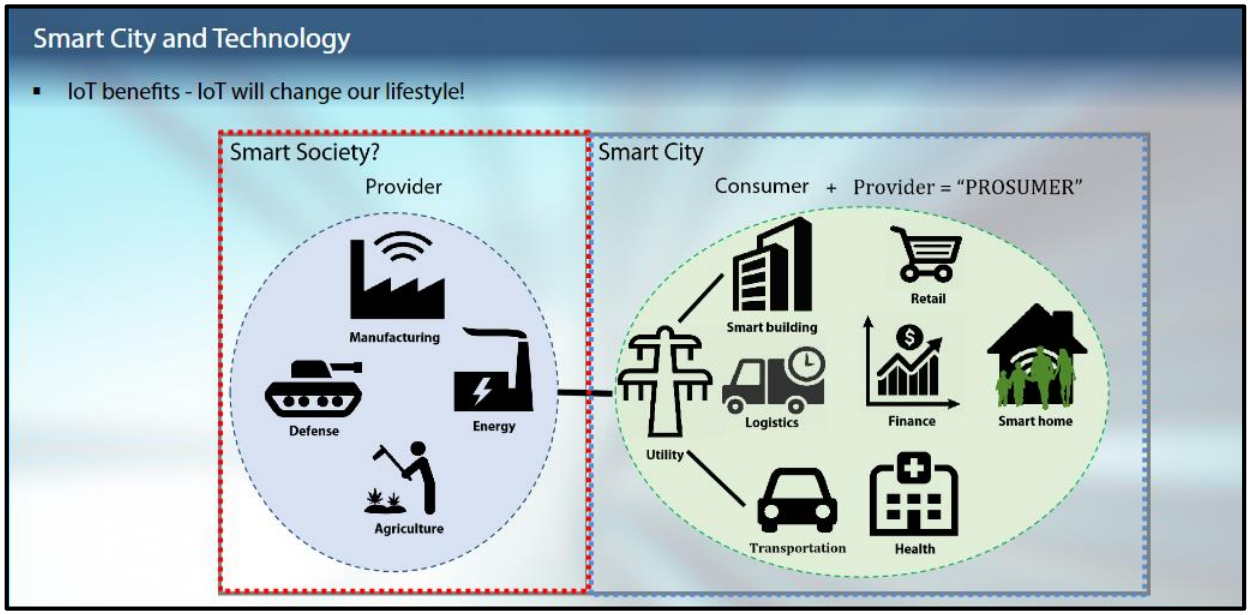


Smart City and Technology

Ultimately, this organic system is likely to change our lifestyle.

Diverse product and service providers and consumers in smart cities actively interact, and the boundary of consumers and providers are blurring.

Even if the product and service providers out of a city are connected to another city, Smart cities will be extended to while forming a smart society.



Urban Problems and Smart Cities

Now, we will focus on the urban problems and smart cities.

In the introductory part, i explained that the technology can itself be a solution to urban problems. Smart city is also a solution to diverse urban problems because the smart city itself is a system (platform) of smart technologies.

The existing urban management method deals with urban-related problems, by focusing mainly on the construction of new infrastructures or on solving problems by adding resources such as manpower

Smart City, on the other hand, collects information from all over the city, analyzes it, and solves emerging problems by introducing resources where necessary and by efficiently utilizing existing resources.

Urban Problems and Smart City

Let's take a look at the Parking-related problems, In old cities, city managers would suggest to construct new parking lots as a solution to the problem.

However, in smart cities, through data monitoring and analysis, real-time alarm services or car sharing services, which permit to reduce a number of traffic-related issues, will be offered as a solution to the problem. There are a number of other applications related to this service.

Urban Problems and Smart City

For leaking issues in water sewage, old cities would lack information on the leaking points. As a result, the sewage system ineffectiveness will persist.

However, in smart cities, the leakage is instantly detected by a sensor and the information are sent through the system.

There are many cases of leakage-responsive systems. The ones in Qatar (Doha), Brazil (Sao Paulo), China (Beijing) have prevented 40-50% of leakage from these systems.

Urban Problems and Smart City

I would like to introduce four Global and Korean smart city cases, as a response to the emerging urban problems.

Case 1: Solutions from Smart City in Siheung, Korea
The first case is about the air pollution.

In Siheung, Korea, air quality signal lights are located in schools, hospitals, and sanatoriums. Citizens are able to proactively respond to the level of air quality by wearing masks or by avoiding going out.

Also, the air quality is monitored by UAV. Drones monitor the industrial complex in Siheung in real-time, and this system is cost-effective.

If you want to learn more about Smart city cases in Korea, It would be helpful to look into the following reading material: “Smart Cities Seoul: a case study (ITU, 2013).”

Other Global cases will be dealt in the module 3.

Case 2: Solutions from Smart City in Shenzhen, China

The second case is about water-related problems.

In Shenzhen, China, there is a smart water management system that Hwaweii, China telecom, and Ningbo water meter have jointly launched, making use of the IoT technologies.

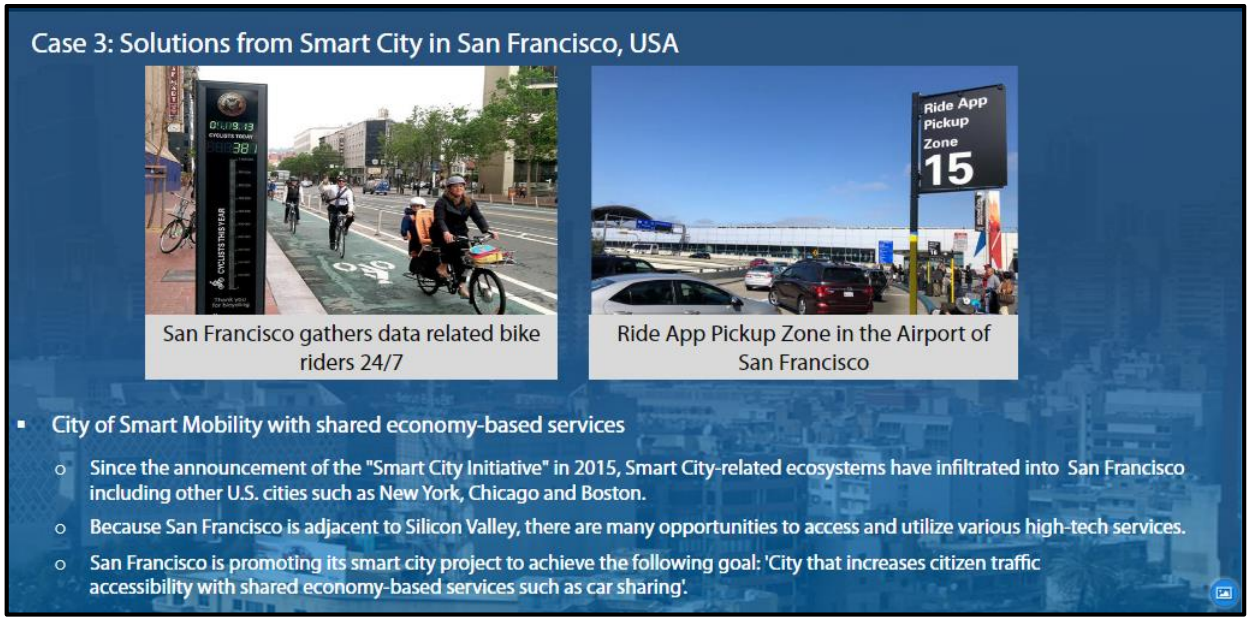
This intelligent water system monitors the water level, data related to the pipelines, water quality, and metering with network-based IoT and IoT platforms.

Case 3: Solutions from Smart City in San Francisco, USA
The third case is about public road traffics and road infrastructures.

Since the Obama administration, the President announced “Smart city initiatives” in 2015, and major cities in USA have initiated the implementation of Smart cities.

Especially, for San Francisco, due to its proximity to Silicon Valley, smart and innovative ecosystems of Silicon Valley have infiltrated into the city. As a result, there have been many opportunities to access smart technology services.

San Francisco promotes smart city projects with the aim of achieving “City of Smart Mobility”. In this sense, the city applied shared economy based services like Uber and smart bikes.



Case 4: Solution from Smart City in Barcelona, Spain
The last case is about public applications in roads again.

In Barcelona, there is a smart public lighting that identifies the population density with noise levels and air pollution levels. Also, smart trash cans sense garbage level information in real-time.

The public applications in roads hence gathers information on the daily lives of the citizens, and these information are used to increase an effective management of energy and other resources.

Thank you

Thank you for your listening.

We have reached the end of this module, where we have examined the backgrounds, definitions, major areas, history, and core technologies of a smart city.
The following module 2, will address Smart City Solutions and Technologies.