Introduction and overview to futuristic systems

(Megacities and Smart cities)

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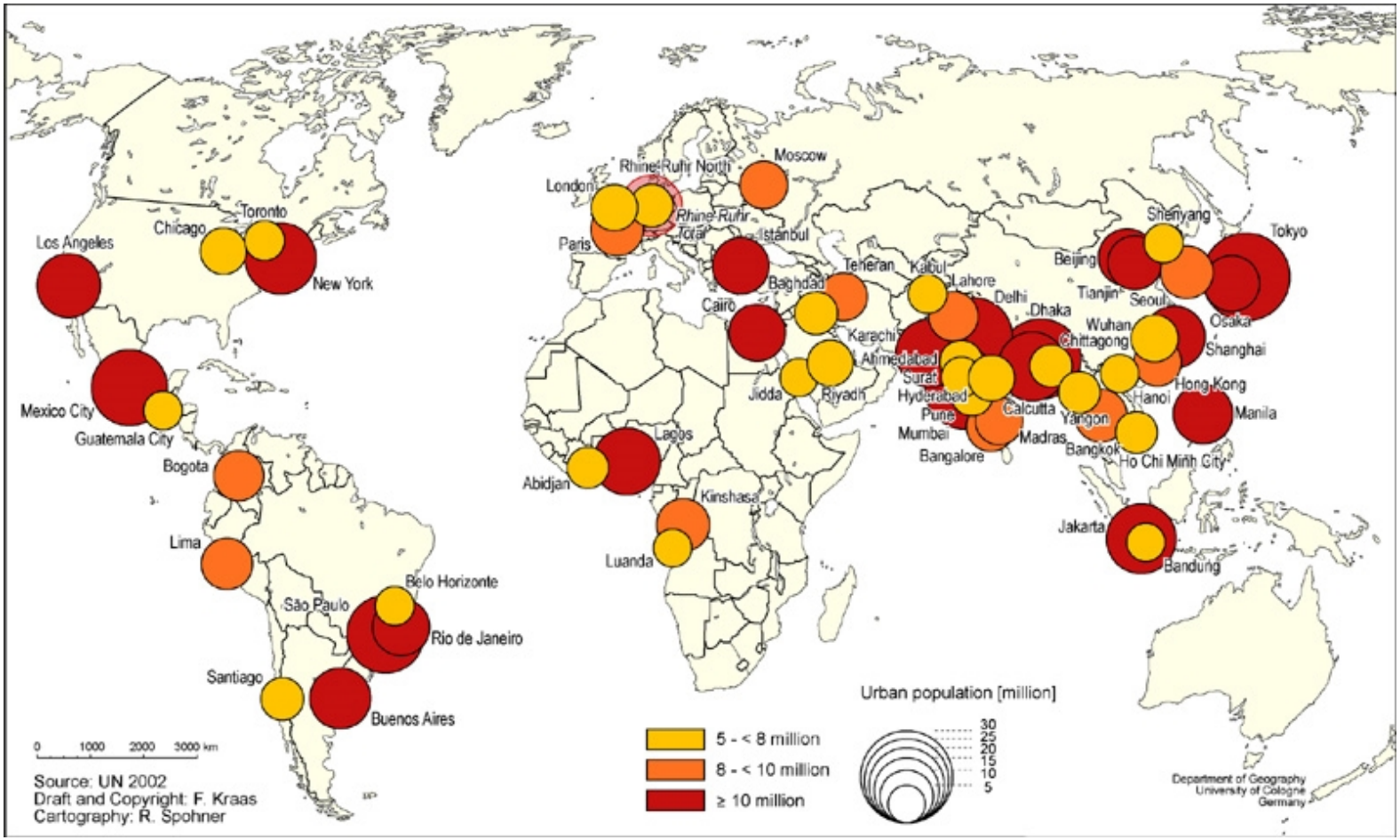
Introduction to megacities

- A **megacity** is a very large city metropolitan area, typically with a population of more than 10 million people. Precise definitions vary: the United Nations Department of Economic and Social Affairs in its 2014 "World Urbanization Prospects" report counted urban agglomerations having over 10 million inhabitants.
- A University of Bonn report held that they are "usually defined as metropolitan areas with a total population of 10 million or more people". Others list cities satisfying criteria of either 5 or 8 million and also have a population density of 2,000 per square kilometre.
- A megacity can be a single metropolitan area or two or more metropolitan areas that converge due to close proximity.
- The terms conurbation, metropolis, and metroplex are also applied to the latter. As of 2017, there are 47 megacities in existence.Most of these urban agglomerations are in China and other countries of Asia.
- The largest are the metropolitan areas of Tokyo, Shanghai, and Jakarta, each having over 30 million inhabitants. China alone has 15 megacities, India has five, and Japan as three. Other countries with multiple megacities include the United States, Brazil and Pakistan, each with two.
- African megacities are also present in Nigeria, Egypt and the DRC.

Map showing megacities



What causes this massive growth?

Rural Urban migration

This is when there is an increase in the proportion of people living in Urban areas in comparison to those living in rural areas and has many factors that lead to it happening

Push Factors:

- War and civil disorder (promotes 'blind' - less informed - migration)
- Intolerance
- Desertification
- Lack of Medical Facilities
- Increasing landlessness (no land ownership) due to loss of land from drought, crop failure, war, poverty, debt...
- Rapid Population Growth
- Rural Poverty
- Natural Disasters - harder to cope in rural areas less resources (promotes 'blind' - less informed - migration)
- Lack of Educational opportunities
- Transfer of land from food production and self sufficiency to export crop production meaning less food for families therefore vulnerable to international commodity price fluctuations
- Lack of medical facilities

Pull Factors

- Attracted to employment opportunities
- Promise of higher living standards
- Entertainment and Cultural events/Bright Lights (woooah so bright wow)
- Educational Opportunities
- Medical facilities
- Safety
- Housing

Internal Growth (Natural Increase)

This is where, due to a younger population living in cities, more babies are born and also as people's standards of living are better the live longer, with more access to doctors and medicine. This all leads to an increasing population

Internal growth accounts for 60% of urban population growth thus growth of megacities with migration taking up 30% and reclassification of rural areas as urban areas10%

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Top 10 largest megacities in the world 2019

- 1- Tokyo-Yokohama, Japan

More noteworthy Tokyo is the biggest urban agglomeration on the planet, gobbling up the neighbouring urban areas of Yokohama, Kawasaki, and Chiba. In spite of its size, Tokyo has exceptionally proficient open transportation, which outlines just about 80% of all voyages.

2- Shanghai, China

Urban area: 34,000,000 people
Population density: 6,100 people per square kilometre
Shanghai has turned into China's money related and business focus and is positioned as the planet's biggest city legitimate. It has one of the world's busiest ports and the world's most broad transport framework with more than one thousand lines.

3- Jakarta, Indonesia

Urban area: 31,500,000 people
Population density: 9,500 people per square kilometre
Jakarta has been blasting since 2005 in the wake of agony monetary emergencies and calamities like surges and quakes in late decades.
Jakarta's economy has supported Indonesia's economy to a development rate of 6 per cent.

4- Delhi, India

Urban Area: 24.9 million people
Population density: 12,100 people per square kilometre
Delhi is India's capital and as of late overwhelmed Mumbai as the greatest city by populace measure. It's a position of striking differentiations. Mosques, bazaars, and restricted paths stamp the old town. New Delhi, the capital, highlights fantastic avenues, business focuses, and shopping centres.

5- Seoul Incheon, South Korea

Urban area: 25,600,000 people.
Population density: 10,400 people per square kilometre.
Seoul has developed quickly since the Korean War (1950-53). Today, almost 50% of the nation's populace lives in and around Seoul. Seoul has gained striking ground in fighting air contamination and is one of the cleanest urban communities in Asia.

6- Guangzhou-Foshan, China

Urban area: 25,000,000 people
Population density: 6,000 people per square kilometre
Generally known as Canton, Guangzhou is China's third biggest city and situated on the Pearl River in southern China around 120 kilometres northwest of Hong Kong. It is a basic exchanging port and capital of China's mechanical and assembling territory of Guangdong, which has been one of the speediest urbanizing regions of the world for a long time.

7- Beijing, China

Urban Area: 21 million people
Population density: 5,500 people per square kilometre
China's capital facilitated a tremendous if questionable Olympic Games in 2008. In spite of burning through billions to clean the city's air, normal air contamination levels stay five times above WHO security guidelines.

8- Manila, Philippines

Urban Area: 24,100,000 people
Population density: 15,300 people per square kilometre
Manila's frontier past is reflected in its design. Intramuros, the memorable focus, is encompassed by a huge divider worked by the Spanish in the sixteenth century. Its parks and memorable structures have turned into a noteworthy vacation spot.

9- Mumbai, India

Urban area: a population of 21.3 million
A resident of Mumbai is called Mumbaikar in Marathi, in which the suffix kar means the resident of. The term had been in use for quite some time but it gained popularity after the official name change to Mumbai.

10- New York, USA

Urban area: 23,876,155 people
Population density: 1,800 people per square kilometre
New York City, particularly Manhattan, is seemingly a good example for adjusting urban improvement with great open transport and access to open spaces. New York is the main American city where most families don't claim an auto. Fairly shockingly, be that as it may, it has the minimum thick populace of any megacity because of the numerous peripheral rural areas.

MEGACITIES AND CLIMATE CHANGE

1. Environmental impacts of megacities

➢Megacities can affect the environment in several ways. The population consumes food and energy and produces waste in solid, liquid, and gaseous form in order to sustain themselves and pursue business activities such as manufacture or services.

➢ Due to the very high population density in many cases neither food nor raw materials or energy can be produced locally. As a consequence, additional impacts on the environment occur through transportation of goods and waste products in and out of the cities.

➢The impact and its extension can be expressed in various forms of footprints reaching from the local to the regional and even to the global scale. Some of the footprints that will be discussed here are ecological, atmospheric and climate footprints. The emphasis will be on the latter.

2. Megacity impacts on air quality and climate

- Many of the human activities in megacities, such as industrial and energy production, transportation or residential heating, produce a variety of waste products. It is, however, the emission of pollutants in the form of trace gases and aerosols that have potentially the most wide-spread effect on the environment. The emission of nitrogen oxides (NO), carbon monoxide (CO) and volatile organic compounds (VOC) produces ozone in the troposphere and consequently leads to the formation of hydroxyl radical (OH) which determines the oxidation capacity of the atmosphere.
- Carbon dioxide is the dominant species not only in the total anthropogenic emissions from megacities but also with respect to their impact on climate. While CO_2 is chemically inert and, thus, does not play a role in air quality, its long lifetime and effectiveness as a greenhouse gas turns it into a major factor with regard to climate impacts of megacities
- The dominant compounds emitted from megacities can be split into two major categories according to their atmospheric lifetimes, 1) greenhouse gases (or long-lived climate forcers, LLCFs) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and 2) atmospheric pollutants (or short-lived climate forcers, SLCFs) such as nitrogen oxides (NO), carbon monoxide (CO), volatile organic compounds (VOC) and particulate matter and their precursors (mainly sulphur dioxide, SO_2, organic carbon, OC, and black carbon, BC)

If there was such a thing as The Future Foresters' Dictionary, a megacity's definition would be "A CONCRETE JUNGLE WHERE EVERYONE IS TOO BLINDED BY THE HARSH CITY LIGHTS TO KNOW THAT STARS EXISTS"

The advantages and disadvantages of megacities.

- Advantages of megacities

1. One of the advantages of megacities would be the effects it has on the labour pool. We'll have a better educated, better trained and more diverse labour pool but more expensive labour costs of course. There is also the concentration of educational and training facilities, increasing the potential for human resource investments. Apart from that, the technological advancements generated from the megacities would help with a lot of things. This will also boost the healthcare in that area.

2. They offer far more options in terms of culture, nightlife, restaurants and recreation in general. For example, New York City has one of the most diverse cultures, which is what attracts many people to live, visit and work there.

3. There are sub-cultures found in virtually every area of the city, for example, Manhattan is split into 5 main areas, such as Harlem and Queens, which are full of immigrants like Italians and Jews which bring their own restaurants and even languages to the area

- Disadvantages of megacities

1. POLLUTION. Sound, air, water and land pollution.

2. The cars and other nature destroying machineries generate exhaust fumes that pollutes the air. This causes all sorts of respiratory illnesses

3.The high cost of living to bear in mind. Some people who can't afford to live up to the high standards and costs of living in the megacity but are still trying to be a part of it would have to resort to living at the edge of the cities instead; some end up as squatters making houses with whatever materials they can get their hands on. Usually this slum area is not a very pretty sight to look at. Although most of the developed countries tried to eliminate them from the area, it doesn't usually work out. The sad thing is, these people who live in the slums end up looking like the dirt bags of the human caste. They are frown upon by those who are fortunate enough to not share the same fate. The 'slummers' are deprived from proper education, food, healthcare and other basic needs.

4. Basic resources such as food, fuel and water decreases very fast and it takes a lot of energy and man power to generate these resources. Depletion of natural resources such as petroleum and gas is also very problematic because these are the main source of power in a megacity.

Some of the problems of megacities include:

- Explosive population growth.
- Alarming increases in poverty
- Massive infrastructure problems with telecommunications services, transportation and congestion. For example, traffic congestion in Bangkok is so bad that the average commute now takes three hours
- Pressures on land and housing
- Environmental concerns, such as contaminated water, air pollution, and overdrawn aquifers. For instance, Mexico City's aquifer is being overdrawn and is sinking by about 1 meter per year
- Disease, high death rates, drug-resistant strains of infection, and lethal environmental conditions. For example, 12.6 percent of the deaths in Jakarta are related to air pollution causes
- Capital scarcity
- Dependence on federal or state governments for funding

SMARTCITIS

What is smart city ?

A **Smart city** is an urban are that uses different types of electronic Internet of Things (IoT) sensors to collect data and then use these data to manage assets and resources efficiently. This includes data collected from citizens, devices, and assets that is processed and analyzed to monitor and manage traffic and transportation systems, power plants, water supply networks, waste management, crime detection, information systems, schools, libraries, hospitals, and other community services.

The Smart city concept integrates information and communication technology (ICT), and various physical devices connected to the IoT network to optimize the efficiency of city operations and services and connect to citizens. Smart city technology allows city officials to interact directly with both community and city infrastructure and to monitor what is happening in the city and how the city is evolving. A Smart city may therefore be more prepared to respond to challenges than one with a simple "transactional" relationship with its citizens

Need for smart city

✓The primary goal of a smart city is to create an urban environment that yields a high quality of life to its residents while also generating overall economic growth. Therefore, a major advantage of smart cities is their ability to facilitate an increased delivery of services to citizens with less infrastructure and cost.

✓As the population within cities continues to grow, it becomes necessary for these urban areas to accommodate the increasing population by making more efficient use of their infrastructure and assets. Smart city applications can enable these improvements, advance city operations and improve the quality of life among residents.

✓Smart city applications enable cities to find and create new value from their existing infrastructure. The improvements made facilitate new revenue streams and operational efficiencies, helping governments and citizens save money.

What are the elements of a SmartCity?

Smart Governance: "SMART Governance" is about the future of the public services, it is about greater efficiency, community leadership, mobile working and continuous improvement through innovation. SMART Governance is about using technology to facilitate and support better planning and decision-making. Smart Energy - ecofriendly energy solutions with alternative sources.
Smart Environment: Smart Environments contains contributions from leading researchers, describing techniques and issues related to developing and living in intelligent environments. Reflecting the multidisciplinary nature of the design of smart environments, the topics covered include the latest research in smart environment philosophical and computational architecture considerations, network protocols for smart environments, intelligent sensor networks and power line control of devices, action prediction and identification.

Smart Transportation: Initiative promotes transportation practices that advance environmental sustainability and equitable economic development, while maintaining high standards of governmental efficiency and transparency.

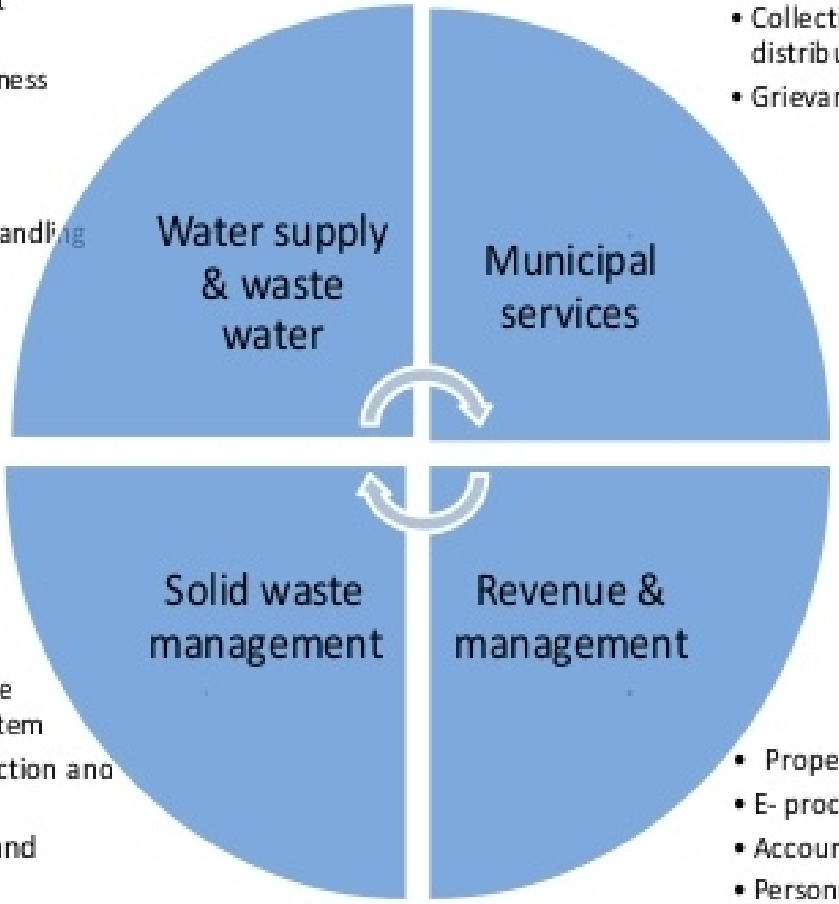
Smart IT & Communication: Smart city communications that connect people, objects, and sensors involve multiple access and aggregation networks that can vary from public to private and wired to wireless.

Smart Health: Smart Health is a new paradigm for the provision of healthcare within smart cities.

Smart Education: Smart Education is having an out of the box procedure to organize class for each of the students of different ages.

Smart Buildings: smart buildings deliver useful building services that make occupants productive (e.g. illumination, thermal comfort, air quality, physical security, sanitation, and many more) at the lowest cost and environmental impact over the building lifecycle

Smart Service delivery areas through ICT for Urban Management



- Resource management
- Distribution
- Internal business process
- Quality
- Billing
- Grievances handling

- Plant management
- Collection, distribution & billing
- Grievances handling

- Bin & vehicle tracking system
- Waste collection and transfer
- Treatment and disposal
- biometric attendance systems for sanitary workers

- Property tax
- E- procurement
- Accounting
- Personnel management

Examples:

Smart **mobility** – HTRIMS, Hyderabad; Bangalore
- **Bicycle sharing** program, Trivandrum
- **Bus** information system over **mobile**

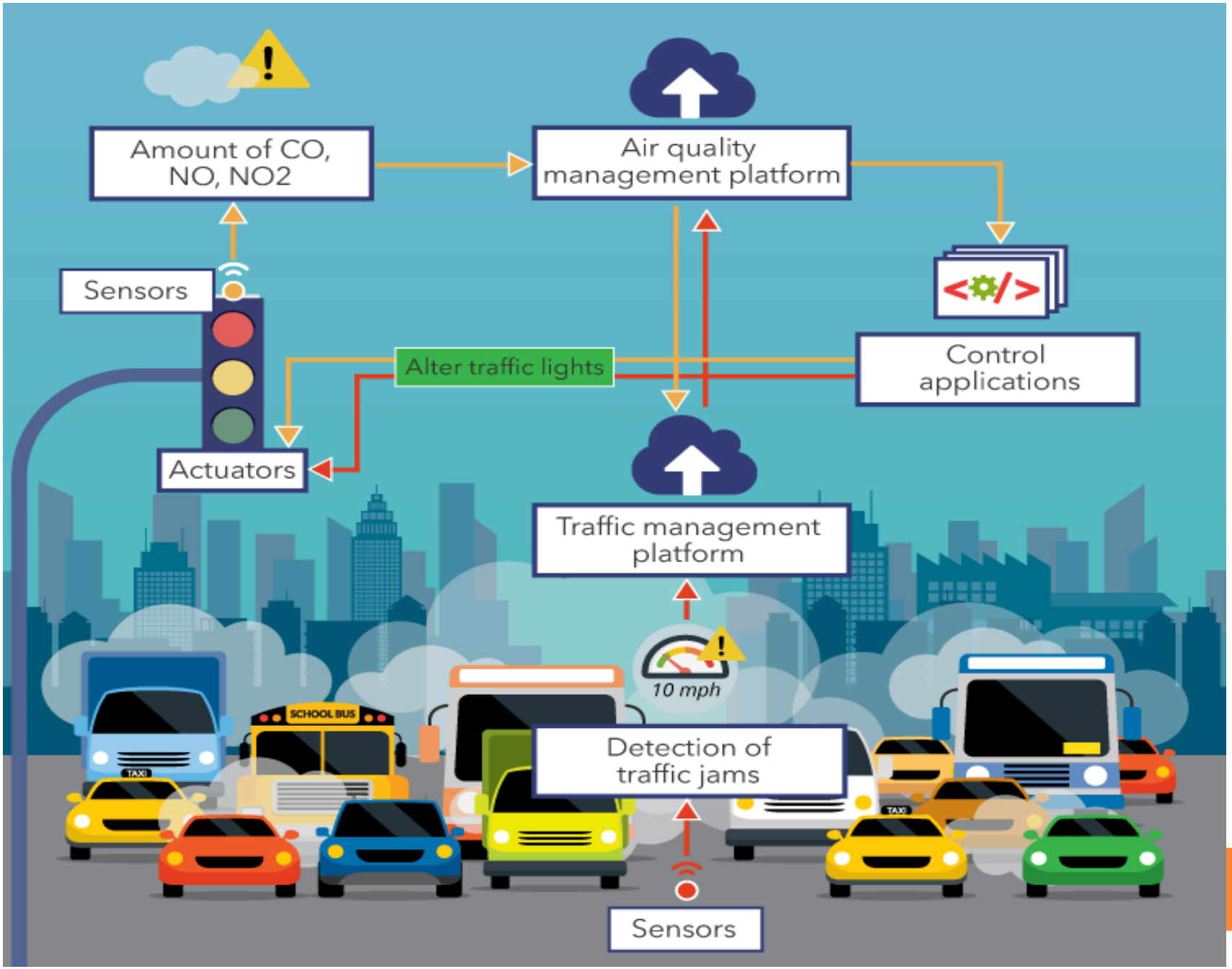
Automatic **meter** reading **Mumbai, Hyderabad**

Water efficiency through **SCADA** – PCMC

Smart toilets: sensor based community toilets - **Trivandrum**

Recommendations:

- GIS and GPS enabled services
- GPS and GPRS technologies through cell phone images are taken and stamped with time and location
- Integrating various database


Amount of CO, NO, NO2
Air quality management platform
Sensors
Alter traffic lights
Control applications
Actuators
Traffic management platform
10 mph
Detection of traffic jams
Sensors

How a smart city works

Smart cities utilize their web of connected IoT devices and other technologies to achieve their goals of improving the quality of life and achieving economic growth. Successful smart cities follow four steps:

1. Collection - Smart sensors throughout the city gather data in real time.

2. Analysis - Data collected by the smart sensors is assessed in order to draw meaningful insights.

3. Communication - The insights that have been found in the analysis phase are communicated with decision makers through strong communication networks.

4. Action - Cities use the insights pulled from the data to create solutions, optimize operations and asset management and improve the quality of life for residents.

Features of a smart city

1. The smart parking meter that uses an application to help drivers find available parking spaces without prolonged circling of crowded city blocks. The smart meter also enables digital payment, so there's no risk of coming up short of coins for the meter.

2. Smart traffic management is used to monitor and analyze traffic flows in order to optimize streetlights and prevent roadways from becoming too congested based on time of day or rush-hour schedules.

3. Smart public transit is another facet of smart cities, used to ensure public transportation meets user demand. Smart transit companies are able to coordinate services and fulfill riders' needs in real time, improving efficiency and rider satisfaction. Ride-sharing and bike-sharing are also common services in a smart city.

4. Energy conservation and efficiency are major focuses of smart cities. Using smart sensors, smart streetlights dim when there aren't cars or pedestrians on the roadways. Smart grid technology can be used to improve operations, maintenance and planning, and to supply power on demand and monitor energy outages.

5. Smart city initiatives also aim to monitor and address environmental concerns such as climate change and air pollution. Waste management and sanitation can also be improved with smart technology, be it using internet-connected trash cans and IoT-enabled fleet management systems for waste collection and removal, or using sensors to measure water parameters and guarantee the quality of drinking water at the front end of the system, with proper wastewater removal and drainage at the back end.

6. Smart city technology is increasingly being used to improve public safety, from monitoring areas of high crime to improving emergency preparedness with sensors. For example, smart sensors can be critical components of an early warning system before droughts, floods, landslides or hurricanes.

7. Smart city technologies also bring efficiencies to urban manufacturing and urban farming, including job creation, energy efficiency, space management and fresher goods for consumers.

8. Attaching sensors to buildings and other structures can detect wear and tear and notify officials when repairs are needed. Citizens can help in this matter, notifying officials through a smart city application when repairs are needed in buildings and other public infrastructure, such as potholes. Sensors can also be used to detect leaks in water mains and other pipe systems, helping reduce costs and improve the efficiency of public workers.

Fostering sustainability with smart cities

1.Smart technology will help cities sustain growth and improve efficiency for citizen welfare and government efficiency in urban areas in the years to come.

2. Making the switch to an electric public transportation system would not only decrease fuel emissions, but could also pose the advantage of working closely with the city's electric power infrastructure in order to minimize the impact of charging batteries during peak hours of electric use. Furthermore, with proper coordination, electric vehicles could also be used to regulate the frequency of the city's electric grid when they're not in service.

3. The number of cars used in cities is also expected to decrease as municipalities become smarter. Autonomous vehicles, or self-driving cars, could potentially change a population's perspective on the necessity of owning cars. It is suspected that the adoption of autonomous vehicles will reduce the amount of vehicles owned by civilians, thus decreasing the number of cars on the street and further lowering the emission of detrimental gases.

Smart city challenges and concerns

Smart city initiatives must include the people they aims to help: residents, businesspeople and visitors. City leaders must not only raise awareness of the benefits of the smart city technologies being implemented, but also promote the use of open, democratized data to its citizens. If people know what they are participating in and the benefits it can bring, they are more likely to engage.

Fostering collaboration between the public and private sector and city residents is key to creating a smart citizen who will be engaged and empowered and positively contribute to the city and community. New and innovative collaboration methods can improve engagement. Smart city projects should include plans to make the data transparent and available to citizens, often through an open data portal or mobile app.

Smart cities are also challenged by finding ways to attract and keep residents without a cultural fabric. The cultural essence of an area is oftentimes what attracts residents the most; this is something that cannot be programmed or controlled with a sensor. Therefore, smart cities may falter because they cannot provide a sense of authenticity, distinctiveness or place.

Smart cities that are being created from the ground up -- like Saudi Arabia's Neom and Arizona's Buckeye which are being built in the desert -- lack an established population and are therefore presented with the obstacle of having to recruit residents. These future smart cities also have no past success to provide confidence. As Neom and Buckeye have been built, concerns have risen over whether or not there is even a sustainable water source available.

Public transit, traffic management, public safety, water and waste management, electricity and natural gas supply can be unreliable, especially as a system ages and grows. However, the importance of these operations will only increase as the city expands and the demands on its infrastructure increase. These systems must be constantly maintained and tested to ensure their proper functioning.

The biggest challenge smart cities face is the problem of connectivity. The thousands or millions of IoT devices scattered across the city would be defunct without a solid connection and the smart city itself would be dead.

Examples of smart cities

- Kansas City, Missouri
- San Diego, California
- Columbus, Ohio
- New York City, New York
- Toronto, Canada
- Singapore
- Vienna, Austria
- Barcelona, Spain
- Tokyo, Japan
- Reykjavik, Iceland
- Dubai, United Arab Emirates
- Hong Kong, China
- London, England
- Melbourne , Australia

Smart cities project

✓Most of the new smart city projects are concentrated in the Middle East and China, but in 2018, Reykjavik and Toronto were listed alongside Tokyo and Singapore as some of the world's smartest cities.

✓Often considered the gold standard of smart cities, the city-state of Singapore uses sensors and IoT-enabled cameras to monitor the cleanliness of public spaces, crowd density and the movement of locally registered vehicles. Its smart technologies help companies and residents monitor energy use, waste production and water use in real time. Singapore is also testing autonomous vehicles, including full-size robotic buses, as well as an elderly monitoring system to ensure the health and well-being of its senior citizens.

✓The smart city initiative of Kansas City, Mo., involves smart streetlights, interactive kiosks and more than 50 blocks of free public Wi-Fi along the city's two-mile streetcar route. Available parking spaces, traffic flow and pedestrian hotspots are all publically available through the city's data visualization app.

✓San Diego installed 3,200 smart sensors in early 2017 to optimize traffic and parking and enhance public safety, environmental awareness and overall livability for its residents. Solar-to-electric charging stations are available to empower electric vehicle use, and connected cameras help monitor traffic and pinpoint crime.

✓In Dubai, United Arab Emirates, smart city technology is used for traffic routing, parking, infrastructure planning and transportation. The city also uses telemedicine and smart healthcare, as well as smart buildings, smart utilities, smart education and smart tourism.

✓The Barcelona, Spain, smart transportation system and smart bus systems are complemented by smart bus stops that provide free Wi-Fi, USB charging stations and bus schedule updates for riders. A bike-sharing program and smart parking app that includes online payment options are also available. The city also uses sensors to monitor temperature, pollution and noise, as well as monitor humidity and rain levels.

THANK YOU