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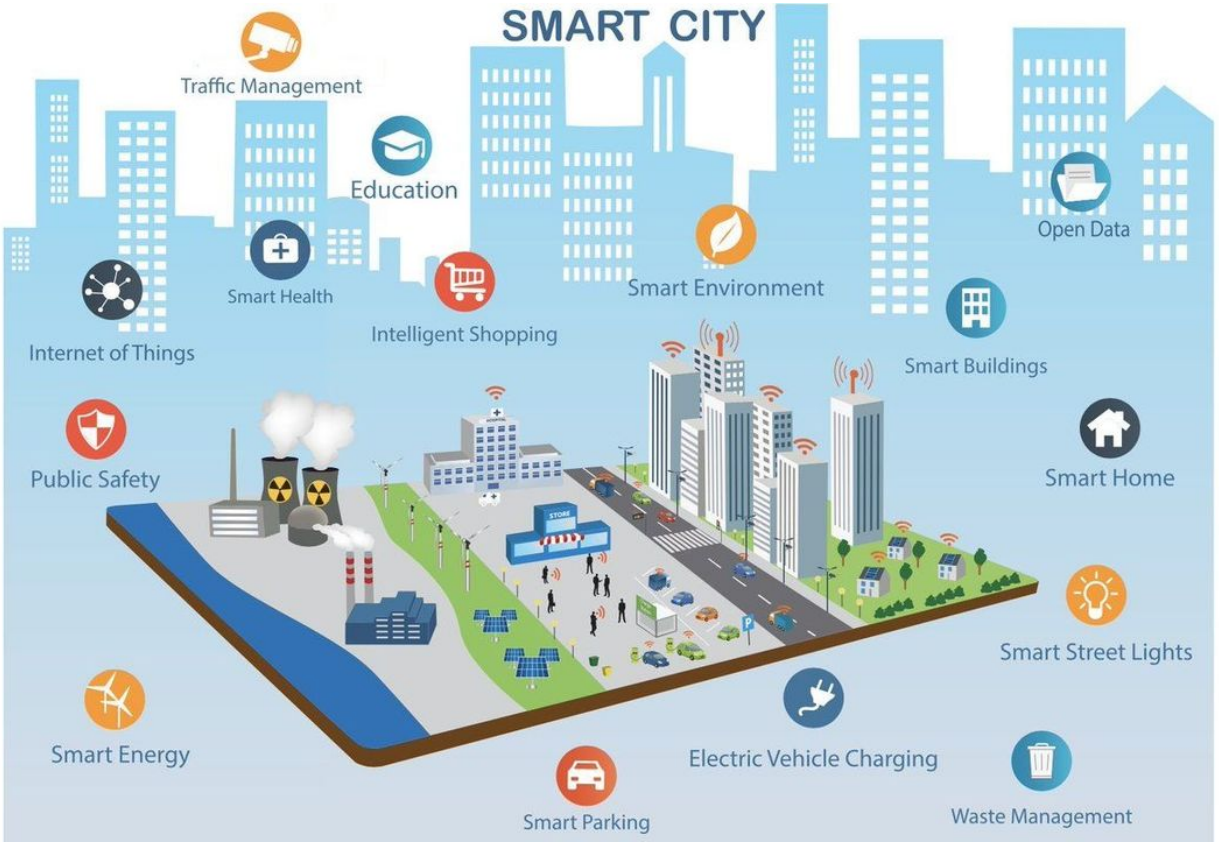
Introduction

In 2007, for the first time in human history, 50 percent of the global population lived in urban areas. Only a century ago, this figure stood at 13 percent but it is now predicted to reach 69 percent by 2050. Moreover, the world is predicted to gain 2.5 billion new urban residents by 2050, increasing mostly in Asia and Africa in cities such as Lagos and Mumbai which will result in a huge demand for housing areas. Not only this, but many more challenges including poor sanitation and lack of food resources face these areas correlating with the Malthusian theory. Many of these megacities are developing into smart cities which result in further obstacles like privacy concerns and problems with legislation. Nonetheless, the concept of smart cities has emerged as a beacon of hope and innovation becoming a global trending topic. They harness cutting-edge technologies and data-driven strategies to improve the quality of life for their inhabitants while promoting sustainability, efficiency, and economic growth. The proliferation of smart technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics, has unlocked remarkable possibilities for urban development. From intelligent transportation systems to energy-efficient buildings, from digital governance platforms to optimised resource management. Thus, in reality, smart cities hold the promise of enhancing urban resilience, liveability, and sustainability.

For more clearance, the precise content, feature, and nature of smart cities vary from country to country, depending upon geographical condition, ecosystems, resource availability and major challenges being faced. Pilot projects have been taken up in almost all parts of the world to emulate such cities. Nonetheless, there have been many challenges regarding security and privacy. As anything affecting a citizen's everyday life can be assigned a digital shadow which can create major problems if the information is leaked. Most importantly, a smart city is usually a combination of different urban systems which for the most part means mobility systems, housing systems and administrative systems.

Cities are incubators of innovation due to the close interaction of their residents and workers who benefit from the exchange of ideas and opportunities. In particular, they benefit from the concentration of diverse, yet specialised skill sets in research institutions, firms and service providers that can pilot and scale new technologies in an already highly networked environment. Fast-growing technological rich areas such as Silicon Valley have had business leaders working for years to leverage the valley's 'innovation advantage' in the green economy (Joint Venture Silicon Valley Network 2009)[1]. And so, with such rapid development and advances issues increase with many concerns for the safety of citizens due to the ability to hack these technologies and endanger many by doing so.



Smart city strategies- A step into the future[2]

[1] The 2009 Index of Silicon Valley (jointventure.org)
[2] SMART CITY- A Step into the Future | TTE (thetechnologyera.com)

Definition of Key Terms

Smart city

A technologically developed urban area that uses information and communication technologies (ICT) to increase operational efficiency and share information which commonly has a better quality of government services and citizen welfare. Adding to this, the definition continues: 'A smart city goes beyond the use of digital technologies 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 (European Commission, 2022)[3].'

Blockchain

Blockchain owes its name to the way it stores transaction data- in blocks that are linked together to form a chain. As the number of transactions grows, so does the blockchain. Blocks record and confirm the time and sequence of transactions, which are then logged into the blockchain within a discrete network governed by rules agreed on by the network participants.

Internet of things

Represents a paradigm shift in how we interact with the physical world. Essentially, a network that connects physical objects and systems that are then embedded with sensors and other types of software in order to be able to exchange data.

Digital Shadow

The accumulation of digital footprints that individuals trace and generate through their online activities and therefore represents the digital presence or profile that is created through the data we generate and leave behind.

Green Economy

An economic system that aims to promote sustainable development and environmental stewardship.

[3] Smart cities (europa.eu)

Circular Economy

A system that preserves and enhances natural capital by controlling finite stocks and balancing renewable resource flows whilst optimising resources yields by circulating products, materials, and components (designing for recycling and remanufacturing of products).

Greenfield smart cities

Contain eco-friendly elements and modern infrastructure to achieve the goals of sustainable development, most commonly considered to be 'ambitious'.

Brownfield smart cities

A smart city development that focuses on the redevelopment or revitalization of existing urban areas or sites with abandoned, vacant, or underutilised properties.

Malthusian Theory

A theory of a geometric population growth whereas food supply increases arithmetically. So as the population approaches the limits of food production a crisis point is reached.

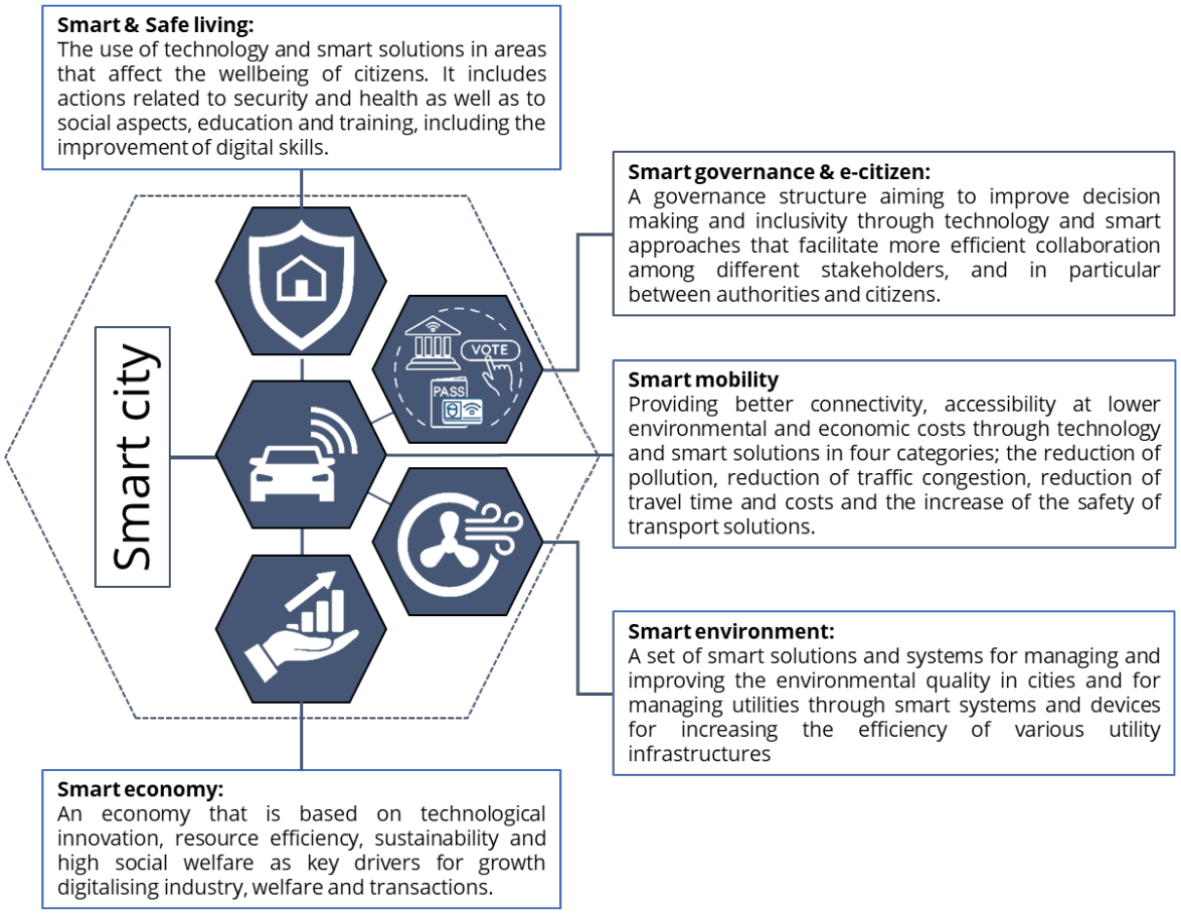
Macro-challenge

A risk to a business due to the malfunctioning of technologies.

General Overview

More specifically, the future of smart cities will depend on the advancement of technologies and will eventually help cope with arising problems due to urbanisation growth. It will include installations such as: smart poles which will replace regular street lights which connect to other internet of thing's devices and provide broadband, driverless cars, drones, robots, urban farms, virtual reality (VR). Nonetheless, in order for these things to happen technical preconditions are essential. A smart city can be designed based on the citizens' demands. However, there are several conditions that need to be considered when creating a smart city; interconnection by adding sensors that collect data to regulate the city or measuring stations throughout the town that record pollution levels, how the data is prepared and analysed and how secure these installations are. After all, the

digital revolution has already enabled citizens to lead a smoother life and perform daily tasks much easier than in the past.



An overview of the five components of a smart city and their definitions[4]

Smart Energy

Cities rely on energy sources outside of their borders and concentrate energy demand in a distinct way. But by cutting back on energy use and implementing green energy systems like combined heat and power (CHP) plants, district heating, and renewable micro-generation, cities have the opportunity to either diffuse the distribution of energy or maximise their efficiency. There are ten times more renewable technologies patents in urban than rural areas and these technologies have the potential to create greenfield smart cities with a green economy.

[4] EPRS_STU(2023)737128_EN.pdf (europa.eu)

Well known strategies include wind turbines, solar panels, and renewable hydraulic systems, but have already met several issues with high costs and noise pollution.

Smart mobility

While having access to and using public transportation has significant social implications, there are often little social dangers associated with the adoption of "smart mobility" technologies. However, there are a few possible problems to take into account. Smart parking strategies or banning certain car types from entering the city centre, for instance, can be advantageous for the local environment but at the same time discriminate against the owners of such vehicles. This is typically harmful for low-income populations because electric cars are typically more expensive than conventional vehicles with combustion engines. Shared cars are subject to additional significant dangers. For instance, safety concerns brought on by users' lack of acquaintance with the vehicle are one of them. Additionally, due to the fact that scooters and bicycles are not parked in the specified areas but rather on sidewalks and in parks, shared mobility services might have a negative impact on the condition of public places. Significant economic risks are also apparent, and these risks may include unintended social effects. The viability of more established mobility providers, such neighbourhood taxicab firms, may be threatened by shared mobility services, and the workers who provide their services through on-demand platforms sometimes endure unfavourable working conditions. Finally, because smart mobility services are currently mostly offered in large urban areas, there is a risk that newly emerging or lower scale cities will miss out on the advantages of emerging smart mobility services.

On the other hand, there are limitless opportunities and benefits from this as the potential of robotics and autonomous systems is huge. Congested transport infrastructure in growing cities can be solved with AV’s (audio-visual) which can radically reduce the demand for parking in central areas and free up valuable space for housing recreation. Additionally, automated traffic control systems make use of artificial intelligence and real-life sensor information. Smartphone applications for car sharing and urban mobility can also help citizens travel more easily with the help of built-in location for navigation and rent cars on a daily basis (for example Uber). Another benefit includes faster and cheaper delivery systems with the inclusion of robots which is a safer and more efficient way. This has already been put to test and has helped students and employees save time and skip lines, especially useful during pandemics and other crises too.

Transport Infrastructure	Capacity [pers/h/d]	Capital costs [US$/km]	Capital costs/ capacity
Dual-lane highway	2,000	10m – 20m	5,000 – 10,000
Urban street (car use only)	800	2m – 5m	2,500 – 7,000
Bike path (2m)	3,500	100,000	30
Pedestrian walkway / pavement (2m)	4,500	100,000	20
Commuter Rail	20,000 – 40,000	40m – 80m	2,000
Metro Rail	20,000 – 70,000	40m – 350m	2,000 – 5,000
Light Rail	10,000 – 30,000	10m – 25m	800 – 1,000
Bus Rapid Transit	5,000 – 40,000	1m – 10m	200 – 250
Bus Lane	10,000	1m – 5m	300 – 500

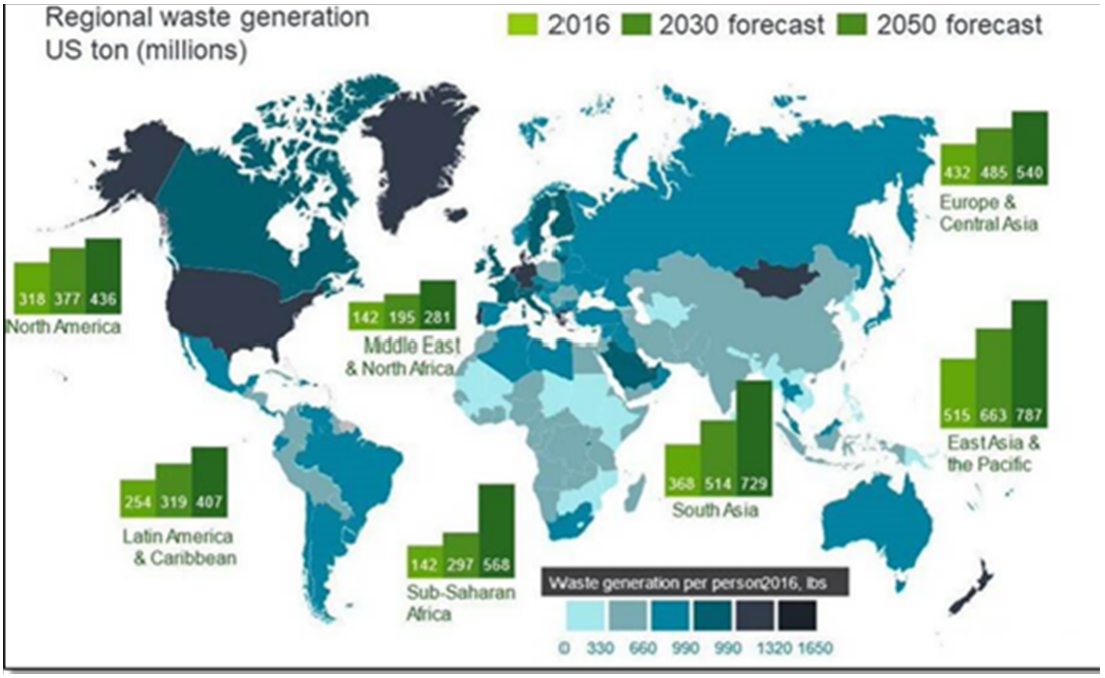
Capacity and infrastructure costs of different transport systems[5]

Waste management

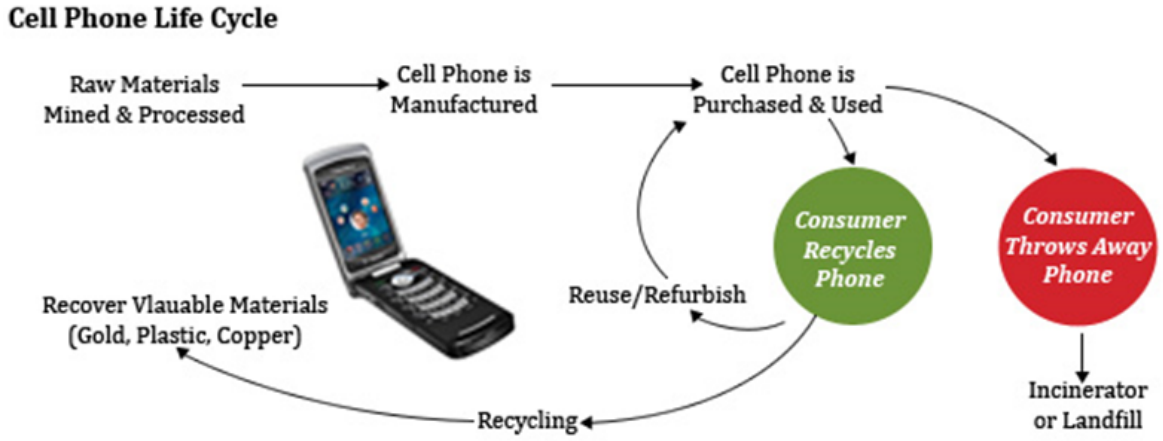
With a large number of residents, the organisation of waste removal is becoming an immense challenge. Today, most urban businesses are still emptying litter bins in accordance with the model of inflexible and long-term schedules. Moreover, 1.4 kg of waste is generated by each city which needs to be disposed of (burned) resulting in air pollution from the toxic ashes. In landfill sites, contaminated liquid can also penetrate the soil and spread throughout, which is why alternative ways need to be found through smart technologies.

One example are smart bin sensors which incorporate various sensors, connectivity features, and data analytics capabilities to improve efficiency, reduce costs, and promote sustainability in waste management practices. Once the bin is full, waste management teams can optimise their collection schedules and routes, avoiding the bins from overflowing and preventing pests and vermin from coming. Other methods such as composting programmes, have increased recycling levels and reduced the potential of waste overfill. In addition to this, a circular economy is being adapted gradually in smart cities and therefore allows the product to have a longer life cycle.

[5] GER_12_Cities.pdf



Waste generation statistics



Mobile life cycle (circular economy)

Domestic life

The most significant social dangers are associated with the digital literacy needed by citizens to use the produced smart solutions, focusing on groups such as the elderly. Users may find the interfaces to be excessively complicated. People may therefore find it challenging to use the newly

developed services and platforms to their full potential. This could exacerbate already-existing social differences, raise social inequities between those who are digitally literate and those who are not, and ultimately lead to the loss of social rights. This is especially concerning when considering the numerous health-related smart city solutions, which are frequently focused more on the elderly, who are often less technologically savvy, as well as the requirement to submit social assistance applications via digital platforms. Along with limited trust in newly developed smart solutions among some social groups, which could pose a danger given the need to either build that trust and raise awareness or offer alternative, non-digital solutions, also constitutes a risk. Finally, a lot of the smart solutions created within this component (such platforms for telehealth, public administration, or education) aim to improve service efficiency by eliminating human touch. Groups that already experience social exclusion may become more isolated as a result of this loss of personal interaction. There are ethical and technological dangers in addition to the social risks. The biggest technological dangers are related to our growing reliance on secure digital infrastructure and other risks associated with cybersecurity.

However, technologies can be used for video surveillance including facial recognition, enabling citizens to be safe in their homes resulting in the decrease of crime levels. Other use cases such as homecare assistance services (remote patient monitoring) can help aid the sick. Sensors for environmental monitoring (air, water, noise, and soil pollution monitoring) can be installed and robots can be used for daily household chores, saving the owner ample time.

11 SUSTAINABLE CITIES AND COMMUNITIES

SUSTAINABLE CITIES: WHY THEY MATTER

What's the goal here?

To make cities inclusive, safe, resilient and sustainable

Why?

Over 90 per cent of COVID-19 cases are occurring in urban areas, with the 1 billion residents of the world's densely populated slums being hit the hardest. Even before the coronavirus, rapid urbanization meant that 4 billion people – over half of the global pupulation – in the world's cities faced worsening air pollution, inadequate infrastructure and services, and unplanned urban sprawl. Successful examples of containing COVID-19 demonstrate the remarkable resilience and adaptability of urban communities in adjusting to new norms.

What are some of the most pressing challenges that cities face today?

Inequality and the levels of urban energy consumption

9 in 10 people living in urban areas worldwide were breathing air that did not meet the World Health Organization's air quality guidelines

Infographic on the 11th SDG and living in urban areas

Education

Education plays a significant role in the development of a nation. It is one of the most effective methods of knowledge transfer, which can be in many forms. It is envisaged that the future smart cities will implement a 100% online education and training, which will make education easily accessible and affordable in the comfort of one's home. Studies have confirmed that online learning is effective (Salter) especially during sudden crises such as the coronavirus pandemic.

Nonetheless, challenges are present as students do not have a lot of interaction with their peers which can result in mental health risks due to the loss of human contact and isolation. Physical health risks can also arise as students are always behind screens, affecting eyesight and the lower back. The teachers do not have the ability to make the student focus or stay on the call (the student could not even be present).

Macro-challenges and related risks

First challenge refers to the risks related to privacy, surveillance, cybersecurity, and the safety aspects. For example, cyber security attacks that have been very common in many countries such as the US (Florida): In a hack that skewed more toward the terrifying and deadly than the financially detrimental, a hacker was able to briefly take over the water supply of the Florida city of Oldsmar and increase the amount of lye to dangerous levels which is utilised in water sources to purify the water, but if present in high enough concentrations, can be dangerous to touch or consume. Apart from infrastructure there have been attacks on traffic management systems and attacks in individuals resulting in the loss of personal data.

Establishing trusted identity remains a problem too due to forgery and expensive background checks required in verification. Millions of people worldwide may have forged their identity documentation and may not be exactly who they say they are. Millions upon millions of refugees and their children go undocumented. People in the poorer parts of the world may not have sufficient proof to establish identity as required by certain service providers; for example, banks typically require proof of residence or utility bills to establish identity, neither of which may exist in the developing country.

Data loss because of technical malfunctions acts as a risk, if dependent on electronic payment methods. And many other risks related to digital inequality and exclusion, financial (or other) burden for authorities and service providers, economic damage and inequalities, and lack of trust or approval in the service.

Fields where risks can arise

Major Parties Involved

Singapore

Having introduced a wide range of smart technologies it is considered as the hub of smart cities in both its public and private sectors. For Singapore's 7.5 million commuters, contactless payment technology has been widely embraced to efficiently manage purchases and movement. A digital health system was launched, normalising video consultations at the same time, and wearable Internet of Things devices to monitor patients to alleviate the pressure of an ageing population. At the same time, introducing a plan for a new eco-smart city, completely vehicle-free.

China

By some estimates, China has half of the world's smart cities, and the percentage does not seem to stop, continuing to increase rapidly with time. Examples include Beijing and Shanghai, two of the biggest cities in China already being smart cities.

United Arab Emirates (UAE)

Abu Dhabi and Dubai have been ranked as the smartest cities in the Middle East and North Africa region. For example Dubai's Smart City project adopts a strategy that calls for the transformation of about 1000 government services which focus on six key sectors namely: transportation, infrastructure, communications, economic services, urban planning and electricity

Netherlands

With Amsterdam's smart city project starting in 2009 featuring more than 170 different operations across the city, the country has proven its ability to stay innovative, whether it is the utilisation of renewable energy for electric garbage trucks, installing solar-powered bus stops, billboards and lights or constructing floating villages to combat overcrowding.

Nigeria

Being one of the fastest developing countries in the world (newly emerging economy- Lagos), Nigeria has faced its challenges. Smart initiatives have helped to eliminate some of these issues and slightly reduce the immense wealth divide in the country.

India

A newly emerging economy with many smart cities including Delhi and Mumbai, with many new infrastructure plans on the way for the future.

Switzerland

In areas such as Zurich (streetlight project) energy savings managed to increase by 70% with the city's smart building management system as well, which connects the city's heating, electricity, and cooling.

United States of America (USA)

Hundreds of smart sensors and technologies have been tested and placed through the different districts in New York City. From technologically booming areas such as Silicon Valley to online charging stations in place of phone booths all over the country, the US is no doubt considered as a technologically rich country.

European Commission (EC)

Part of the executive of the European Union and operates as a cabinet government, with 27 members of the Commission headed by a President. Including an administrative body of about 32,000 European civil servants. Relates to the promotion and its involvement in the provision of smart cities.

Association of Southeast Asian Nations Smart Cities Network (ASEAN)

A collaborative platform that aims to facilitate co-operation on smart city development whilst catalysing bankable projects and securing funding.

Cisco

An American-based multinational digital communications technology, best known as a manufacturer and vendor of networking equipment that has been involved with the creation of future smart-cities.

United Nations (UNECE region)

The UNECE region is home to 17 percent of the world population. With over 75 per cent of the population of the region already living in urban areas, this is where the social, intellectual, and economic power of the region is concentrated. The UNECE region is also a leader in sustainable urbanism and is home to many cities that are leading the way in becoming smart and sustainable.

Timeline of Key Events

Some dates are not mentioned throughout the research report but are relevant and will be self-explanatory, where the idea and existence of smart cities is relatively new:

Date	Description of event
December 13th 1974	Los Angeles created the first urban big data project: 'A Cluster Analysis of Los Angeles' report.
1994	Amsterdam created a virtual 'digital city'- De Digitale Stad (DDS) – to promote internet usage.
2005	Cisco put up $25m over five years for research into smart cities.
2009	The EU Electricity Directive required EU states to roll out smart meters to 80% of consumers by 2020.
2011	IBM named 24 cities as Smarter Cities winners from 200 applicants.
2015	China announced a third batch of 84 smart cities, comprising 277 in all.
2015	India's Prime Minister Narendra Modi launched 'Smart Cities Mission' for 100 Indian cities.
2019	G20 nations picked the World Economic Forum as secretariat for a G20 Global Smart Cities Alliance.
2019	The US Federal Communications Commission picked New York and Salt Lake City as 5G testbeds.
2030	By 2030, the number of cities in the world with a population of more than 10 million will grow to 43.
2050	By 2050, up to 70% of the world's population is expected to live in cities.

UN involvement, Relevant Resolutions, Treaties and Events

- New Urban Agenda, 23 December 2016 (A/RES/71/256)
- Open-source technologies for sustainable development, 22 July 2021 (E/RES/2021/30)
- Science, technology and innovation for development, 22 July 2021 (E/RES/2021/29)
- The role of digital technologies on social development and well-being of all, 8 June 2021 (E/RES/2021/10)
- Science, technology and innovation for development, 21 July 2022 (E/RES/2022/16)

Previous Attempts to solve the Issue

Many countries have rolled out grand plans for the development of both greenfield and brownfield smart cities. Even though there have been several agitations against such extensive infiltration of information technologies in societies due to the fear of cyberattacks and privacy threats, there have been endless attempts to solve the issue that are still in action to this day.

Regarding transportation in Europe, cities are following Zurich's example of investing in a tram system as the backbone of urban transport in preference to an expensive underground system (EcoPlan 2000). Emissions standards and car sharing schemes (Schmauss 2009, Nobis 2006) have reduced car dependency while low-emission zones and timed delivery permits have helped reduce congestion and pollution (Geroliminis and Daganzo 2005). In recent years, some cities have led efforts to electrify road-based transport, even though walking and cycling are still the greenest forms of transport. Copenhagen, Amsterdam, London, and New York are investing in pro-cycling and walking strategies. While Cycle hire schemes have changed attitudes towards cycling in London and Paris. In South America, cities such as Bogotá, Mexico City and Rio de Janeiro have instituted regular car-free days or weekend street closures (Parra et al. 2007).

Countries such as Singapore with a strong economy and technological backbone, have set high targets for smart city development and considerable progress has already been made in domains like smart energy, strong Internet, smart mobility, and smart health care.

Many other attempts have been made but were not as successful due to the lack of stakeholder engagement and technological complexity with security concerns. An example includes Quayside (Toronto, Canada) which was a smart city project by Sidewalk Labs, an Alphabet subsidiary. It aimed to incorporate innovative technologies and sustainable design. However, the project faced concerns related to data privacy, surveillance, and corporate influence over urban governance. These issues led to public backlash, and the project was ultimately cancelled.

Possible Solutions

The best solution so far is blockchain which has massive potential for streamlining business operations securely and much more. It is a shared, immutable ledger that facilitates not only the process of recording transactions but also the tracking of assets in a business network. An asset can be tangible (a house, a car, cash, land) or intangible (intellectual property, patents, copyrights, branding). And the best thing is that virtually anything of value can be tracked and traded on a blockchain network, reducing risk, and cutting costs for all involved. It can be put into action in all types of cases from financial services to healthcare and from multinational policy management to supply chain management. Managing complex multinational insurance across jurisdictions is a complex process defined by unique regulatory environments, inefficient information sharing, and different currency flows. In response, IBM blockchain helped convert a multinational, controlled master policy and local policies into a blockchain ‘smart contract’ that provides a shared view of policy data and documentation in real time across the insured, insurer, brokers, and network partners.

It may seem self-explanatory, but another solution could involve raising awareness of the consequences of rapidly developing technological advancements and how to stay safe on the internet. This may include educational programs or even conferences for all age groups. Focusing on SDG’s 7, 9 and 11 whilst searching for change.

Another idea is to establish solutions intertwined with architecture such as promoting initiatives to work with natural materials that can be found near a given construction site, adapting to a circular economy, and increasing the life cycle of a resource.

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Appendix or Appendices

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II. LNOB (un.org)

III. GER_12_Cities.pdf

IV. *SSC nexus_web_opt_ENG_0.pdf (unece.org)