Smart Cities and Digitalisation: A Research Agenda of Public Administration

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Abstract
The emerging smart cities framework and the core of next-generation information technology innovations serve as the landscape of near-future management of city development and e-Government systems guided by policies and strategies. Data science, or big data is an essential area for governments as data is collected in various forms of e-commerce, traffic, security, energy, and geographical aspects as well as data sharing from private sector data. This paper is aimed at evaluating the extent of development of smart cities in selected countries in Asia and the adoption of resources, connectivity, and business coordinations in promoting technology and deployment of innovation for public administration. Meta literature and case studies are employed in this paper, focusing on the publications from year 2000 onward to capture the latest development in smart cities and digitalization. The findings contribute to research agenda and practical implications thus far in advancing our understandings of smart cities and digitalization transformation in the pursuit of smart city development in and around Asia as this is yet to be reviewed. Consequently, this paper paves the way towards a better understanding of the extent of smart city initiatives and development in and around Asia. This study is supported by the Ministry of Higher Education Malaysia under Fundamental Research Grant Scheme (FRGS), Project ID: 18252, FRGS/1/2020/TK02/UM/01/1.

Keywords: digital transformation, urban infrastructure, smart city development, big data, technology

1. Introduction

Can any city become a smart city? Citizens create smart cities via technology and its usage. Cities are in transition; becoming smarter, using technology to make them more sustainable and more efficient, employing digital technologies to greatly improve quality of life, whilst simultaneously making the city sustainable and more environmentally friendly. Business and government can tap into open government data encouraging innovations and co-creation of exciting opportunities. Developers and industries can co-create solutions in societies in line with SDG 11 on Smart Cities and Sustainability Communities. Regarding this digital transformation, data science is crucial as in-depth knowledge of statistics and data analytics for analysing data as well as knowledge of the use of instruments and techniques in creating policies, legislation and public values in various areas (geographical, traffic, social security, energy, and others) [19],[20]. Data is an enabler for creating new innovative applications to improve public values such as security, safety, transparency, and accountability [35]. Big data or data science promises benefits in terms of real-time prediction, adaptation, higher energy efficiency, higher quality of life and greater ease of movement [4],[22].

1.1 Concept and Characteristics of Smart Cities

Urban population keeps increasing and it is expected that three quarters of the world's population will live in urban areas by 2050 [3]. The concept of smart city evolved in various ways based on the fast urbanization. There are a few key characteristics in various concepts of smart city, which are technology itself, information and communication technologies (ICTs), city performance and city investments [6],[9],[15]. By emphasizing focal characteristics, there are various definitions of a smart city such as "the use of smart computing technologies to make the critical infrastructure components and services of a city—which include city administration, education, healthcare, public safety, real estate, transportation, and utilities—more intelligent, interconnected, and efficient" [38], emphasizing technology, "an urban area functioning and articulated by mod- ern information and communication technologies in its various verticals, providing ongoing efficient services to its population."[2], emphasizing ICTs), "a city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens." [13], focusing on performance), and "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural re- sources, through participatory governance" ([7], focusing on city investments).

Studies on smart cities in Europe [36] have mainly focused on how to solve the urban problems of existing cities with smart city technology. In this case, research has explored ways to rank smart cities in Europe, how to make existing cities "smarter", and how to provide benefits to citizens using smart technology [11];[31]; [39]. Smart city cases in developed countries are different for each region, and studies focusing on developing countries have recently shown that smart city development in China [30], the Middle East, and Southeast Asia have adapted various technologies for their new town developments. In addition, research has been conducted in Singapore, Australia, and South Korea as well as in developing countries such as India, some African nations, Brazil, and others.

They evolve towards a strong integration of all dimensions of human intelligence, collective intelligence, and also artificial intelligence within the city. The intelligence of cities "resides in the increasingly effective combination of digital telecommunication networks (the nerves), ubiquitously embedded intelligence (the brains), sensors and tags (the sensory organs), and software (the knowledge and cognitive competence)".

In November 14, 2018, Amsterdam, Barcelona and New York City formally launched the Cities Coalition for Digital Rights, a joint initiative to promote and track progress in protecting residents' and visitors' digital rights.

The Cities Coalition for Digital Rights builds upon five shared principles to create policies, tools and resources to promote and protect resident and visitor rights online. The Coalition will create policies, tools and resources to help advance this effort in alignment with the Charter for Human Rights and Principles for the Internet, established within the framework of the UN's Internet Governance Forum around five core shared principles. The Coalition marks the first time that cities have come together to protect digital rights on a global level.

The shared principles will set the agenda for further policy discussions in coordination with the United Nations Human Settlements Programme (UN-Habitat) and other participating cities:

1. Universal and equal access to the Internet, and digital literacy
2. Privacy, data protection and security
3. Transparency, accountability, and non-discrimination of data, content and algorithm
4. Participatory democracy, diversity and inclusion
5. Open and ethical digital service standards

Some of the common characteristics in a smart city may include:

I. Connected objects

In a smart city, you might want to take a second look at some of these everyday objects - buildings, cars, lampposts, trees, trash cans,etc. Digitalisation opens up a huge range of possibilities. For example, a smart lamppost will not only incorporate LED light bulbs to reduce energy usage, but could also have sensors installed. These sensors could measure a slew of different things, like whether or not there are people on the street in order to dim and brighten lighting as necessary and could even measure air quality.

II. Engaged citizens

In a smart city, citizens create the city and offer solutions. They're active participants in shaping the city and how it works. This difference between smart cities and normal cities often gets overlooked, but citizen participation is essential to a smart city. That means smart cities are adaptable to their citizens' needs, and can grow and change with their residents.

Detroit recently gave teens kits to collect their own data, like foot traffic, air quality, and temperature - and then come up with solutions. The very same technology is also used in cities around the world to measure structural integrity. They adapted it so that anybody could use it on the go to help make their city a better place. This means that citizens can work on solutions to problems quickly and flexibly where sometimes, city officials in a regular city may not even realize that a certain issue needs fixing [41]

III. Streamlined transportation

Opportunities for building urban smartness are provided by the provisions for smart development in a long and medium-term development strategy at the national level. These include the construction of automated traffic control systems, intelligent transport systems, improved communication with public administration, and increased efficiency in energy projects.

In a regular city, you might have to wait for a long time for the next bus to come without a good idea of when it will actually show up. Transport for London (TfL), in UK has led the

way with contactless payment. In 2014, TfL essentially popularised the use of contactless payments on transport networks for the world. Over 50% of journeys are now currently contactless – this is a major advancement which enables people to get through the stations quicker. Similarly, in Singapore, there is the use of digital data to improve bus journeys. Citizens will be able to consult up to the-second information about bus arrival times, with a smartphone app or a bus station with a display with the latest information. The bus routes will also be able to be optimally planned using data about real people's behaviour [41].

IV. Environmentally friendly

Tracking data can help cities design more energy-efficient policies and identify areas they can improve. It can help cities figure out what its citizens are really doing and present more efficient solutions.

By using smart lampposts for example, the city of Barcelona reduced their energy usage by 30%, resulting in $37 million saved each year [41]

V. Optimal budget planning

Cost management is a big issue for city governments and administrations, and it can be difficult to allocate budgets to cover all the different needs a city has. But because smart city technologies prioritize efficiency, they provide lots of opportunities to reduce spending. In one California city, these technologies helped the city reduce water consumption by 20% [41].

VI. Age-Friendly Smart Cities

As many city environments are still designed to support an able-bodied working population, older people risk being excluded from the social and economic life of the city, especially when they lose functional ability. Age-friendly urban environments are therefore essential to enable a good quality of life across the life course, including the ability to age healthy and actively, with dignity, within one's community.

The UNECE region is at the forefront of population ageing with rising numbers of people growing old in cities. If at the turn of 21st century just below 14 per cent of urban population in Europe were 65+, they accounted for 16.8 per cent in 2015 and in North America, the proportion of 65+ among urban population increased from 12 per cent to 14.3 per cent, respectively (based on UN Population Division estimates, 2015).

UNECE's latest policy brief on ageing therefore puts the spotlight on the important role of local governments and communities in creating sustainable and smart cities for all ages. Focusing on three aspects of urban life – housing, access to green spaces and public places, and transport – the brief explores how smart technologies can be leveraged in ways that enhance the quality of life and social inclusion of population groups that risk being left behind as a result of urban planning if new developments are tailored to the young and

able-bodied and ignore the prevailing 'digital divide' excluding those who either lack the technical ability or socio-economic means to utilize digital services.

The population aged 80+ is the fastest growing age group in Europe's urban areas – up from 2.8 per cent in 2000 to 4.5 per cent in 2015 [41]. Inclusive planning that enhances accessibility of the built environment and services can – if designed holistically – simultaneously benefit several population groups and generations including persons with disabilities, children and families

Smart technologies, as the examples discussed in this brief illustrate, hold significant potential for older persons and persons with disabilities assisting them to live independently in their homes, enhancing their mobility and connection with their communities and can be a valuable tool for social inclusion and healthy ageing.

One example is the 'functional flat' concept applied to the Finnish senior home development Wilmankoti that designed 54 rental flats to enhance functionality to support ageing in place. Physical accessibility features include grab bars on all fixtures and wall-hung cupboards in the kitchen, entrance hall and bedroom, as well as a sturdy safety stool designed specifically for seniors. In addition, the toilet and shower facilities of the flats are equipped with a sufficient number of grab bars. The toilet is accessed from the bedroom through a sliding door. The lights in the toilet have motion sensors. The use of home appliances, such as a vacuum cleaner, has been made easier with wall sockets placed 60 cm from the floor. The senior home's wireless network connection and smart lock system support the production and availability of personalized services, enabling residents to use safety systems if they wish. The model of a comprehensive senior home supports communal living while providing residents with personalized housing in their own flats and creating a safe living environment. In a comprehensive senior home, the forms of housing used by the seniors range from independent renting to palliative care, changing along with the residents' life situations and service needs. The services change seamlessly without residents having to move out of their home.

Measures to enhance the energy efficiency of buildings in cities – promoted through the UNECE Framework Guidelines for Energy Efficiency Standards in Buildings – also make an important contribution to enhancing thermal comfort that is particularly important for health and well-being of older persons as well as reducing energy bills as "fuel poverty" significantly contributes to anxiety, depression and poor mental health. In the United Kingdom, over 11 million smart meters installed in homes help inhabitants manage their home heating with healthy temperatures.

Several examples in the brief discuss the design of urban transport services. The Polish City of Rzeszów, among others, has modernized its fleet of city buses to make them more environmentally friendly and accessible. New buses with wheelchair space and low floors entered at street level are accessible for older travellers, people with movement, hearing or sight impairments and those with baby strollers or luggage. Buses are fitted with passenger information systems, including monitors and voice prompts, ticket machines and a video monitoring system for safety. As part of Rzeszów's commitment to investing in renewable

technology, the city has been constructing 140 new smart bus shelters. These not only provide a bench and shelter from the weather, they also have solar panels that are continually working to absorb the sun's energy. Shelters have been adapted for people with reduced mobility and equipped with ticket machines and electronic passenger information systems. The blind and visually impaired can get voice prompts via buttons with Braille or remote controls.

In order to move towards sustainable and smart cities for all ages, this policy brief sets out key recommendations:

Mainstream ageing, gender, disability and human rights considerations in urban planning

To ensure that the design of housing, public and green spaces and transport systems in cities is responsive to the needs of all generations and all levels of ability, it is important to take gender, disability, human rights and ageing considerations into account when planning, designing, implementing and evaluating new city developments.

Involve all generations and stakeholders for people-centred local development planning

Following the principle of "nothing about us without us" it is recommended to engage, consult, design with and for city residents of all ages and abilities to learn about the different needs, preferences and habits of all citizens to ensure that they are not "left behind" through technological developments and urban design that do not cater to their needs.

Avoid working in silos – cooperate across sectors to connect the dots between different realms of city life

Find a synergy between the environmental, economic and social considerations to be taken into account in sustainable urban planning and facilitate developments of projects that are mutually beneficial such as smart housing developments that are energy efficient and connected to public transport, barrier-free and adaptable to the changing needs over the life course, facilitating intergenerational contact and relations. Success will depend on effective cooperation across all sectors, at regional, national and local levels.

Policy Brief No. 24 on Ageing in Sustainable and Smart Cities was prepared by the UNECE Working Group on Ageing within the framework of the UNECE "nexus" approach to leveraging expertise for the SDGs for sustainable and smart cities for all ages. By connecting sectoral expertise and capitalizing on synergies, this approach aims to help countries unlock the interlinked benefits of sustainable development action.

2. Literature Review -Smart Cities and Governance

2.1 Definitions of Smart Cities

Smart city varies in definitions despite being discussed extensively. It was mentioned by [26] that the precise definition of the term 'smart city' is yet to be agreed among the practitioners as well as academicians. Although the term 'smart city' is associated with technology, a wide range of definitions has been provided each from a slightly different perspective [1]. The Smart Cities Council proposes the most often used definition of a smart city in which smart city is defined as one that utilizes information and Information Communication Technology (ICT) to boost the liveability, workability as well as sustainability of the citizen [5], [7]. On the other hand, European Commission defines smart city as a place where digitalization is applied to enhance traditional network and services more efficiently to create benefits for both the users and businesses [12]. European Commission further elaborates that smart city leads to smarter transportation, enhanced water supply, and waste disposal facilities, as well as efficient light and heat in buildings [36]. However, the smart city shared one key concept which is the application of technology to address the issue faced in urbanization [5]. This can be seen through smart cities covering a variety of important industry sectors including ICT, GreenTech, Smart Grid, Transportation, and Infrastructure [28].

Definitions and application of 'smart city' among countries also vary depending on the goals to be achieved by the country itself depending on its level of economic, and urban development as well as urban conditions [23]. Singapore, the top one smart city globally outlined three pillars in creating a smart nation which includes digital society, digital economy, and digital government with the vision to utilize digital society, digital economy, and digital government to enhance health, transportation, urban life, government services, and companies [33]. Meanwhile, in South Korea, a smart city is defined as a place that uses innovative technology from the 4th Industrial Revolution era to improve inhabitants' quality of life, improve the quality of cities, and promote new industries [23]. Oslo on the other hand describes a smart city as an open, connected, sustainable, and innovative urban development vision aimed at enhancing the lives of its residents [27].

2.2 Past studies on smart cities

Countries and its cities are widely enhancing their efforts on establishing smart cities by using ICT to improve various aspects of municipal administration and management including local economy, transportation, traffic management, environment, citizen quality of life, and electronic service delivery [18].

(a) Smart Mobility

Smart mobility is the ability to move around in which is highly associated with transportation and traffic congestion. Basically, smart mobility is an initiative to reduce traffic congestion that is one of the challenges faced in urban living. Smart mobility often comprises more car-sharing enabled by apps, fewer individually owned automobiles, and the potential use of electric driverless vehicles [14],[15],[16]. Pedestrian mobility and

bicycles are also example of sustainable modes of transportation. According to Smart Nation Singapore, Singapore utilizes its digital technologies to develop smart solutions that improve public transportation and promote the objective of a car-free Singapore by providing more comfort, convenience, and reliability. Singapore's commuting experience has improved as a result of the Land Transport Authority's ability to quickly identify commuter hotspots using anonymized data received from commuter fare cards, resulting in a more efficient bus system [32]. Parking is also an essential item when it comes to mobility. In their survey [24] on smart parking solutions it is noted that smart parking assists in creating smooth-running traffic, increasing urban mobility, and expanding city capacity [24]. An efficient and easily accessible public commuting system will reduce traffic congestion as well as dependence on self-owned cars.

(b) Smart Environment

Environmental consequences are mostly caused by population growth, fast urbanization, a strong reliance on private automobiles, deregulated industrialization, and large-scale animal production. Smart environment can be described as the application of technology to enhance the quality of life and make life more comfortable and secure in which involves efficiency and sustainability as well as resources. Smart environment on the other hand also can understand its people and their physical surroundings and utilize that knowledge to improve the environment's performance [14],[15]. For instance, with the implementation of smart parking, environmental pollution can be reduced and lesser fuel consumption [24]. Taking Singapore as a perfect example of having a smart environment, more Walk-Cycle-Ride transportation nodes are springing up all around Singapore, allowing more Singaporeans to finish their commutes in a more environmentally friendly manner [32],[33],[34].

(c) Smart Building

A smart building is where technology is applied to create a safe and comfortable space for the citizens while enabling an economical way of usage. Examples include sensors, waste management systems, and face detection systems for a more comfortable way of life. As proven by IBM and Innovate UK, international building research is now focusing on cognitive building and intelligent homes, which initially appeared as elaborations of home automation or smart building. As can be seen, the ELISIR project offered an integrated method for making the entire construction supply chain smart at various levels in order to maximize the benefits of digitalization. A study on demand response system installed in the central heating systems of existing apartment complexes, found that the provided demand response system considers weather forecasts, indoor temperatures, and drops in space heating temperatures when demand for domestic hot water is at its greatest, resulting in peak demand control and potential savings in fixed costs. This shows that smart building plays a significant role in providing a more comfortable life to both the tenants and owners. In the 2021 Smart City Index conducted by Institute for Management Development (IMD)-Singapore University for Technology and Design, Singapore, Zurich (Switzerland), and Oslo (Norway) are found as the top three smart cities in the world. The survey was conducted through query related to five key areas including health and safety, mobility, activities, opportunities as well as governance to hundreds of citizens of each 118 cities in

July 2021 [17]. The score for each of the key areas for Singapore, Zurich and Oslo in both structure and technologies aspect can be seen in Table 1.

Table 1. Smart City Index for Singapore, Zurich, and Oslo, Source: Smart City Index, 2021

	Country	Singapore	Zurich	Oslo
Structure				
1.	**Health & Safety**			
1.	Basic sanitation meets the need of poorest area	83.9	83.7	78.0
2.	Recycling services are satisfactory	66.4	86.7	79.8
3.	Public safety is not a problem	74.9	77.1	73.5
4.	Air pollution is not a problem	60.7	59.5	62.9
5.	Medical services provision is satisfactory	84.9	87.3	78.8
6.	Finding housing with rent equal to 30% or less of a monthly salary is not a problem	48.7	30.4	33.7
2.	**Mobility**			
1.	Traffic congestion is not a problem	47.9	40.7	53.3
2.	Public transport is satisfactory	77.6	79.5	69.9
3.	**Activities**			
1.	Green spaces are satisfactory	78.3	73.9	80.6
2.	Cultural activities (shows, bars, and museum) are satisfactory	76.0	82.6	79.4
4.	**Opportunities (Work & School)**			
1.	Employment finding services are readily available	74.1	74.1	73.4
2.	Most children have access to a good school	82.0	85.9	82.1
3.	Lifelong learning opportunities are provided by local institutions	81.7	74.5	72.6
4.	Businesses are creating new jobs	67.6	70.3	69.6
5.	Minorities feel welcome	69.1	67.4	64.3
5.	**Governance**			
1.	Information on local government decisions are easily accessible	77.1	70.9	66.2
2.	Corruption of city officials is not an issue of concern	68.8	68.1	59.9
3.	Residents contribute to decision making of local government	59.9	73.0	61.4
4.	Residents provide feedback on local government projects	68.5	73.6	66.6

Technologies				
1.	**Health & Safety**			
1.	Online reporting of city maintenance problems provides a speedy solution	70.5	59.5	51.4
2.	A website or App allows residents to easily give away unwanted items	65.3	55.9	69.5
3.	Free public wifi has improved access to city services	76.4	52.9	49.4
4.	CCTV cameras has made residents feel safer	80.2	49.7	49.6
5.	A website or App allows residents to effectively monitor air pollution	63.6	42.6	41.7
6.	Arranging medical appointments online has improved access	81.9	56.0	69.6
2.	**Mobility**			
1.	Car-sharing Apps have reduced congestion	59.6	42.4	43.6
2.	Apps that direct you to an available parking space have reduced journey time	57.9	44.2	44.8
3.	Bicycle hiring has reduced congestion	51.9	51.4	61.9
4.	Online scheduling and ticket sales has made public transport easier to use	62.9	79.6	76.2
5.	The city provides information on traffic congestion through mobile phones	75.2	57.9	52.6
3.	**Activities**			
1.	Online purchasing of tickets to shows and museums has made it easier to atend	83.5	78.5	76.3
4.	**Opportunities (Work & School)**			
1.	Online access to job listings has made it easier to start a new business	80.3	75.4	68.9
2.	IT skills are taught well in school	72.3	58.5	59.6
3.	Online services provided by the city has made it easier to start a new business	70.5	55.0	52.2
4.	The current internet speed and reliability meet connectivity needs	82.6	77.3	70.3
5.	**Governance**			
1.	Online public access to city finances has reduced corruption	58.1	46.6	47.2
2.	Online voting has increased participation	49.3	50.4	49.3
3.	An online platform where residents can propose ideas has improved city life	60.9	49.3	47.2
4.	Processing identification Documents online has reduced waiting times	78.1	56.8	52.3

Based on the index in Table 1, it can be seen that Singapore scores higher in most of the criteria for a smart city with some improvement on certain aspect such as recycling,

resident's contribution to decision making of local government as well as online scheduling and ticket sales in which is slightly lower compared to Zurich and Oslo. However, these three countries should be considered as benchmark for other countries to achieve the goal of smart city.
There are many examples of smart cities currently being developed and here are some examples in the West and East.

3. Examples of Smart Cities in the West

Helsinki, Finland

Finland's capital Helsinki is piloting smart city projects through city innovation platforms that enable the testing of solutions in an existing urban environment. The area where these pilots take place is the Smart Kalasatama district, where co-creation and agile development take centre stage. Its residents are the initiators and testers of new technology and smart services. Kalasatama wants to become so efficient that its residents gain one hour of extra time per day. Some of the pilot projects include parking places with car charging facilities as well as automated waste collection systems that reduce the traffic of garbage trucks by up to 90 percent. Then there's smart grids and real-time energy monitoring pilots that aim for a 15 percent reduction in energy usage, and apps that plan the most efficient traffic routes with any type of transportation method. Finnish schools are widely known for their forward-thinking education systems. The curriculums move away from conventional pedagogy towards a more inquiry-based method of learning. Open data innovation, hackathons as well as open app competitions are part of this and are held on an annual basis. Different smart city projects in Helsinki are driven at the district, metropolitan area, city, state and regional levels, which fosters resilience in cases of shifts in talent or budgets. Helsinki has not only developed various local co-creation platforms, competitions and boot camps, but also engaged in active dialogue with other cities under the Six City Strategy in Finland and the Horizon 2020 in Europe. Adopted by Helsinki, Espoo, Oulu, Tampere, Turku and Vantaa, the Six City Strategy is an open innovation platform that allows the cities to share and learn from over 45 million euros worth of smart city projects launched since 2014.

Barcelona, Spain

Named European Capital of Innovation in 2014, Spain's second-biggest city, Barcelona, is involved in over one hundred smart city projects and is a global leader in its extensive use of the Internet of Things. Smart city projects range from smart lighting, the promotion of charging infrastructure for electric vehicles, and Wi-Fi in public transportation systems and public places. Barcelona provides global leadership by hosting the annual Smart City Expo World Congress – supporting the growth of the smart cities industry. The city's Telecare service looks after its more than 70.000 elderly and disabled citizens by proactively checking on them with the use of sensor technology. Barcelona has smart LED streetlights throughout that are only activated when they detect movement. This leads to energy savings of no less than 30 percent. The sensors in the street lights also collect environmental data while rain and humidity sensors determine the amount of water required to irrigate public

parks. Smart garbage bins are only emptied when full and smart parking systems show vehicles to free parking spots, reducing carbon emissions and traffic congestion. Digital bus stops provide real time overviews of bus times, USB charging ports as well as free Wi-Fi. The city's Smart Urban Platform aims to solve urban challenges by bringing together data from social networks, the city's information systems and the open-source Sentilo sensor network.

4. Examples of Smart Cities in the East

Singapore

The Republic of Singapore has announced its quest of becoming the first smart nation. A program launched by Prime Minister Lee Hsien Loong in late 2014 calls for an unspecified number of sensors and cameras to be deployed across the island to track everything from cleanliness to traffic. In any case, the number of sensors being installed across the island will be large. Already, the city can detect if people are smoking in unauthorized zones or if people are throwing litter out of high-rise buildings. But substantially more data is coming, according to the Wall Street Journal, which announced in a recent headline that "Singapore Is Taking the 'Smart City' to a Whole New Level" for its smart mobility policies and technology as well as its wireless connectivity. In 2014, the city-state announced that it was developing software it calls "Virtual Singapore," a dynamic 3-D model that enables city planners to run virtual tests—verifying, for instance, how crowds might evacuate from a neighborhood facing an emergency.

South Korea

Korean government defines a smart city as "a platform to improve the quality of life for citizens, enhance the sustainability of cities, and foster new industries by utilizing innovative technologies of the 4th Industrial Revolution era" [25]. Korean government set up the law (Act on the construction of ubiquitous city (U-city)) to support the innovative urban planning since 2008 and amended this law to "Act on smart city creation and industry promotion" in 2017. Korean smart city policies were designed in three phases following the master plan by the law. The first phase was for the construction of U-city during 2008 and 2013 and focused on infrastructures such as a high-speed ICT network system, U-eco city projects, U-city services, element technology and integrated platform [25]. The second phase was for the system linkage during 2014 and 2017. Information and system linkage projects were developed to utilize the established smart city infrastructure. Korean government started the five major public services based on the integrated platform: 1) 112[1] Emergency Video, 2) Emergency Dispatch, 3) 119[2] Emergency Dispatch, 4) Disaster Safety and 5) Support for the socially underprivileged. The third phase is from 2018 and ongoing to encompass new concepts such as living labs and testbeds and launching various policies such as building an industrial ecosystem, smartization of existing cities and developing national pilot cities. There are national projects to support smart city such as

[1] Emergency call number for crime connecting to police stations
[2] Emergency call number for fire or medical issues connecting to fire stations/ambulances

smart governance project for urban regeneration, the integrated platform project to connect all types of emergency centers and local governments, R&D projects to develop the data hub platforms and smart city services based on AI technologies, and the human resources development projects to support masters and PhD students to study topics related to a smart city [25].

Seoul, the capital city of Korea, has been developing their own smart city policies since it is on the special status in Korea. Seoul is operating six strategies, 1) Smart Seoul Network (S-NeT), 2) Smart Seoul Data of Things (S-DoT), 3) Smart Seoul Data (S-Data), 4) S-Brain, 5) S-Map and 6) S-Security as Seoul's smart city ecology. S-Net is for ensuring internet access in any area and providing public Wi-Fi as a basic public service. S-DoT is building a tight data net covering all city areas to collect various city information such as air quality, weather, UV, noise, living population and commuting population, traffic, crime, and road conditions via S-DoT sensors and CCTVs. S-Data is sharing public data with public agencies, research institutions, and citizens, so that all stakeholders can utilize the data and participate in policy making. The data storage, administration system and the integrated data portal system were developed, and now it focuses on developing policy examples to utilize big data analyses. S-Brain is for developing automatic administrative services based on AI. The consulting chat-bots, AI forecasting systems for traffic, environment, economy and safety, and learning programs for AI services are being operated. S-Map developed the 3D virtual map of Seoul and uses this to simulate urban planning, city safety policies, and city environmental policies. Images collected from CCTVs, airplane and drones are being used to build the 3D map. S-Security focuses on the cyber security and privacy. The cyber security center is monitoring big data, the data storage, sensitive data related to privacy, and any potential threats [40].

China

China is another country that can be categorized as among the forefront of smart city development. China government has shown efforts in implementing relevant policies to smart cities. National New Urbanization Plan (2014-2020) is one of the main policies that focused on the development of smart cities and incorporate main elements such as technologies used in the urban planning and management, provision of infrastructure, public services, industrial development urban governance. The plan outlines four main goals, namely (a) promoting the orderly conversion of rural migrants into urban residents; (b) optimizing the patterns of urbanization; (c) enhancing the sustainability of cities, and; (d) promoting urban-rural integration [10]. Since 2013, there are 2,080 smart city pilot projects under progressing [37]. The main purposes of smart cities development in China are thorough perception, ubiquitous interconnection, fusion application and people oriented sustainable innovation. The plan direction of smart cities pays attention on eight focal aspects of smart city, namely community, medicine, energy, material transportation, logistics, government and construction [42]. Despite the well-continuing progress on smart cities development in China, [8] suggested that there are a few important aspects the China government should pay attention and improve such as governance reform, policy transparency, greater citizen participation and the introduction of rule of law.

Malaysia

Kuala Lumpur, Kota Kinabalu, Kuching and Iskandar Malaysia are the four pilot cities in Malaysia out of 26 pilot cities in ASEAN. Meanwhile Cyberjaya, Putrajaya, Selangor, Melaka and Penang are Malaysian smart cities [28],[29]. Smart city policies are also developed to serve as guidelines for the establishment of smart city as can be seen in Table 2.

Smart City Policy	**Component**
Malaysia Smart City Framework	1. Smart Economy 2. Smart Living 3. Smart Environment 4. Smart People 5. Smart Government 6. Smart Mobility 7. Smart Digital Infrastructure
Smart Selangor Blueprint	1. Smart Governance 2. Smart Disaster Management 3. Smart Building 4. Smart Safety & Security 5. Smart Food & Agro 6. Smart Energy 7. Smart Water Management 8. Smart Digital Infrastructure 9. Smart Transport & Mobility 10. Smart Waste Management 11. Smart Healthcare & Well-being 12. Smart Education
Penang2030	1. Smart Community 2. Smart Environment 3. Smart Government 4. Smart Mobility 5. Smart Economy
Sarawak Digital Economy Strategy	1. Digital Government 2. Digital Health 3. E-Commerce 4. Smart City 5. Cyber Security 6. Digital Innovation & Entrepreneur 7. Social 8. R&D 9. Digital & Data 10. Digital Skills & Talent Development 11. Digital Inclusivity 12. Digital Infrastructure Agriculture 13. Manufacturing 14. IR4.0 15. Tourism
Putrajaya Smart City Blueprint	1. Smart Transportation & Mobility 2. Smart Home & Environment 3. Smart Government Services

	4. Smart Infrastructure & Utilities 5. Smart Safety & Security 6. Smart Economy 7. Smart Community
Cyberjaya Smart & Low Carbon City	1. Smart Mobility 2. Walkability 3. Compact Development 4. Integrate Nature into Urban 5. Efficient & Effective Resource 6. Smart & Green Building 7. Smart Community
Smart City Iskandar Malaysia Framework	1. Smart Governance 2. Smart Living 3. Smart People 4. Smart Mobility 5. Smart Environment 6. Smart Economy

Table 2: Smart City Policy
Source: Malaysian Smart City Outlook, 2021-2022

The Smart City Framework Malaysia (MSCF) is a national-level framework that acts as a guide and reference for city managers, state governments, federal ministries and departments, industry actors, academics, and other stakeholders in Malaysia's smart city planning and development [28],[29]. In term of smart city element implementation, Malaysia's SMART tunnel (Stormwater Management and Road Tunnel) is an example in which it functions as a flood-control project that works like a traditional tunnel. Another initiative of smart city's smart building in Malaysia can be seen through SmartZone lighting control where it is fully integrated with HVAC systems and motorized shades, allowing intelligent routines to be created wherein natural light, electric light, and room temperature are properly regulated to create a comfortable work environment and an energy-efficient facility.

5. Conclusion

As a continuing research agenda of public administration, smart city concept has brought about substantial improvement in daily living, ranging from public transportation to home facilities. The "smart" technology and facilities were well established in the developed countries since two decades ago, and many developing countries are gradually picking up this technology, data transformation and data analytics [35]. Most of these developing countries, however, are still grappling with the latest technology development. Technical assistance from the developed countries would therefore be useful in assisting these developing countries in expanding the smart city concept, and in turn, the developed countries may generate additional revenue by promoting the technology. There is a need to have more careful coordination and efforts of many stakeholders in the city so as to ensure a better achievement of policy goals, as big data is necessary for a balanced urban

development in the context of smart city policy, digitalisation and governance and this is a work-in-progress study.

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