Smart Cities in South East Asia

A Landscape Review

Smart Cities
Innovation Lab

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List of Abbreviations

ASEAN	Association of Southeast Asian Nations
AASCTF	ASEAN Australia Smart Cities Trust Fund
ADB	Asian Development Bank
AFD	French Development Agency
AI	Artificial intelligence
AIIB	Asian Infrastructure Investment Bank
AIS	Advanced Info Service
AITI	Authority for Info-communications Technology Industry
AMS	ASEAN Member States
ASCI	Asian Development Bank ASEAN Smart Cities Initiative
ASCN	ASEAN Smart City Network
AWS	Amazon Web Services
BNCCP	Brunei Darussalam National Climate Change Policy
BOI	Board of Investment
CLM	Corona Likelihood Metric
COVID-19	Coronavirus Disease 2019
CRM	Citizen Relationship Management
DEPA	Digital Economy Promotion Agency
DICT	Department of Information and Communications Technology
DICT	Department of Information and Communications Technology
DOST	Department of Science and Technology
DOTr	Department of Transport
DPWT	Division of Public Works and Transport
EEC	Easter Economic Corridor
EMR	Electronic Medical Record
GDP	Gross Domestic Product
GFCP	Global Future Cities Programme
GI Hub	Global Infrastructure Hub
GSCA	Global Smart Cities Alliance
GSMA	Global System for Mobile Communications Association
ICT	Information and Communications Technology
IDC	International Data Corporation
IDSUN	Indonesia Sustainable Urbanization Trust Fund
IMD	International Institute for Management Development
IoTs	Internet of Things
ITS	Intelligent Transport System

ITU	International Telecommunication Union
JAKI	Jakarta Kini
JETRO	Japan External Trade Organization
JICA	Japanese International Cooperation Agency
KKMM	Ministry of Communications and Multimedia Malaysia
KPKT	Ministry of housing and Local Government
LGU	Local Government Unit
LOI	Letters of Intent
MCMC	Malaysian Communications and Multimedia Commission
MDEC	Malaysia Digital Economy Corporation
MDES	Ministry of Digital Economy and Society
MoNRE	Ministry of Natural Resources and the Environment
MoT	Ministry of Tourism
MOU	Memoranda of Understanding
MPI	Ministry of Planning and Investment
MPWT	Ministry of Public Works and Transport
MSCF	Malaysia Smart City Framework
MTIC	Ministry of Transport and Infocommunications
NDI	National Digital Identity
NUS	National University of Singapore
ODA	Official Development Assistance
OPWT	Office of Public Works and Transport
SDG	Sustainable Development Goals
SUTD	Singapore University of Technology and Design
U4SSC	United for Smart Sustainable Cities
UDAA	Urban Development Administration Authority
UK	United Kingdom
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNN	Unified National Networks
US	United States
USASCP	U.S.-ASEAN Smart Cities Partnership
USTDA	United States Trade and Development Agency

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1. Introduction

Smart city policy goals are becoming mainstream in South East Asia but lack a supply of innovative smart city business models, products and services. ESCAP is joining the movement to support the acceleration of smart innovative solutions for cities through its Smart Cities Innovation Lab project.

The project builds on the flagship Future of Asia Pacific Cities Report – Smart Cities Pillar and seeks to support the smart cities innovation ecosystem in the region, bringing together cities, entrepreneurs, large companies, and development actors to collaborate on the implementation of their smart cities action plans.

The objectives of this Landscape Review are to understand the current context of smart city development within South East Asia and to provide a common basis of understanding for the deployment of Smart Cities Innovation Labs in the region. This Landscape Review was completed through secondary research comprising of a desk top review of publicly accessible literature.

This report seeks to answer the following questions:

- How are smart city guidelines or frameworks being applied within South East Asia?
- What are the opportunities and challenges facing smart cities in South East Asia?
- What ongoing regional platforms and networks exist which could amplify knowledge sharing and collaboration across countries and cities?

Why Smart Cities?

The Asia-Pacific region is rapidly urbanising. Predictably, the region will become mostly urban within the next decades. Within South East Asia, urban areas are currently home to one third of the population, but two thirds of its economic activities. With a projected annual growth rate of over 5.5% per year, ASEAN is forecast to overtake the EU and Japan to become the 4th largest economy in the world by 2050, behind China, India, and the United States (US-ASEAN, 2019).

Rapid urbanisation fuels economic growth, but also comes with sustainability challenges related to air pollution, waste management and climate change, particularly when infrastructure and services fall behind, or become outdated in modern societies. Rapid city expansion is putting increasing pressure on limited resources and infrastructure, while climate change and cyber threats add new risks and uncertainties.

Governments are increasingly turning to technology to manage and monitor their cities and support urban efficiencies. With innovation occurring at pace, powerful new technologies are redefining the ways cities operate and people live, work, play and learn.

Cities in South East Asia are well positioned to take advantage of new technologies within the smart cities sector. With widespread levels of digital literacy, smart phone penetration and ICT infrastructure to underpin smart solutions. Disruptive technologies including cloud computing, the Internet of Things (IoT), open data and big data, have the potential to generate between US$220-US$625 billion in annual economic impact in ASEAN by 2030 but are also estimated to potentially displace 12-17 million non-farm jobs in ASEAN from 2015 to 2030 (The ASEAN Secretariat, 2018)

A smart city is also a sustainable city. The aim of a smart sustainable city is to promote economic and social development alongside environmental protection through effective mechanisms to meet the current and future challenges of its people, while leaving no one behind. At a strategic level, a smart city in ASEAN aims to achieve a balance between three interdependent objectives which are competitive economy, sustainable environment, and high quality of life (Centre for Liveable Cities, 2018). This will create a more equitable, inclusive, and resilient society

What is a "Smart City"?

[Pexels/Kostiantyn Stupak]

There are many definitions of what a "Smart City" is. Definitions vary from between countries and cities, depending on the level of development, willingness to change and reform, resources and aspirations. For the purposes of the Smart Cities Innovation Lab, the UNESCAP definition of a "smart city" is adopted:

A Smart City is [a city] where technologies seamlessly support more efficient work-life-play-learn opportunities for every individual in an inclusive manner, fuel greater economic growth and facilitate the creation of sustainable living environments in cities. (UNESCAP, 2019)

Current smart city solutions are focused on virtually every domain of urban life: mobility, social infrastructure, built environment, utilities, security, community, and economic development (UNESCAP, 2019). See Box below for an example of smart city features from ASEAN.

Smart cities often apply technology to address the following general features (Centre for Liveable Cities, 2018):

Civic and Social
- Social Cohesion Culture and Heritage Tourism
- Public and Municipal Services Governance

Health and Well-being
- Housing and Home Healthcare Education

Safety and Security
- Resource Security Cybersecurity
- Public Safety, City Surveillance and Crime Prevention

Quality Environment
- Clean Environment Resource Access and Management Urban Resilience

Built Infrastructure
- Utilities
- Mobility and Transportation Building and Construction

Industry and Innovation
- Business and Entrepreneurship Trade and Commerce Upskilling Technology Incubation Research

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The Opportunity for Smart City Solutions

Applying technological breakthroughs to transform city operations has drastically increased in the past decades. From mobile technology to broadband, and from cloud computing/IoT to social media, many disruptive technologies have emerged and been applied to create more efficient and sustainable cities. Cities can use technology creatively in master planning, building infrastructure, managing environmental challenges, delivering essential services to the people, creating economic opportunities, and making urbanisation more inclusive and sustainable.

Digital transformation can spur innovation and productivity growth across many activities, transform public services, and improve well-being as information, knowledge and data become more widely available.

In South East Asia, smart cities are helping to change the development paradigm towards growth, driven less on the demand-side by exports and more on the supply-side as urban productivity increases, enabling countries to "move up the value-chain". Moreover, smart solutions are helping to address policy challenges such as the meeting of future energy, food, and water needs, or improving the delivery of health and education services.

Smart city applications in South East Asia

Technology now is a significant aspect of a city, transforming virtually all urban systems. The following list of smart cities use cases is taken from the UNESCAP flagship Future of Asia-Pacific Cities Report (2019).

Enhancing mobility infrastructure for inclusive accessibility [Pexels/ Peng Liu]	Whether or not autonomous vehicles live up to their promise, most city dwellers circulate on public transport now and will continue to do so in the future. Data that reveals behavioural patterns can provide rich insights for transport planners to enhance mobility services that better serve residents' needs. Real time sensors coupled with big data analysis can also prove effective traffic management tools. Cities experiencing increased private automobile ownership rates and more vehicle miles travelled find that the resultant traffic congestion slows down urban productivity and generates air pollution.
Improving the natural environment for a high standard of living [Pexels/Scott Webb]	A clean, biodiverse natural environment offers a foundation for productive and sustainable economic development, enhances quality of life through ecosystem services and reduces the risk of natural disasters. Technology and smart systems enable cities to address environmental degradation and manage environmental resources in a more responsive and integrated manner. They also provide the means to promote sustainable consumption and production through information sharing.
Advancing industry and nurturing innovation	The rise of internet innovations, such as e-commerce, cashless payment, and all-in-one smartphone apps, provide unprecedented opportunities to transform and upgrade traditional industries, such as health care, education and tourism, for those who have the tools to use them

[Unsplash/Kate Trysh]

Many businesses are digitizing parts of their operations and bringing them onto these integrated platforms facilitated through QR codes and electronic payment functionality.

Advancing civic and social development

[Pexels/Yan Krukov]

South East Asian cities enjoy a rich mix of ethnic diversity. Building a cohesive and resilient community is among the top agenda items of cities, especially in the face of rising fears of domestic violence and transnational terrorism. While social media platforms have been misused as a tool of division, they can also act as a radical force that brings people together, fosters strong community ties and enables public authorities to connect with residents to hear feedback and address their concerns directly.

Care must be taken to ensure the security of integrated data systems to avoid eroding trust.

Improving health and well-being in a smart city

[Pexels/Lum3n]

COVID-19 has altered the dynamic of urban life is countless cities around the world.

Healthy lives and well-being are a priority for sustainable urban development, especially as urban populations enjoy longer life expectancies. Many cities are working to provide all residents with affordable and accessible health-care services, a goal that has typically been impeded by financial and labour constraints. With innovative, technology-aided solutions, cities have found new ways to provide a larger segment of the population with affordable care. The advent of sensors and environmental and health data enable people to understand the urban environment and their own health in new ways. Smart systems have provided unprecedented opportunities for Governments to work together with people to create a better living environment. (UNESCAP, 2019)

Robust digital infrastructure and applications through data security [Pexels/Scott Webb]	Smart applications rely heavily on robust, secure ICT and digital infrastructure. Digital infrastructure, such as fibre-optic broadband and data centres, ensures basic virtual connectivity between people, companies, and organizations. It enables delivery of solutions to remote and even resource-poor locations that are traditionally hindered by poor accessibility.
Urban management [UNESCAP/CKMS]	Adopting an integrated and holistic urban planning approach supports cities in prioritising their smart and sustainable development actions. Sensors and other types of digital touchpoints allow us to gain a better understanding of how cities work and how people act in real time. These data enable decision makers across different sectors – facility managers, transport operators, and public health workers – to provide more accurate, impactful, and real-time decisions. Smart sustainable city indicators can address both the smartness and sustainability aspects of urbanisation, with a focus on localizing the Sustainable Development Goals.

Prerequisites for Smart Cities

Digital technologies are key to development. For cities to realise the promising benefits of smart city, they need to have the capabilities in ICT development and institutional arrangements. There are several common types of technologies that are often mentioned in smart city development. The wired and wireless networks, such as 5G, WiFi, fibre-optic, and data centres, form the foundation on which smart city applications are built and ensure the communication of data between users themselves and with the applications (Urban Studies Lab, 2020). Sensors and the Internet of Things collect and assign the data that a smart city needs to operate, whereas data analytics, AI, and automation analyse the inputs from sensors for staff to interpret and translate to institutional policies. Therefore, a city's understanding of the potential of ICT is key to build smart cities, and lack of basic infrastructure and ICT infrastructure readiness can greatly hamper the effort of smart city development.

All-round development is needed. Additionally, other aspects of development are highly intertwined with technological development in defining a smart city, including social

development, economic development, environmental reforms, governance reforms, and human development. Recommendation ITU-T Y.4900 has outlined similar aspects of sustainability that "smartness" should consider, and these features are all interconnected under the SDG 11, to "make cities inclusive, safe, resilient and sustainable". City administrations are encouraged to set plans and actions in line with SDGs (ITU, 2016).

Government frameworks play a vital role. Government actors are important in the process of improving city development. A central authority should have a unifying strategy for smart cities as coordination and cooperation across various public institutions are important to roll out smart city projects effectively. For instance, China has a combination of top-down and bottom-up design where national governments devise experimental ideas and select cities to test smart city policies, and local governments operates and evaluates these projects (Tan & Taeihagh, 2020).

A planned and coordinated smart city mechanism can promote the aggregation of data for analysis, the deployment of productive policy instruments, operational efficiency, and active participation of local governments. If developing countries have a clear governance framework to specify the objectives, strategies, regulatory norms, and evaluation processes of smart city development, this will help prioritise development challenges, improve budget allocation, and set regulatory safeguards to avoid the breach of data privacy and security and illicit activities online.

A supportive ecosystem will also promote innovation and learning for smart city development, this includes well organized network meetings, contractual agreements with solution providers, and informal relations with investors and entrepreneurs. This is because although governments are essential actors, they cannot accomplish smart city projects alone. Therefore, smart city projects usually require horizontal and vertical collaboration to realise a qualitative change.

2. Smart City Landscape in South East Asia

[Pexels/Robert Stokoe]

Smart City Governance in South East Asia

The ambition of SDG 11 is to make cities and human settlements inclusive, safe, resilient, and sustainable. To achieve this, cities are seeking to implement a range of smart technologies that can help them improve overall efficiency and quality of life and respond to shocks and stresses. Governance has emerged as a critical area in the application of advanced digital technologies to drive smart city objectives, especially given the importance of public trust in local government. Gaps exist regarding the ethical and responsible governance of smart city programmes particularly around issues like data privacy and protection, cybersecurity, and connectivity.

In South East Asia, central governments play a critical role in driving forward smart city efforts. National or municipal governments often institutionalise smart city strategies as part of their overall development plan and political agenda. Therefore, governments usually have a high level of participation throughout the process. Typically, the national government sets out regulations and plans to provide the basis for smart city development, and local governments are responsible for designing concrete local schemes for the transformation in their respective jurisdiction. Local governments are also in charge of allocating and collecting funding for smart city projects. Hence, they tend to be the main implementing agents of smart city plans, while the national authority acts more like a guide.

Within South East Asia, the national ministries responsible for information, communications, and technology are typically provided the overall mandate to govern smart city development. For example, in Philippines, the Department of Information and Communications Technology (DICT) plays a key role in promoting ICT infrastructure and digitalisation, while the Ministry of Communications and Multimedia Malaysia manages similar digital developments in Malaysia. Most other ASEAN countries also have corresponding agencies at national and sub-national levels, indicating a clear hierarchy in smart city governance.

At the regional level, the ASEAN Smart City Network (ASCN) provides a recognised approach to build cooperation and partnership, focusing on city-level technology and innovation-based initiatives and solutions. The ASCN was established at the 33rd ASEAN Summit in 2018. In October 2020, the ASCN High Level Forum was held in Ha Noi and involved 500 delegates from national ministries and international businesses. A Smart Cities Governance Workshop was held in the same year, a key outcome of which was the development of Smart City Action Plans and city priorities.

One of the ASCN's foundational documents is the ASEAN Smart Cities Framework. The ASEAN Smart Cities Framework was endorsed in 2018 to provide a voluntary guide for the participating network pilot cities. The Framework defines three strategic outcomes, two urban systems and six focus areas, and two key enablers as elements of a Smart City Plan. The framework can be conceptualized and translated into concrete projects in the pilot cities. Focus areas are selected based on their significance for achieving the three strategic outcomes.
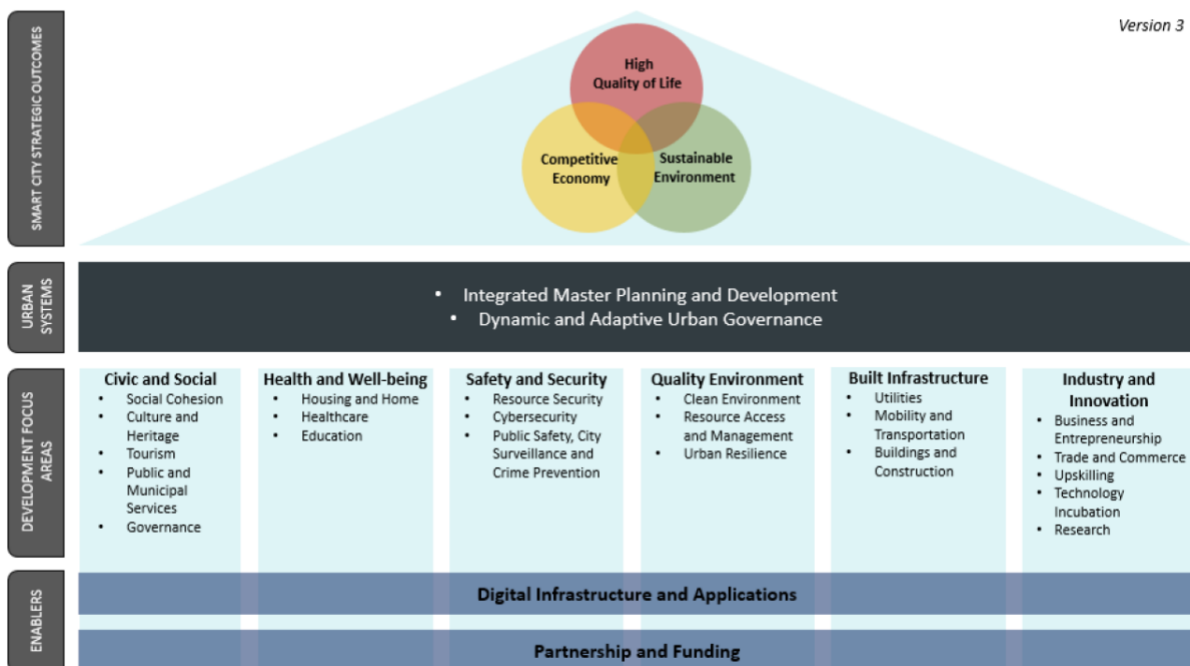
Figure 1: ASEAN Smart Cities Framework (ASEAN, 2018)

Similarly, following a call to action from the G20 ministers in 2019, the G20 Global Smart Cities Alliance was established to help cities identify and adopt foundational policies for smart city technologies. The Global Smart Cities Alliance has developed a Global Policy Roadmap – a technology governance framework - that city leaders and administrators can refer to as a baseline for sound technology governance and customize based on local conditions (WEF, 2021). The roadmap is organized around five core principles (see Figure 1). The principles represent the core requirements that smart cities should meet, regardless of their strategic objectives (WEF, 2021). The Global Policy Roadmap is compiling and analysing policies from around the world to identify model policies for successful and ethical smart cities (GSCA, 2022).

Figure 2: G20 Global Smart Cities Alliance - The 5 core principles from the Global Policy Roadmap

At the global level, United for Smart Sustainable Cities (U4SSC), coordinated by the ITU, serves as the platform for public policy and works to encourage the use of ICTs to facilitate

and ease the transition to smart sustainable cities. U4SSC hosts Thematic Working Groups in the following six areas: 1) City Platforms; 2) Lessons learned from building urban economic resilience at city level during and after COVID-19; 3) Compendium of Practices on Innovative Financing for Smart Sustainable Cities Projects; 4) Guiding principles for artificial intelligence in cities; 5) Procurement Guidelines for Smart Sustainable Cities; and 6) Digital Transformation for People-Oriented Cities. U4SSC has also published Key Performance Indicators for Smart Sustainable Cities based on international standards. The indicators provide cities with a standardised method of self-assessment and monitoring of progress to achieving SDGs and assessing the level of smart-ness and sustainability (ITU, 2022).

Application of Smart City Guidelines and Frameworks in South East Asia

The following section provides an overview of how smart city guidelines and frameworks have been applied within South East Asian nations.

Singapore

[Pexels/Alex Qian]

Ranked the world's smartest city, Singapore launched its Smart Nation initiatives in 2014 and has achieved remarkable progress in implementing national strategic policies. In 2021, Singapore topped the IMD-SUTD Smart City Index for the third year (IMD, 2021). Meanwhile, the country ranked among 82 countries for its digital inclusiveness, accessibility, affordability, and attitude (Roland Berger, 2021). Besides, Singapore outperformed London for first place in the worldwide study of smart city governments due to its intelligent technology infrastructures and its 'sterling' response to the COVID Pandemic (Eden Strategy Institute, 2021). Moreover, Singapore also clinched the top spot in KPMG's 2011 Global Ranking of Leading Technology Hubs, which attracts young professionals, a pipeline of skilled talent, and modern infrastructure (KPMG, 2021).

Singapore is a nation "where we can create possibilities for ourselves beyond what we imagine possible." – Prime Minister Lee Hsien Loong

Singapore's Smart Nation initiatives aspire to make the city-state the world's first smart nation by 2025. In 2014, Prime Minister Lee Hsien Loong introduced the Smart Nation initiative in a speech. "Support better living, stronger communities, and generate more opportunities for all" is the mission statement of the national initiative. It also consists of two components: 1) the improvement of people's lives and 2) the creation of new economic opportunities. Lee further addressed that the Smart Nation initiatives allow citizens to connect through adopting smart devices, enhancing economic productivity, and exploring new technology opportunities. The government's earlier efforts to 'e-government' program served as the foundation for today's Smart Nation initiatives. It started with the introduction of the Civil Service Computerization Programme in the late 1980s, which was followed by the IT 2000 Strategic Plan (1992), the iGov 2010 Plan (2006), the Smart Nation Initiative in 2014, and the eGov Masterplan in 2015 (Figure 3). Throughout the development of the e-government initiatives, the earlier Programmes and Plans focused on enhancing efficiency in delivering public services. Contradictory, the current Smart Nations initiative was much more comprehensive, which seeks to digitise all aspects of urban life in Singapore through partnerships with the business sector, the non-profit, and civil society.

Figure 3: Timeline of e-government initiatives (NUS, 2017)

The Smart Nation Initiatives of Singapore consist of three pillars: 1) digital society, 2) digital economy, and 3) digital government. Singapore's goal is to develop into a top-tier, technologically advanced city-state. By applying technology to transform how its people and business live, work and play, Singapore is developing into a Smart Nation. Digital society is the first core component of the Smart Nation Initiatives. The Digital Readiness Blueprint (2017) maps out that Singapore will empower all the cities in the digital society by making technology more accessible to every Singaporean, improving Singaporeans' digital literacy, helping the local community and business drive widespread adoption of technology, and designing inclusive digital service. The digital economy is another key element of the Smart Nation initiatives. The Digital Economy Framework for Action (2018) illustrates that the country's government aims to accelerate Singapore's economic growth by digitalising industries and business, to develop an ecosystem to help enterprises to stay vibrant and competitive, and transforming the Infocom Media industry to be a key growth driver of the digital economy. Digital governance is the third pillar of the Smart Nation Initiatives. The Digital Government Blueprint (2020) addressed 24 key performance Indicators to measure the Singaporean government's digitalization progress. Amid the COVID Pandemic, new policies were added, for instance, developing digital tools for contact tracing and safe reopening of Singapore's economy (Smart Nation Singapore, 2022).

Singapore's Smart Nation initiatives are being implemented through eight strategic national projects: GoBusiness, CODEX, E-Payments, LifeSG, National Digital Identity, Punggol Smart Town, Smart Nation Sensor Platform, and Smart Urban Mobility.

Project	Description
CODEX	A shared digital platform between government agencies and private sectors to develop better, faster, and more cost-effective digital services.
E-Payments	It is to make financial transactions more seamless and efficient for all, we're constantly working towards a simple and secure platform that operates across various systems.
LifeSG	It allows you to easily access Government services, keep up with the latest news and updates, track your applications and more.
National Digital Identity	Singpass, the National Digital Identity (NDI) initiative, provides a convenient and secure platform for users - both citizens and businesses - to transact with the Government and other private service providers.
Punggol Smart Town	Bringing together residents, businesses and students, Punggol is slated to become a thriving, tech-enabled, sustainable town showcasing our Smart Nation ambitions.
Smart Nation Sensor Platform	SNSP is an integrated, nationwide platform that uses sensors to collect essential data that can be analysed to create smart solutions.
Smart Urban Mobility	We use digital technologies to find smart solutions that enhance our public transport system and provide greater comfort, convenience, reliability, and support for our vision of a car-lite Singapore.

Laos

There is not a specific smart city framework published by the Laos government, yet national policies acknowledge that Smart City movement is part of a larger agenda of sustainable urban development, alongside green growth, climate resiliency, and innovation and industry.

In its latest Five-Year National Socio-Economic Development Plan (2021-2025), the Laos authority focuses on six sustainability and quality-of-life outcomes covering aspects of economic growth, quality of human resources, well-being of people, environmental protection, cooperation and integration, and public governance and administration. Smart city is one of the priority activities for regional and international integration. The government wants to develop cities along various economic corridors and the capital city as they have economic potential to become centres and support the development of other surrounding towns.

Examples include the AMATA Smart City modern urban development project in Luang Namtha and Oudomxay Provinces, and Smart City construction projects in Nongpan Village,

Naxaithong District, Vientiane Capital. Latest news show that the AMATA project will start construction early in 2022 and potentially expand to 20,000 hectares in following phases (Apisitniran, 2022). The Vientiane Capital has also reserved plots of land for a smart city initiative that will turn the place into a new urban centre, providing better city services and living experiences for citizens. The plan aligns with the Urban Development Strategy 2030, which is a main reference for infrastructural developments and protection of national heritages. The plan aligns with the Urban Development Strategy 2030, which is a main reference for infrastructural developments and protection of national heritages.

The document also mentions the need of greater regional integration through the expansion of economic centres along main transport corridors. Therefore, smart city projects can be seen as part of the development of Special Economic Zones which attempts to transform Laos from a landlocked country to one that is land-linked.

[Shutterstock/No. 1797227446]

The main public actors in urban planning include the Ministry of Public Works and Transport (MPWT), the Ministry of Planning and Investment (MPI), the Ministry of Natural Resources and the Environment (MoNRE). At sub-national level, there are Division of Public Works and Transport (DPWT), Office of Public Works and Transport (OPWT), Urban Development Administration Authority (UDAA). These actors manage the planning, legislation, investment, and implementation of urban plans (Epprecht, et al., 2018). Apart from engaging in national policy dialogue, working with other tiers and sectors are also vital in urban development for Laos due to shortage of finance and techniques. International actors like Asian Development Banks, companies from other Asian countries, and regional networks like the ASEAN Smart City Network thus engage in Lao's smart city development.

The Philippines

Smart cities in the Philippines are fast-emerging. Although the government has not enacted a specific smart city guideline, several policy documents have been published to guide smart city development. They mainly focus on innovation & industry 4.0; ICT ecosystem development; e-government building; and socio-economic development and green growth.

[Pexels/Marfil Graganza Aquino]

Among all the documents, The National ICT Ecosystem Framework 2019 is paramount in setting out the country's latest ICT plans, strategies, and initiatives. It aims to address: (i) Inadequate Skills and Mismatch of Competencies; (ii) High Cost of Access and Devices; (iii) Disaggregated Platforms (Apps/Services, Data/Content); (iv) Lack of Infostructure; and (v) Outdated Standards, Regulations, and Policies. Six strategic thrusts were laid out to tackle these challenges, such as the development of regional ICT industry, participatory e-governance, connectivity projects, information security legislation and system, wider ICT applications on emergency and crisis response, and digital upskilling of workforce. Other important policies include E-Government Master Plan 2022 and the Inclusive Innovation Industrial Strategy (i3s), which respectively guide ICT initiatives to establish a digitised government and industry 4.0 technology to promote industrial innovation and linkages. These key policy documents, frameworks, and masterplans cover different facets of smart city, and form the political aspect of the smart city ecosystem in the Philippines.

The smart city agenda is further accelerated by the Digital Cities program, launched by the Department of Information and Communications Technology (DICT) in 2020. It aims to transform 25 priority cities into innovation and IT-based hubs through nationwide public-private partnerships. It will boost digital economy as a main driver for Philippine economic growth. In July 2021, 9 cities have completed and launched their five-year roadmaps, releasing more specific strategies and implementation plans (DICT, 2021). Additionally, the adoption of e-governance technologies has also grown vigorously in Philippines. Since 2019, the City Baguio has been integrating ICT technologies into government services and become the first in the country to have a united digital governance, surveillance, and emergency response system (Philippine Daily Inquirer, 2021). Cities like the New Clark City, Cebu, Davao, and Manila have also laid the groundwork to utilise e-governance technologies to make their areas smarter (Manila Standard, 2021).

The Philippines' smart city ecosystem involves stakeholders from the private, civil, and public sectors. Large telecoms, IT solution providers, and developers often act as service providers and project leaders in driving smart city projects. In Baiguo again, private companies have contributed to the realisation of the city's smart agenda, this includes Cisco, MultiSys Technologies Corporation and other companies who assist local government units (LGUs) through software development and system integration. Associations and academia also support the development and innovation of policies and programs. The National ICT Confederation of the Philippines is a recognised national organisation of ICT councils. It has been a strong champion for country-wide digital development and various ICT policies including the creation of DICT.

The Digital Cities program has also planned to invite industry experts as ambassadors to help strengthen the influence of IT-BMP sector in national economic growth. Among all the governmental agencies, DICT and the Department of Science and Technology (DOST) have been taking leading roles in driving policies and projects related to digital infrastructure and smart city. DICT authorises policies and programs to support digitised economy and governance. It guides local governments to create a Smart City agenda to participate in the national ICT ecosystem and propagates the codes and regulations for applying ICT to smart city projects. The DOST supports the smart city movement through its DOST Framework for Smart Sustainable Communities and Cities, which aims to enhance research collaboration and fund excellent research to address urban challenges. In addition, DOST conducts self-research and partnership research on various technologies such as remote sensing, artificial intelligence, and many others.

Apart from these actors, Philippines also partners with other countries. Japan has collaborated with Philippines in the development of the New Clark City through its Japan External Trade Organization (Umali, 2018). China has also invested in the New Manila Bay under its Belt and Road imitative to create a new smart city on a man-made island (Espejo, 2017). Through the Global Future Cities Programme (GFCP), the United Kingdom government wants to bring UK companies in the field of urban innovation to Philippines to create business opportunities and drive smart city development. Overall, there are multiple stakeholders involved in Philippines' smart city programs (Arup, 2021).

Case study: Cebu smart mobility projects

[Pexels/Stephan Audiger]

Cebu is Philippines' second biggest metropolitan area after Metro Manila, with an approximate population of 2.9 million. Cebu metropolitan area consists of Cebu City and 12 surrounding cities and municipalities, and is growing rapidly as a major trade, commerce, and industry hub. Cebu's rapid growth has placed immense pressure on its transportation infrastructure, causing traffic delays and congestions that generate inefficiencies and risks of accidents (USTDA, 2021). As a pilot city of the ASEAN Smart Cities Network, Cebu has focused its smart initiatives on public safety and on smart mobility.

Cebu is working on an integrated intermodal transport system, which will include a Bus Rapid Transit (BRT) system, a monorail, and a cable car (Israel, 2019). The whole system is set to transform public land transportation and reduce traffic congestion in the metropolitan area. The BRT system is expected to become 'fully operational' by 2023 (Lorenciana, 2021). A fully integrated cashless payment system for Cebu's mass transit system is also in progress (Villamar, 2018). In 2021, the city's largest bus terminal has centralised an automated ticketing system to reduce queuing and congestion during peak travel times (Vivomigsgee, 2021).

The project is planned and coordinated by the Department of Transport (DOTr) and Cebu LGU. The project has received funding from the World Bank and French Development Agency (AFD). In 2021, DOTr has also signed a grant agreement with the United States Trade and Development Agency (USTDA) to receive funding and technical assistance for the development of an Intelligent Transport System (ITS) master plan for Cebu City. ITS is a system that integrates CCTV and AI software to spontaneously capture and record traffic conditions and violations. It can also be combined with facial recognition technology to address crime cases (Erram, 2018).

Malaysia

[Pexels/Khairi Harry]

The Malaysia Smart City Framework (MSCF) was published in 2019 which streamlines and coordinates the development of smart cities in Malaysia. It positions smart city as a new way to manage urban matters and meet national agenda. The document includes the smart city definition in the context of Malaysia, which comprises smart economy, smart living, smart environment, smart people, smart government, smart mobility, and smart digital infrastructure. 92 initiatives are proposed and 30 of them have been identified as the priority initiatives. They mainly focus on internet and 5G connectivity, cashless payment, efficient public transport, energy-efficient community, and smart waste management and water treatment. Examples include adopting A.I and IoT Sensors for data collection, traffic management and pollution tracking, enhancing the usage of e-payment, boosting city wide electric bus fleets, and more.

The implementation of the smart city development is divided into three phrases: Foundation stage from 2019 to 2020, Development Stage from 2021 to 2022, and Advanced Development and Monitoring Stage from 2023 to 2025. Five cities have been selected as pilot project areas, which are Kuala Lumpur, Johor Bahru, Kota Kinabalu, Kuching, and Kulim. At sub-national level, some states have developed their own smart city framework in line with the MSCF,

including Smart Selangor Blueprint, Penang2030, Sarawak Digital Economy Strategy. Some cities such as Putrajaya and Cyberjaya have developed more local level guidelines.

There are many projects going on under various pillars of Malaysia's smart cities. For instance, the government aims to implement the Electronic Medical Record (EMR) system to digitise the lifetime health records of citizens and share the data across different health facilities (Rozlan, 2021). The initiative is part of the 12th Malaysia Plan and contributes to the development of smart living. The government also focuses on smart digital infrastructure as it is prioritising Cyber Security Strategy 2020-2024, a comprehensive strategy to prevent cyberattacks through public-private partnerships and bilateral and multilateral relationships. On smart government, the Malaysian government have conditionally granted Amazon Web Services (AWS), Microsoft, Google Cloud, and Telekom Malaysia to build and manage hyperscale data centres, which will empower the digitalisation of public sector through more effective data collection and management (Kaur, 2021).

Multi-stakeholder approach is seen in the implementation of MSCF as initiatives often require multiple key implementing agencies. For example, to increase city-wide electric bus fleets, the Ministry of Transport, local authorities and transport operators, green tech companies, and electric utility companies must collaborate to introduce and promote electric vehicles for smart mobility. Among all agencies, the Ministry of housing and Local Government (KPKT) and the Ministry of Communications and Multimedia Malaysia (KKMM) play a leading role in addressing smart city agenda (Arup; Think City, 2021). KPKT sets the MSCF and oversees the implementation of smart cities in Malaysia. KKMM is the ministry that manages all ICT and digital economic-related infrastructure and technologies. It is in charge of the Malaysian Communications and Multimedia Commission (MCMC) and the Malaysia Digital Economy Corporation (MDEC), which are at the forefront of driving 5G connectivity, digital economy transformation, and other national smart city initiatives. Other important actors that facilitate smart city projects include regulators and facilitators such as PlanMalaysia and Urbanice (under KPKT), practitioners and associations, enablers and providers, and financial and investment institutions.

Brunei

Brunei Darussalam aims to become a 'Connected Smart Nation' through digital transformation. One of its most important frameworks is the Digital Economy Masterplan 2025, which outlines strategies for Brunei to become a Smart Nation. Specific projects include developing the public transport information system, national business service platform, school network infrastructure and halal certification system. The main emphasis of the Digital Economy Masterplan 2025 has shaped the Strategic Plan for Ministry of Transport and Infocommunications (MTIC 2025). The MTIC 2025 communicates the vision for the transport and info communication sectors from 2020 to 2025, which aims to utilise technology and connectivity to spur innovation and improve the lives and needs of citizens and businesses for continued national development. The Authority for Info-communications Technology Industry (AITI) Strategic Plan 2025-2025 is also aligned with the above plans to focus on developing the digital industry to a new level to enable ubiquitous connectivity for the nation. These plans, in overall, contributes to the three

goals of Brunei Vision 2035: having educated, highly skilled and accomplished people; high quality of life; and dynamic and sustainable economy.

[UNESCAP/CKMS]

Network infrastructure development is one of the key priorities today for Brunei's smart nation-building. In 2019, the country consolidated all telecommunication services from existing providers to modernise all the transferred networks and expand coverage to underserved areas (The Scoop, 2019). The Unified National Networks (UNN) was formed as a result of the endeavour.

By September 2021, 54% of the country's base stations has been modernised (four carriers for 3G and up to five 20MHz carriers for 4G) (Oehler, 2021). 65% of the population is covered. The 5G network was also launched in April 2020, supported by the MTIC and AITI, and is carrying out trials in selected hot spots like the University of Brunei Darussalam. The National 5G Task Force sets the target to rollout 5G services by mid-2022 (Bakar, 2021). Additionally, the country is also conducting Electric Vehicles pilot projects from 2021 to 2023 to assess the marketability and the preparedness of potential customers in Brunei (The Star, 2021). This is aimed at achieving the objectives of 'Strategy 3: Electric Vehicle' under the Brunei Darussalam National Climate Change Policy (BNCCP) (TheStar, 2021).

The MTIC is a key player in facilitating the above plans and projects. Since 2020, its role has expanded to include cybersecurity, e-Government, and science and technology. This implies that it will monitor the initiatives of the Digital Economy Masterplan 2025. Other departments such as the Ministry of Primary Resources & Tourism, Ministry of Education, Ministry of Finance & Economy, and Ministry of Energy also are in charge of smart national-building projects in their jurisdiction. The smart city planning is overall centralised in Brunei, with private-public partnerships in local ICT development.

Thailand

Smart city becomes an important strategy for national development when the Thai government launched several strategies and plan since 2016, including the Thailand 4.0 policy in 2016, the 20-year National Strategy (2017-2036), and 12th National Economic and Social Development Plan (2017-2021).

[Pexels/Nextvoyage]

Thailand 4.0 is a national agenda that aims to transform the kingdom into a high-income nation with vastly improved quality of life in urban centres. The use of industry 4.0 technology is emphasised in shifting the country towards national 'prosperity, security, and sustainability'. This encompasses the Easter Economic Corridor (EEC) Development Plan that seeks to revitalise the eastern seaboard with innovation-driven industries like biochemical, automation and robotics, aviation and logistics, and digital economy. Under this framework, digitalisation of workforce and services has been incorporated into nearly all other strategies and plans. Additionally, in accordance with Thailand 4.0, the country aims to achieve 100 smart cities by 2024. The implementation of smart city is mainly overseen by the Ministry of Digital Economy and Society (MDES) which established the smart city pilot city programme.

The Digital Economy Promotion Agency (DEPA), which supports and promotes the development of digital industry and economy, was formed under MDES, and became the main guiding body of smart city movement in Thailand. Besides, the Office of the Board of

Investment (BOI) offers various incentive programs to support stakeholders to engage in approved smart city projects. To be eligible for financial support, projects should meet at least two of seven development aspects: smart environment, smart economy, smart mobility, smart energy, smart people, smart living, and smart governance (The Bangkok Post, 2021). The proposals of smart city programs also need to be assessed by depa's Smart-city Office, the Ministry of Energy, and the Office of Transport and Traffic Policy and Planning. To date, 10 cities in seven provinces have been approved, namely Phuket, Chiang Mai, Khon Kaen, Chon Buri, Rayong, Bangkok, and Chachoengsao.

Smart city candidates should also determine whether the city is transforming into a 'smart liveable city' or a 'smart new city'. A 'smart liveable city' incorporates technologies and innovations as needed by its residents or specific contexts. For instance, Phuket cities are focusing on the development of smart tourism and public safety in local communities, deploying citywide free high-speed Wi-Fi and CCTV cameras with analytical capabilities to improve people's experiences and mobility on the island (NationThailand, 2018). A 'new smart city' focuses on the development of land and labour, and new opportunities in line with national policies, such as in the case of EEC. EEC spans Chonburi, Rayong and Chachoengsao provinces, and is piloting Smart Mobility, Smart People and Smart Economy projects. In Thailand, different cities materialise smart city developments in contrasting ways. Most cities blend their cultural and traditional resources with technologies and infrastructures to provide residents with greater convenience.

## Case study: Adoption of 5G services in Thai healthcare system to combat the coronavirus

During the novel COVID Pandemic, the introduction of 5G commercial service has considerably accelerated Thailand's digital healthcare transition to combating the coronavirus. Thailand was the first ASEAN member state to introduce the 5G service in 2020. After the outbreak of the Pandemic, the demand for telemedicine and hospital robotics increased dramatically. The gradual introduction of 5G commercial service at hospitals equipped thousands of Thai medical personnel fighting against the healthcare emergency.

Sri Racha is Thailand's first 5G Innovation Centre and testbed in the EEC. Thai 5G commercial service establishment strategy consists of three segments: 1) immersive experience, 2) for everything, and 3) instant action. To achieve these goals, the Kasetsart University at Sri Racha provided technical support to develop enhanced Mobile Broadband, massive Machine Type Communication, and Ultra-Reliable and Low Latency Communication. Since then, the 5G service has been widely adopted in manufacturing, medical and healthcare, and autonomous vehicle development to enhance Thai smart cities transition.

With 42 million subscribers in the country, the biggest mobile operator - Advanced Info Service (AIS), has introduced 5G networks at158 hospitals in major cities of Thailand since 2020. During the Pandemic, 5G-operated robots are adopted in hospitals to provide telemedicine service and reduce face-to-face interactions between patients and doctors.

Like AIS, the other top telecommunication company - True Corp, facilitated its 5G network at major hospitals in Bangkok, Chiang Mai, Khon Kaen, and Phuket. Thanks to the 5G internet service, delivery robot, remote cart, and quarantine telepresence are introduced in the hospital, lowering the risk of infection for patients and medical staff. In this global public health emergency, commercial mobile operators in Thailand have taken their corporate social responsibility to become digital infrastructure providers. They provided sufficient measures and efficient devices to reduce risks caused by direct contact in the hospitals and help the country move from the Pandemic Crisis.
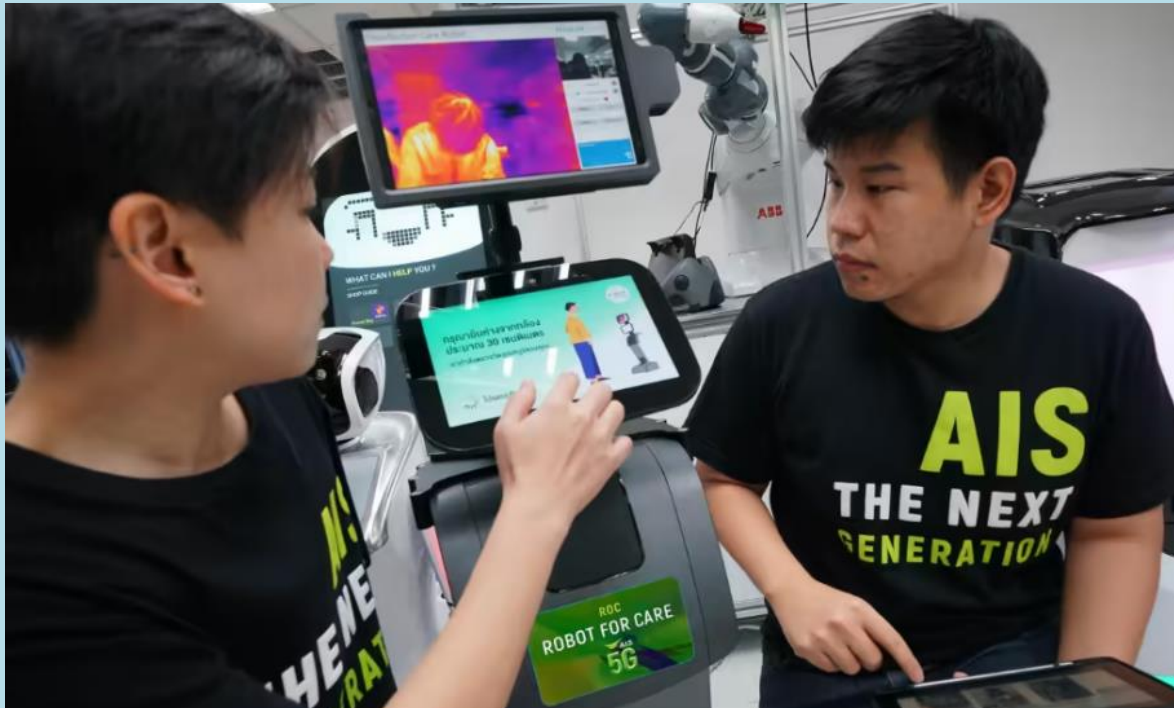
5G-operated robots at Thai hospitals during the COVID Pandemic. Source: Nikkei Asia.

The deployment of 5G commercial service in Thailand, specifically the adoption of IoT, has accelerated the smart cities transformation and boosted the digital capacity of Thailand's urban management ecosystem. The IoT market in Thailand is forecast to grow to 2.19 billion US dollars by 2030. Before the introduction of the 5G network in Thailand, IoT was merely adopted in the logistics and transportation industries. After 2020, IoT has been gradually appearing in smart healthcare innovation, smart governance development, smart building construction, and smart education planning. Hence, the introduction of the 5G network and the application of IoT not only provided capacity building for the country to overwinning the COVID Pandemic, but also enhanced Thai cities' sustainable development in the long run.

Indonesia

Indonesia started its smart cities transformation in 2013 with Bandung, the capital of West Java, creating the first-ever city-command center in Indonesia, followed in 2014 by the country's current capital, Jakarta, developing its own system.
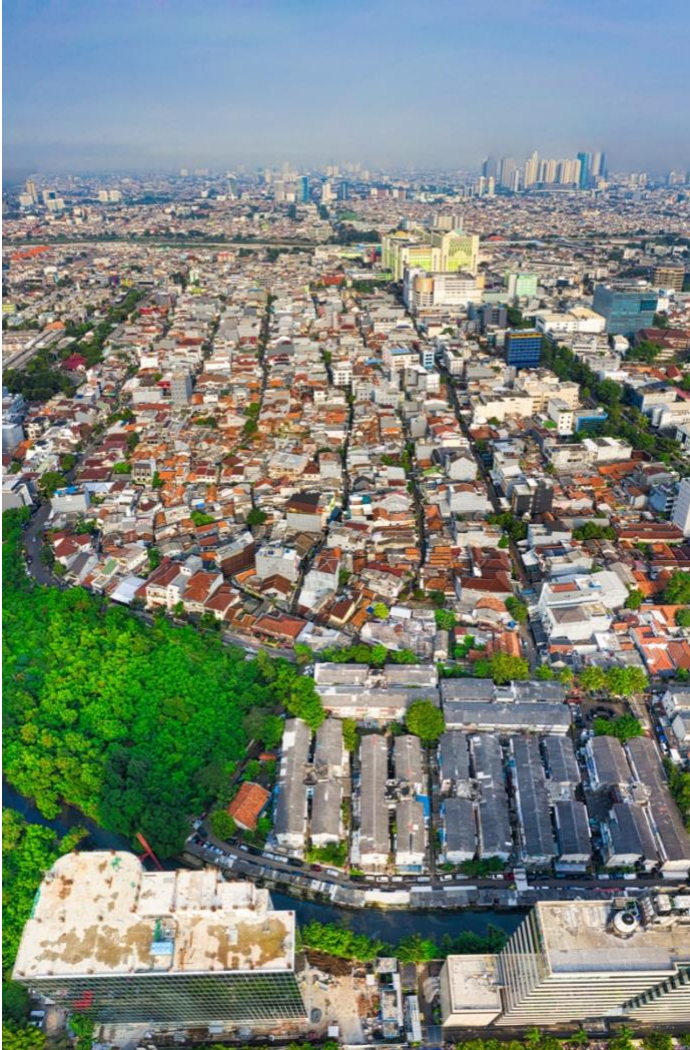
[Pexels/Tom Fisk]

Large-scale planning for smart city growth began with the introduction of the nationwide Smart Cities Movement in 2017, which aims to create 100 smart cities within the country by 2045, focusing on pillars such as information, infrastructure, and implementation. These are all made possible through private-public sector cooperation and partnerships that utilize digital solutions such as Artificial Intelligence, Machine Learning, and the IoTs to address technology and efficiency gaps in education, government, business, and other sectors. Indonesia's central government has issued a grand design along with regulations and enforced a strategic national project to support this endeavour. The dynamic landscape, diversity, and rapid urbanisation growth of Indonesian cities have created a unique yet challenging approach for each city in realising this concept, as many cities are facing major challenges to tackle the implementation phase.

To sustain the mission of developing smart cities, Indonesia has identified several primary areas that will drive growth. Indonesia will look to leverage its technology engaged population and high volume of start-ups, while further bolstering efforts through national to municipal government initiatives.

As it stands, Indonesia's emerging economy currently has 2,209 start-ups operating within the country, and by 2024 the Indonesia Ministry of Research Technology is forecasting a total of 4,500. Moreover, the Indonesian government is planning to invest heavily in infrastructure wherein a budget of approximately 400 billion USD will be spent across several projects. Examples of national to municipal governmental expenditure and support can already be seen in initiatives such as the Strategic National Project (SNP), and West Java's provincial government adoption of the smart cities developmental plan.

For the problem of lacking the fund, early in 2019, there has been some help at hand for the smart city project in Indonesia. Asian Development Bank (ADB) has been tasked with managing ASEAN-Australia Smart Cities trust fund, which focuses on building livable cities that are green, competitive, inclusive, and resilient. Moreover, the World Bank and the Swiss

government have also established a US $13.4 million Indonesia Sustainable Urbanization Trust Fund (IDSUN) (2016-2022). Swiss Ambassador to Indonesia Yvonne Baumann said that the IDSUN fully supported Indonesia's effort to prioritise sustainable urban development. Besides, the non-government cooperation route could also be an option. Qlue was awarded a grant project from the Global System for Mobile Communications Association (GSMA) to empower three cities in Indonesia to become smart cities in 2019.

Indonesia hopes to replicate and use the successful transitions of Jakarta and Bandung toward smart cities as a blueprint. As the centre of urbanisation in Indonesia, Jakarta has adopted the concept since 2014. In that year, the governor of Jakarta promoted the smart city by raising issues of governance, mobility, environment, and community service. Since then, Jakarta has been building an integrated management system throughout the public sector by utilizing information and communication technology by working with private parties and academics. There are various programs planned to achieve Smart City.

It is a challenge for Jakarta as a transitioning city, namely a city experiencing a high level of urbanisation, so it requires necessary infrastructure and smart infrastructure for city development. To meet these needs, the Jakarta government has built a system using the Smart City Wheel Framework that allows Jakarta to transition from its current state to the desired condition to become a Smart City before 2025. Jakarta adopts six Smart City categories: smart living, smart mobility, smart governance, smart environment, smart economy, and smart people (Salsabila I Syalianda and Ratih D Kusumastuti, 2021).

As Indonesia's capital city, smart city development in Jakarta has manifested in several ways. For example, the city has created a mobile application named JAKI wherein citizens can freely access public information and service. Other initiatives include the installation of CCTVs and traffic lights with ACTS capability across main roads, integration of e-commerce and unicorn start-ups to boost Smart Economy, and the creation of Jakarta Smart City, a body dedicated to ensuring successful implementation of the smart city.

In Bandung, smart cities technology can be seen in the creation of a command centre which monitors major city operations, or even in the improvement of public infrastructure via the implementation of smart parking and a bike-sharing system. Projects aimed at empowering citizens have also been initiated as evidenced by the construction of a creative hub and MSMEs (Micro, Small and Medium Enterprise) centre (YCP Solidiance, 2021).

Case Study: Jakarta Kini (JAKI)

In the era of industrial revolution 4.0, smart city technology can help city governments operate more efficiently while improving services to citizens. It is agreeable that the definition of a smart city is still changing. However, a few things have become clear: smart cities manage information and communication technologies to enhance service levels. Other than that, a smart city enables the improvement of citizen well-being, sustainability, and economic development. Jakarta, as the capital city, tries to answer the citizen's need to solve problems as fast as they can, through an application called Jakarta Kini (JAKI).

Implemented by Jakarta Provincial Government and Jakarta Smart City Management, JAKI was launched in November 2019. As of October 2021, the app has a rating of 3.8 stars in the Google Play store, based on over 8400 ratings. Also, it was awarded with "Best in Future Digital Innovation" by the International Data Corporation (IDC) of Indonesia on October 8, 2021. And as of October 25, 2021, the Jakarta app is now not only useful to the citizens of the province, but also tourists.

The integration of government services in a megacity whose metropolitan area covers 6,392 square kilometers presents complex problems. The sheer amount of data involved in providing such services required infrastructure that was unsustainable during the early 2000s. With the arrival of technological advances in mobile computing, the consolidation of all necessary information while including functionality for citizens became both achievable and sustainable in the long term.

Source: Jakarta Kini (JAKI)

The Jakarta local government tested the waters of citizen engagement through mobile applications with Qlue in 2016 and the Citizen Relationship Management (CRM) App in 2017. However, both almost exclusively dealt with non-emergency complaints and concerns and did not utilize information functionalities. Developed by the Jakarta Smart City Management, the Jakarta Kini (JAKI) App is a one-stop solution mobile application for a variety of local government services.

The Jakarta Smart City Management introduced the Jakarta Kini (JAKI) App to its citizens in November 2019. The platform features broad multifunctionality, providing 14 distinct functions as of October 2021:

• JakWarta: an official news source directly from the DKI Jakarta Provincial Government

• JakLapor: a rapid community response platform with geo-tagging features where residents can report crimes

• JakRespons: a tool where residents can monitor the status of their complaints and assess the response to said complaints

• JakISPU: a tool that presents location-specific Air Pollution Standard Index (ISPU)

• JakSurvei: a platform where residents can rate public services and participate in other related surveys such as those about policies, facilities, and other official matters

• JakSiaga: a directory of emergency hotlines that is updated automatically

• JakApps: a collection of all the online services by the DKI Jakarta Provincial Government

• JakPantau: a tool for monitoring the weather, river flow, and floodgate information

• JakPangan: a tool for calculating food prices where the prices are constantly updated

• JakSafe JAKI: a tool for reporting when one is in a dangerous situation like an accident, medical emergency, criminal event, and alike

• JakSekolah: a collection of learning materials and classes for education levels kindergarten through high school which the general public may access.

• Jako: a one-stop access to the five different applications which have collaborated with the DKI Jakarta Provincial Government, namely Bukalapak, Gojek, Grab, Shopee, and Tokopedia

• JakServ: a day-to-day virtual aide that primarily contains the departure and arrival schedules of buses at the Pulo Gebang Integrated Terminal

• JakPenda: a tool for checking and calculating citizens' taxes

• Jejak: a tool that monitors visitors' movement in and out of specific buildings via the scanning of QR codes

• Chatbot: a Java virtual assistant that can provide information about population, emergencies and disasters, health and COVID-19, social aid, vaccination, reporting channels, and other government services.

• JakWifi: a tool for finding free public Wi-Fi in Jakarta

• Tes-Mandiri: a platform that can access the Corona Likelihood Metric (CLM) self-assessment tool that evaluates a citizen's possible risk of contracting COVID-19

• Zonasi: a tool to detect the risk level of COVID-19 surrounding the citizen.

JAKI integrates various public services in the Jakarta municipality and provides enhanced functionality and citizen engagement which ties directly and efficiently to the relevant platforms. The COVID-19 pandemic has also pushed the JAKI team to add crucial functionalities such as contact tracing and free distance learning. This speaks to a potential for flexibility on how local governance can be consolidated with pandemic response (GOVPH, 2022).

Cambodia

The Cambodia Digital Economy and Society Policy Framework sets out the vision of "building a vibrant digital economy and society to accelerate new economic growth and promote social well-being based on the path of new normal". This vision is to be achieved in 15 years, from 2021 to 2035, and in line with three principles: "Building Digital Foundations- Digital Adoption- Digital Transformation".

At the policy level, 44 specific policy measures have been set out to build two foundations: (1)- developing digital infrastructure focusing on digital connectivity, financial technology infrastructure and digital payment systems, and logistics and last-mile delivery; and (2)- building trust and confidence in digital systems focusing on responsive and effective legal frameworks and strengthening digital security management. 82 policy measures have been

put in place to strengthen the three pillars, including (1)- building digital citizens focusing on digital leadership, pools of talents, and digital citizens, (2)- building digital government focusing on digital government and public services, keys to boosting digital performance, and data-driven governance in the public sector, and (3)- enabling digital businesses focusing on enterprise transformation, entrepreneurial and start-up ecosystems, and the digital value chains. The policy framework also considers 13 necessary measures to ensure inclusive participation in the digital sector, as well as to absorb, mitigate, and address the impacts of new trends stemmed from digital technology on the economy and society. These include changes in the structure of the workforce and labour; changes in tax revenue; increased state spending; impacts on culture, tradition, and communications; the loss of personal data; and cybercrime.

[Pexels/Monyserei Ra]

At the same time, to promote the implementation of policy measures and monitor the achievement of the objective of digital economic and social transformation, Cambodia has decided to establish the "National Digital Economy and Society Council", which is a permanent and top-level institutional mechanism to monitor, to provide directions, to set new policies, and to coordinate relevant institutions to implement the Cambodia digital economy and society policy framework. The General Secretariat of the National Digital Economy and Society Council will be established to be responsible for coordination and communication. This National Council has three committees: the Digital Economy and Business Committee, the Digital Government Committee, and the Digital Security Committee, which are responsible for the technical works. The National Council also has an "Advisory Board for Digital Technology" to provide technical inputs. However, the implementation of this policy framework requires the participation of the relevant ministries and institutions, the private sector, and all citizens with the spirit of ownership, cooperation, and high responsibility.

For the city selection in Cambodia, Phnom Penh, Battambang and Siem Reap have been selected to take part in ASEAN's Smart Cities Network, which was founded during the 32nd summit of the 10 Southeast Asian nations in 2018. They will work on reaching ASEAN's common goal of achieving smart, sustainable urban development in 26 cities around the region by 2025 (Cambodia, 2021).

Case Study: Smart Siem Reap supported by Japan ASEAN Mutual Partnership

In 2021, The Japanese International Cooperation Agency (JICA) drafted a smart city master plan for Siem Reap city in Siem Reap province, home of famed Angkor Wat Temples, to become a model smart city in ASEAN.

JICA's expert team started the feasibility study in 2020 for the smart city at the request of the Siem Reap provincial administration. According to the feasibility study, the draft smart city roadmap focuses on four main areas – Smart Tourism, Smart Security, Smart Mobility and Management, and Smart Waste Management.

[UNESCAP/CKMS]

The master plan will contribute to transforming Siem Reap city into one of the Smart Cities in the ASEAN Region. Siem Reap is a historical and cultural province in Cambodia, a tourist destination that contributes to the national economy, and in the future, it will make Siem Reap a model city in the ASEAN region, a smart city with technology. The smart management will also contribute to the development of Siem Reap (Vanyuth, 2021).

After Siem Reap city was included in the ASEAN Smart Cities Network in 2018, the Siem Reap Provincial Administration began working to increasing public urban infrastructure projects to facilitate people's travel, enhance the beauty of the city, as well as implementation of ASEAN Smart City Development Plan. The smart city project from JICA will not only make the city a smart city but also build the capacity of human resources for local officials and authorities to take on technology and digital management skills.

The survey by JICA also aims to examine and propose a roadmap for Smart City, which includes programs of solutions introducing advanced technologies to solve the urban problems of the five key sectors.

Based on the survey, there are also projects raised to promote smart city solutions. For example, the JICA focused on the water supply problem in Siem Reap.

As demands for safe water in the city of Siem Reap have been rapidly increasing due to the sharp-growth of population and surge of tourists around Angkor archaeological sites registered on the UNESCO's World Heritage List. Even though SRWSA owns two water purification plants sourcing from underground water and reservoir, the supply volume is still falling behind the demands. In dealing with such problems, commercial establishments such as hotels are forced to pump up ground water by themselves. This has led to a growing concern on the environmental impact including subsidence. In this Package 3 of the project, Kobelco Eco-Solutions is constructing a water purification plant (capacity of 60,000m3/day), the largest in the region, utilizing the Tonle Sap Lake as the water source, which is expected to stabilize safe water supply as well as to contribute to environmental preservation (KOBELCO, 2020).

The Siem Reap Water Supply Expansion Project, which was awarded in December 2019, was under a Japanese Official Development Assistance (ODA) loan granted by the JICA. Following the project commencement in March 2020 and the completion of primary site preparation, the project is progressing smoothly as planned.

In addition to the water supply expansion project, there are also many actions in other areas the Provincial Hall conducting like smart tourism. For example, the Tourism Development Master Plan 2020-2035 by the Ministry of Tourism (MoT) for a new city where it will accommodate high-rise buildings or constitutions. The aim of this development is to support the old city of Siem Reap and a development that will not affect the cultural heritage.

Besides, the development project by the NagaCorp with the vision to promote Angkor Wat and Naga World as twin tourism icons in Cambodia - a tale of two cities which is expected to be completed by approximately 2025. This project will consist of a Naga Water Theme Park, two hotels, a nonmotorized boating canal system with landscaping, a China Town, and indoors interactive Hi-Tech Theme Park (NAGACORP, 2020).

Currently, the Smart City Committee remains as virtual organization and actual action is expected together with progress of existing Smart City related projects. As sectoral development policy, Siem Reap Provincial Administration is currently working on the formulation of a roadmap towards Smart City in Siem Reap with the support of JICA (The Basic Survey for Smart City in Siem Reap).

Viet Nam

Vietnamese cities have been growing twice as fast as the national average rate and contributing over half of the country's gross domestic product (GDP). As such, its urban centres now house 36.8% of the total population, compared to 19.6% in 1999, and that number is expected to reach 50% by 2040. Rapid urbanisation and spatial transformation have been accompanied by a concomitant increase in the provision of basic services and infrastructure.

As Viet Nam's economy developed, so did its cities and core infrastructure. While the country established strong project development processes to meet its infrastructure needs, the spontaneous nature of its urban development has led to challenges. Traffic congestion, pollution, resource shortages and other woes highlight a strain placed on Viet Nam's urban infrastructure, economies, and communities.

[Pexels/Markus Winkler]

Combined with the rising threat of climate change and global pandemics, the challenges of Viet Nam's rapid urbanisation create unique opportunities for smart city technologies. These technologies will further add to Viet Nam's tremendous efforts to address their key urban priorities. One such area of success was Viet Nam's containment of the COVID-19 pandemic. Through its National Response Plan and the establishment of a National Steering Committee on Epidemic Prevention, Vietnam's strict containment and tracing strategy has left its domestic economy in a better state than the rest of the region (ASEAN, 2021).

As part of the Fourth Industrial Revolution, Vietnam aims to develop at least three smart cities by 2020 according to Ministry of Construction. By 2021, 41 out of 63 provinces and centrally run cities in Vietnam have developed projects on smart cities of various scale, in particular Hanoi, Ho Chi Minh City, Danang, Binh Duong, and Nha Trang.

The Vietnamese government has been researching new technologies, of which the realization of the Internet of Things, artificial intelligence and big data is the key to achieving the goal. Smart Urban Development plan (2016-2030) was established with the key focus on transportation, e-government, security, healthcare, and education sectors:

- Phase 1: 2016-2020 – The focus laid on building legal policies and intelligent infrastructure foundation subject to pilot implementation.

- Phase 2: 2020-2025 – Finalization of legal regulations and application of ICT framework to smart cities development. The first phase of pilot implementation will be carried out, taking smart cities into operation.

- Phase 3: 2025-2030 – First-phase pilot is expected to be completed by 2030, forming a network of smart cities nationwide. Hanoi, Ho Chi Minh, Da Nang and Can Tho are subjected to be the core of smart city network in the Northern, Southern, Central and Mekong Delta regions respectively.

Vietnam smart cities development plan anticipates growing interest from foreign investments. In 2018, a joint venture between Vietnam BRG Group and Japanese Sumitomo Corporation resulted in US$4 billion investment for Hanoi Smart City Project. Hanoi's city council has increased its budget to US$127 million to implement smart city plans. While in 2017, Korean Lotte Group signed US$884 million contract with Ho Chi Minh City People's Committee for Ho Chi Minh city development.

In 2018, Ho Chi Minh, Hanoi and Da Nang join the ASCN. Ho Chi Minh aims to be Vietnam first smart city. From now till 2020, the city places great emphasis on big data, cloud computing infrastructure, development of data and security centre. Moreover, it plans to incorporate smart solutions in healthcare, education, traffic management, flood control and food safety. With Hanoi's plan to be smart city by 2030, it focuses on 4 major sectors include education, healthcare, transportation, and tourism. By 2020, Hanoi sets to establish core infrastructure and smart applications while the second phase from 2020 to 2025 will plan to make solutions operational.

Da Nang plans to be a smart city by 2020 and green city by 2025. Currently, it works with FPT, a leading technology corporation in Vietnam on various smart city projects such as traffic systems and natural disaster management. The city as well works on improving public transport and residential management (AIBP, 2018).

Smart Cities in South East Asia during the COVID Pandemic

The outbreak of the COVID-19 pandemic has profoundly changed people's daily lives, causing hardship and suffering with a disproportionate impact on the most vulnerable, and highlighting prevailing inequalities, concerns over governance, and the unsustainability of the current development pathway. The pandemic led to the urgent mobilization of ICT instruments, often using locally developed technologies to address COVID-19, such as in Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam. Technologies such as contact tracing, hotspot localization, contactless delivery service systems, and health monitoring were developed and proliferated among citizen users. Data collection and analysis capacity subsequently increased, providing countries with a more robust information network. Building

upon these advancements, the barriers to smart city solutions have been lessened, providing an opportunity for greater smart city uptake.

During pandemic, cities in Indonesia deployed ICT infrastructure in the fields of smart governance, smart branding, smart economy, smart living, smart society, and smart environment. In 2021, the Indonesian Gadjah Mada University published an article (Rachmawati et al., 2021) examining how smart solutions were applied in five Indonesian cities – Jakarta, Banyuwangi, Makassar, Semarang, and Surabaya to help human settlements combat, mitigate, and overcome COVID-19 (see Table 1). Generally, all five cities prioritized the smart governance and smart living sectors. The five studied Indonesian cities introduced online administrative public service by using ICTs and provided citizens with a user-friendly government. Alongside these initiatives, the cities introduced interactive, collaborative, and visual models for smart education designed to strengthen the ties between students and teachers in remote learning. Smart solutions were also deployed to protect socially vulnerable groups, including pregnant and feeding mothers.

Location of Study	Smart Governance	Smart Branding	Smart Economy	Smart Living	Smart Society	Smart Environment
Province of Jakarta (DKI Jakarta)	• Alpukat Betawi (administrative service) • One-door integrated permit service		• Jakarta Alert for COVID-19 • JakOne Mobile • Jakpreneur	• Safe Jakarta • Qlue (complaint service) • Jaki (Jakarta at present)	• i-Jakarta (digital library) • Tije (Transjakarta) • KRL-Access • MRT-J	• Jaki (Jakarta at present)
Regency of Banyuwangi	• Banyuwangi Smart Kampung • Laman COVID-19 Banyuwangi • Service for Adminduk Dukcapil (ID Documents) • Bunga Desa (Regent at village offices) • Camping Embun (camping services for garden communities) public service mall	Banyuwangi Tourism App	• Innovation on UMKM's side • E-Bilaperdu • Wenak (Warung Naik Kelas /class promotion stall) • A friend of public entreprise • Top farmer • Shopping day at UMKM and public market • Online single submission (OSS)	• Provision of isolation rooms • Stipulation for referred jospitals • Data taking for citizen's mobility as an effort of case tracking in COVID-19	• Program of smart student • Social safety network, nutrience for pregnant and feeding mothers • Data taking and distribution of social aid	• Simpling (online environmental quality assessment) • SIMPEL (online regular environmental report) • Frequent mobile garbage bank /Bagiak (garbage saving)
City of Makassar	• Makassar data open platform • Layanan NTPD 112 • Kucata'Ki	• Mobile story telling • Big Data for tourism human resource (BIASAMATA • Application for job information • Smart library card • e-Pustaka of Makassar	• (SIPAKATAU) Sistem Pelayanan Pajak Online Terpadu/ online integrated tax service system • e-Tax	• Care and rescue center • Home care • DOTTOROTTA • Makassar smart card • Siaga emergency for disaster • SUGISURA • Makassar recover • Website info for Corona Makassar • E-puskesmas	• Information system for data management of citizens with social welfare problems • Movement of 'Touch The Heart' based on forum/discussion • Save the City	• Healthy Lane • Center for street vendors • Garbage bank • Sangkasarung
City of Semarang	• Applications for permits and documents through an online system • Robot public services website siagacorona.semarangkota.go.id, accessed on 24 October 2021 • Musrenbang online • Situation room • SI IMUT (intergrated service system for space and building matters) • One Map	Branding UMKM by making a mask	• Gulo Asem (Application for small- scale industry and UMKM) • Ijus Melon (Online Entreprise Permit) • Authority credit	• Ambulance Hebat • Halo Doc • Universal health coverage	• WiFi provision for society	• Monitoring water and air condition • Zeta Green (air purifier)
City of Surabaya	• Surabaya single window (SSW) • Surabaya against COVID-19 • KLAMPID (Online service for birth certificate, mortality, divorce, etc.), • E-letter • Surabaya's media center • Hotline 112 • E-planning Surabaya		• Application E-PEKEN Surabaya	• E-health Surabaya • SITS CCTV Surabaya	• Website for school admission for new students • Website for online school report card • Website SIAGUS (alertness for teachers) • E-education • Application of Wargaku (my citizen)	

Table 1: Matrix of application and service comparison between the five Indonesian cities during the COVID Pandemic

COVID-19 has indeed created an opportunity for rapid smart city development in Southeast Asia. The use of IoTs and ICT infrastructure in the detection of future medical emergencies in their early stages in now being considered. Investigations on the outbreak of COVID-19 indicated that the virus spread quickly because the initial precautions were not appropriately designed and taken. Such a lack of efficient reaction is even more evident and influential in highly populated cities. In 2020, Costa and Peixoto (2020) introduced a system to detect a potential health pandemic using an IOT system of sensors that can identify a future public health emergency at the early onset stage (Figure 1). The authors propose a key requirement for the success of such a system is the formation of a data-sharing system. Stakeholders from governments, public system, business sector, and civil society need to establish a data sharing system in which IoT sensor infrastructures, public health services, social media, and individual

gadgets can provide and transfer comprehensive data and information relating to the outbreak of an epidemic.
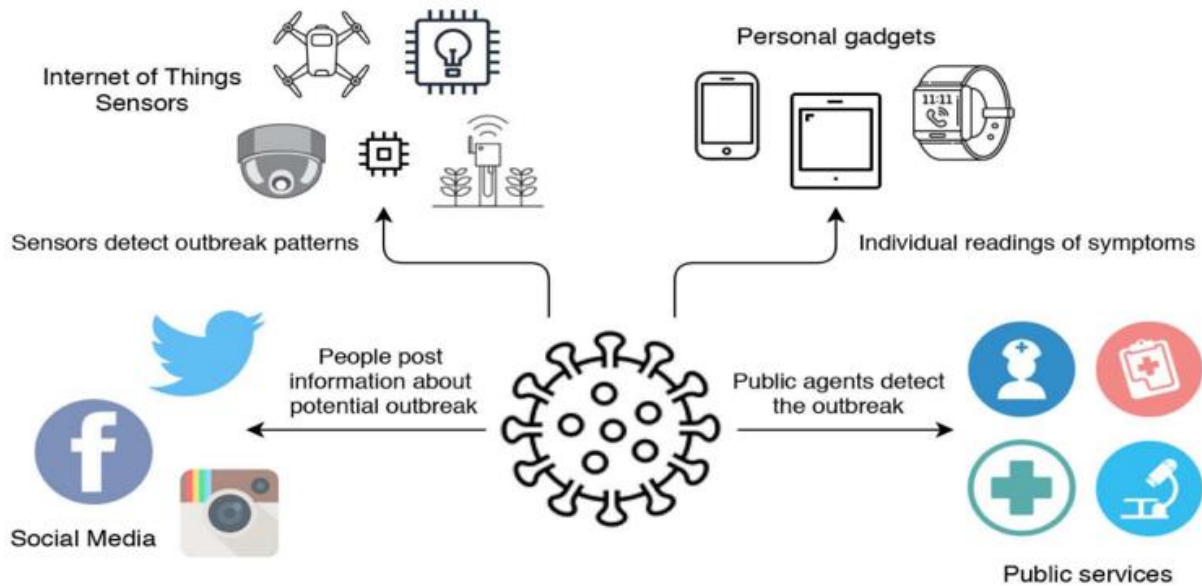
Figure 4: Detection of potential pandemic system by using shared big data from multiple sectors

Figure 5: smart solutions for mitigating the damage caused by a (possible) pandemic

Smart infrastructures can be also adopted to help mitigate the damage caused by the public health emergencies. Worldwide pandemics have shown how fast and dramatic they can evolve and spread, therefore, the response to them must be equally efficient and effective. According to Costa and Peixoto (2021), several resources can be deployed to mitigate the damage caused by a medical emergency (Figure 2), such as:

- Automatised hospitals and healthcare systems: This refers to an intelligent healthcare system where the number of available IC beds, medical staff, and medicines must be managed in advance through processing big data provided by the smart city or employing AI technologies.

- Smart transportation: Processing data provided by the city, affected areas can be rapidly isolated, limiting the movement of people from and to that area. Public transit can also display warning messages and instructions on preventing infection, as seen in many large cities during the COVID Pandemic.

- Response team: Public decontamination, prophylactic isolation, and tracking of potentially infected people are some examples of required responses, which will typically involve public health workers, transit agents, police, and even special response teams.

- Research and innovation: Labs and universities should receive all information from the city cyberspace, supporting a better perception of the disease and medical emergencies. Moreover, the research outcomes should also be transferred to the public services, e.g., guiding the public on how to prevent disease infection.

- Alert and notification: When emergencies are detected, alert and notification should be sent to a greater number of citizens through TV, smartphone, radio, or other digital devices which can immediately deliver the message to the recipients.

Smart City networks in South East Asia

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ASEAN Smart Cities Network (ASCN)

The ASEAN Smart Cities Network (ASCN) is a platform for cities across ASEAN to work together towards the common goal of smart and sustainable urbanisation. The Network is a collaborative platform which aims to unify smart city development efforts across ASEAN by facilitating cooperation on smart city development, creating bankable projects in conjunction with the private sector, and securing funding and support from ASEAN's external partners. The ASCN's primary goal is to improve the lives of ASEAN citizens, using technology as an enabler.

The ASEAN Smart Cities Framework serves as a non-binding guide to facilitate smart city development in each ASCN city, in a manner that is specific to each city's needs and potentials, as well as its local and cultural context. This document articulates the key features of ASEAN's smart cities, by (i) identifying strategic outcomes; and (ii) outlining key urban systems, focus areas, and enablers. This Framework seeks to complement existing national development plans or help to build new ones.

ADB ASEAN Smart Cities Initiative (ASCI)

Launched by ADB in May 2019, the ASEAN Smart City Initiative (ASCI) is financed by the Government of Australia through the ASEAN-Australia Smart Cities Trust Fund with a total of AUD$20 million for technical assistance and small grants. The ASCI focuses on developing digital solutions for cities in three main areas: urban planning, service delivery, and financial management. The activities include mainly capacity building and knowledge sharing, designing proofs of concept, and preparation of grant investments. The Urban Development Working Group discussion focused on identifying entry points for the ASCI with ongoing and future urban development projects in the GMS and looking at eventual city twinning arrangements.

The Urban Development Working Group discussion of ASCI showed the countries' strong commitment towards the goal of developing smart city features as a means towards enhancing city liveability. They identified several next steps, namely the undertaking of pilots in selected cities, with a first batch starting in 2020. The ASCI team of ADB also informed the Urban Development Working Group that it will work with the East Asia Regional Department of ADB on coordinating their work plan with similar smart cities activities planned by ADB for the People's Republic of China.

ASEAN Australia Smart Cities Trust Fund (AASCTF)

The fund is a single-donor trust fund established in April 2019, under the Urban Financing Partnership Facility. The fund adopts an operational focus on building liveable cities that are green, competitive, inclusive, and resilient, consistent with ADB's Strategy 2030 and the ASEAN's Sustainable Urbanisation Strategy which aims to promote high quality of life, competitive economies, and sustainable environments.

The fund will support activities that will enable cities to facilitate adaptation and adoption of digital solutions, systems and governance systems in the participating cities.

U.S.-ASEAN Smart Cities Partnership (USASCP)

The U.S.-ASEAN Smart Cities Partnership (USASCP) launched at the 2018 U.S.-ASEAN Summit in Singapore. The Departments of State, Commerce, and Transportation; National Science Foundation; USAID; USTDA; and others have launched 20 projects to improve transportation, water and resource reuse, and health system capacity for cities in the ASEAN Smart Cities Network (ASCN).

The USASCP is a key component of demonstrating U.S. commitment to ASEAN and its role at the heart of the Indo-Pacific. The USASCP seeks to harness U.S. public and private sector expertise to collaborate with the 26 ASCN participating cities to meet the varied challenges of rapid urbanisation and to help improve the quality of life for people in the region.

The three main goals of the USASCP are to:
1) Promote U.S. private sector engagement in smart, sustainable city solutions and advance capacity of urban service delivery in ASEAN;
2) Share best practices and technical collaboration among U.S. cities, universities, and industry leaders with their counterparts in the ASCN; and
3) Strengthen the digital economy and cybersecurity capability in ASCN cities.

ASEAN-China Leaders' Statement on Smart City Cooperation Initiative

The Heads of State/Government of the Member States of the Association of Southeast Asian Nations (ASEAN) and the People's Republic of China, gathered on 3 November 2019 in Bangkok on the 22nd ASEAN-China Summit and recognised the importance of addressing the challenges arising from rapid urbanisation and developing a regional smart cities ecosystem to harvest the opportunities associated with the ongoing digital and 4th industrial revolution.

The summit recognised the common goals of ASEAN and China to maximise the positive impact of smart cities projects on citizens' lives, including to build a competitive economy, promote a sustainable environment and a high quality of life, and to minimise the negative impact of urbanisation such as city congestion, water and air pollution, vector-borne diseases, loss of green areas, poverty, lack of mobility and transportation, rising inequalities, urban-rural disparity, insufficient citizen security and safety, and to avoid problems associated with achieving energy conservation as well as the environment.

The commitment is also reaffirmed to explore science, technology and innovation cooperation and collaboration in areas of mutual interests, including achieving innovation-driven development in areas such as smart city development and support for the ASEAN Smart Cities

Network (ASCN), as stated in the ASEAN-China Strategic Partnership Vision 2030 adopted at the 21st ASEAN-China Summit on 14 November 2018, and the East Asia Summit Leaders' Statement on ASEAN Smart Cities adopted at the 13th East Asia Summit on 15 November 2018.

SWOT Analysis of Smart Cities in South East Asia

While smart cities have the potential to change cities for the better, they also come with potential hidden costs. Defining appropriate, scalable, efficient and realistic smart city policies requires a clear understanding of the strengths, weaknesses, opportunities and threats facing smart cities in South East Asian countries. Table 2 and the following section below recall the main strengths, weaknesses, opportunities, and threats of smart cities from the literature.

Strengths - the South East Asia region benefits from strong political priorities placed firmly on smart city development – as evidenced through national smart city frameworks in almost all countries of ASEAN and of regional cooperation through the ASEAN Smart Cities Network. Cities in South East Asia are also benefiting from greater autonomy. Many ASEAN Member States (AMS) are increasingly shifting the responsibility for public service delivery to local city governments, granting them increased authority to make "smart" decisions.

Weaknesses - yet a digital divide persists within the region which limits opportunities and reduces inclusivity. A lack of integrated cross-sectoral planning to support smart city solutions and underdeveloped systems around data privacy and security are limiting the full development potential that smart cities could bring to the region. Smart city projects often face difficulties in finding finance to cover capital expenditure due to limited budgets. 41% of municipalities engaged in this transition rely on a mixture of public and private funding, the most popular options. A combined 49% relied on solely public funds of some kind, which breaks down at 19% using a mix of public funds and state grants, 11% using regional funds and 4% using EU funding to achieve their respective transitions. Only 10% of Smart City projects are purely privately financed (Deloitte, 2018).

Opportunities - looking ahead there are a number of key opportunities that cities in South East Asia could leverage to support their smart city ambitions. Strong regional cooperation around the ASEAN Smart Cities Network provides an opportunity to leverage the strengths within the region and leapfrog the challenges. There is also an opportunity to turn toward more integrated and cross-sectoral strategies to strengthen sustainability and reduce the growing inequality gap.

Threats - smart technologies and innovative solutions for sustainable cities do not provide a substitute to good planning and governance, financial management and smart use of existing data sets in a secure way. These are critical safeguards to stimulate innovation, instil trust in citizens, and to embrace smart city solutions. Further, the need to maintain rule of law in a digital age is also raising the profile for cyber-security needs. Cities in ASEAN are stepping up their fight against cyber-crime efforts by increasing the number of specialist law enforcement officers, and cooperation on trans-national crime and terrorism. There have also been several instances of cyber-attacks in various AMS, yet 78 percent of internet users in South East Asia have not received any formal education on cyber-security (ASEAN, 2018).

Strengths	Weaknesses
• In most countries, a varying degree of regulatory frameworks already exists to support application of smart city solutions (apart from Cambodia, whose government is in the process of developing the national Smart City Framework); • Active regional cooperation through ASEAN Smart City Network (to capitalize from lessons learned, capacity building and established guidance on regulatory frameworks, institutional set up and support between countries and possible funding, cross-border solutions). Various partnerships were reported under the umbrella of the network, which connected private sector and their solution to different stakeholders and investors (ESCAP, 2019). In 2022, the year of the implementation of this project, Cambodia is the Chair of this Network; • Cities in South East Asia are benefiting from greater autonomy with many AMS increasingly shifting the responsibility for public service delivery to local city governments, granting them increased authority to make local "smart" decisions; • Competitive local market for ICT.	• Lack of robust digital infrastructure that is inclusive, especially broadband connectivity; • Digital divide in terms of uneven access but also varying levels of digital literacy; • Lack of viable funding possibilities to finance smart city solutions; • Governance structures that can impede funding at regional and local levels, as well as implementation (structures at different tiers of government); • Limited education and capacity to implement the smart city visions; • Lack of strong and enduring sustainable partnerships for smart cities; • Issues of congestion and emergent urban and territorial planning systems; • Governance systems that are yet to evolve into integrated cross-sectoral (vertical) and multi-tier (horizontal) systems to support the implementation of smart city solutions; • Lack of robust systems to provide cyber security; • Political stability – terms and tenure; • Lack of trust in data privacy and protection of citizens' data.
Opportunities	**Threats**
• Optimise urban management through smart systems can make cities more efficient and less costly to manage; • Improved decision making at all levels with data operation can be more precise, impactful and carried out in real-time; • Enhance the way residents interact with the city through mobile applications; • Reform the governance systems to function as integrated cross-sectoral and multi-tier to facilitate planning and implementation of smart city strategies, allocate appropriate funding and enable business environment for market solutions and public-private partnership; • Synchronize and capitalize on ASEAN Smart City Network; • As a result of the reforms in governance systems, through smart city frameworks governments could accelerate the implementation of 2030 Agenda;	• Cyber security and privacy concerns; • Any political changes at national and local levels that could impact commitment towards smart city policies and strategy; • The Fourth Industrial Revolution provides a risk of further delayed sustainable development and a wider inequality gap if countries do not create the enabling environment for smart city solutions; • As smart cities solutions are not panacea to the core structural problems cities face, if not implemented strategically and with care, they can create more problems (ex. Surveillance technologies and concerns over privacy); • Intellectual property issues across the subregion-uneven application and enforcement.

Table 2: Summary of the SWOT analysis of Smart Cities in South East Asia

Key Stakeholders

Smart cities involve various stakeholders, from individuals all the way to central ministries, from start-ups all the way to the largest industry conglomerates. Each actor plays a critical role, and a well-balanced smart city ecosystem will typically involve actors at all levels to varying degrees. (Arup, 2021)
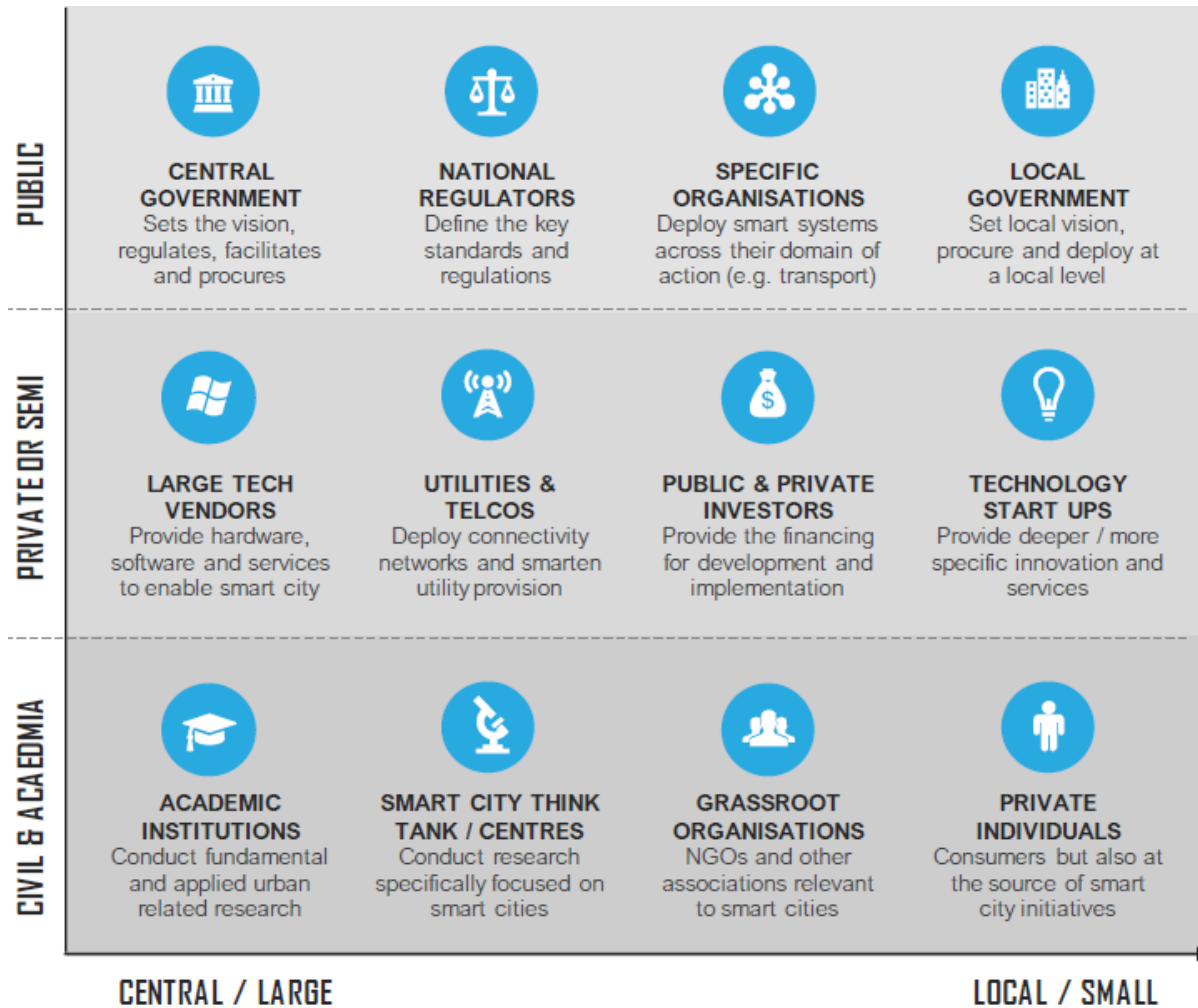
Figure 6: Who are the main smart city players? (Arup, 2021)

The following list of stakeholders was developed through a review of ASEAN Smart Cities Network literature.

Type	Name	Description
Bi-lateral donors	Australia, Department of Foreign Affairs and Trade (DFAT)	Australia pledged to establish an AU$ 20 million ASEAN Australia Smart Cities Trust Fund (AASCTF). The Fund assists ASCN pilot cities to enhance their planning systems, service delivery, and financial management by developing and testing appropriate digital urban solutions and systems. By working with cities, AASCTF facilitates their transformation to become more liveable, resilient, and inclusive, while in the

		process identifying scalable best and next practices to be replicated across cities in Asia and the Pacific. This fund is managed by the Asian Development Bank (ADB) under the Urban Financing Partnership Facility.
	US, The Departments of State, Commerce, and Transportation; National Science Foundation; USAID; USTDA, and other	US supported ASCN by introducing the US-ASEAN Smart Cities Partnership (USASCP). This partnership is developed as part of the US commitment to the Indo-Pacific region. To start the partnership, the US invested US$ 10 million, targeting private sector engagement in smart city solution and digital economy, sharing best practices to promote collaboration, and strengthening regional cybersecurity capacity at the sub-national level.
	Japan, the Ministry of Land, Infrastructure, Transport and Tourism	In October 2019, the Ministry of Land, Infrastructure, Transport and Tourism of Japan invited the Ministers in charge of infrastructure development of ASM, ASEAN Secretariat, and the Chief of Smart City Officers from ASCN smart cities to the first ASEAN-Japan Smart City Network High-Level Meeting in Yokohama. The meeting facilitated knowledge exchange on Japan's know-how and technologies on smart cities and matching up Japanese public and private organisations to ASCN. Japanese support of ASCN complements Prime Minister Shinzo Abe's vision to promote "Japanese Quality Infrastructure" internationally. The Japanese International Cooperation Agency (JICA) is supporting city-wide infrastructure in South East Asia. In Yangon, JICA is collaborating with the Yangon Downtown Conservation Project to assist the city government of Yangon in mitigating traffic congestion and improving the urban environment in Yangon. The collaboration has further expanded into the technical assessment towards rehabilitating drainage facilities, removing bottlenecks on major roads, improving the streetscape to restore the city liveability, and advancing the socio-economic development in Yangon Central Business District.
	Chinese government	ASEAN leaders and China issued a statement on the Smart City Cooperation Initiative. This statement underlines ASEAN and China's commitment to addressing urbanisation challenges while harvesting the opportunities associated with the digital and 4th industrial revolution. The cooperation will focus on eight areas of collaborations, such as exchanging best practices, exploring collaboration, advancing research and technology adoption, supporting private sector collaboration, and city to city partnership.

	the Republic of Korea (ROK)	At the recent 2019 ASEAN-ROK Commemorative Summit in Busan, the Republic of Korea (ROK) stated its willingness to collaborate in smart cities, digital economy, and cybersecurity as part of its New Southern Policy that envisions stronger ROK diplomacy with ASEAN. President Moon Jae-in has consistently raised a smart cities and information & communications technology agenda on ROK bilateral partnership with ASEAN State Members. The ASEAN-Korea Centre, which has served in advancing cooperation between ASEAN and the ROK for ten years, actively conducts seminars, training, and capacity-building programmes on urban innovation and creativity-driven growth in various ASEAN cities.17 This strategy has put the ROK as an active partner for exploring collaborations to nurture mutual benefit.
	Singapore, Ministry of Foreign Affairs (MFA) and Enterprise Singapore	MFA launched and led the initial strategy of the ASEAN smart cities network (ASCN). The MFA also helped to promote regional cooperation with different countries in the region and to promote diverse smart city solutions. The International Enterprise Singapore (IE) signed an MOU with the City Government of Makassar to build Makassar's digital service platform which includes smart cards, intelligence transportation, flood detection, and intelligent street lighting. With this MOUs, the City of Makassar invites more Singapore companies to be involved in providing technology solutions for enhancing urban development in the city of Makassar.
Private sector enterprise	Fujitsu	In the safety and security sector, a Japanese multinational technology corporation, Fujitsu, has assisted the Jakarta Regional Disaster Management Agency (BNPB) in developing the Disaster Information Management System (DIMS) for anticipating severe flooding that hit Jakarta. Through this technology, BPNP Jakarta is now able to provide a web portal to disseminate information to the public using digital maps and to send out messages to the related disaster-management organisations.
	Huawei	A Chinese technology company, Huawei, launched the first Artificial Intelligence (AI) centre powered by 5G capabilities in Singapore with a total investment of US$ 18 million. The centre serves to harness research and development on AI to harness urban safety and security systems. It allows Singapore's government agencies, research institutes, and small-medium size

		enterprises to use the facilities as a learning hub for digital transformation.
	Pundi X	The Singaporean blockchain company, Pundi X, also stated an interest in working with the City Government of Phnom Penh in building a 100-hectare business district supported by blockchain infrastructures that include public safety systems, water & power network, road traffic and commuting command.
Multi-lateral institutions and funding bodies	ASEAN Infrastructure Fund (AIF) Co-Financing partners include ADB, Agence Française de Développement, AIF, the European Investment Bank, the European Union, KfW, and the Republic of Korea	ADB has been urging Southeast Asian policymakers to implement green and innovative financing to fill the estimated USD3.1 trillion investment gap required for climate adjusted infrastructure in the region. The ASEAN Catalytic Green Finance Facility (ACGF) is an innovative finance facility dedicated to accelerating green infrastructure investment in Southeast Asia with over USD1.4 billion in loans from co-financing partners, under the ASEAN Infrastructure Fund (AIF). The ACGF's technical assistance supports governments to identify and prepare commercially viable green infrastructure projects while the ACGF loans are utilised to cover upfront capital investment costs.
	Global Infrastructure Hub	The Global Infrastructure Hub (GI Hub) is a not-for-profit organisation, formed by the G20, that advances the delivery of sustainable, resilient, and inclusive infrastructure. They collaborate with the public and private sectors, acting as a knowledge sharing hub, to produce data, insights, knowledge tools, and programs that inform both policy and infrastructure delivery. These resources help decisionmakers, policymakers, and practitioners create positive impacts through infrastructure in the ASEAN smart cities solutions.
	Asian Development Bank (ADB)	The Asian Development Bank (ADB) has launched their Promoting Smart Systems in ADB's Future Cities Program. The technical assistance aimed to enhance operational knowledge of promoting pro-poor smart solutions with emphasis on poverty reduction and inclusiveness in five pilot cities: Bandung, Greater Suva Area, Mandalay, Tbilisi, and Ulaanbaatar. It endeavoured to achieve this aim by developing knowledge and learning products; facilitating partnerships between cities; and conducting prefeasibility studies on smart solutions to enhance and leverage city and business investments, and citizens' potential.
	Asian Infrastructure Investment Bank	The Asian Infrastructure Investment Bank (AIIB) has approved USD60 million as a commitment to the STIC Asia Infrastructure Innovation Fund. The Fund will predominantly invest in small and medium-sized companies across digital infrastructure and green energy infrastructure

		sectors in South Asia, Southeast Asia, and the Republic of Korea. Working with partners, AIIB continuously meets clients' needs by unlocking new capital and investing in infrastructure that is green, technology-enabled and promotes regional connectivity. It also provides help for different smart cities projects in ASEAN cities.
	United Nations Capital Development Fund (UNCDF)	Initiated the Smart Green ASEAN Cities (SGAC) programme. With EUR 5.1-million support from the EU from 2021–2025, the Smart Green ASEAN Cities (SGAC) programme will assist ASEAN Member States anticipate the substantial pressure from the high urbanisation rates by focusing on green and smart solutions through digitalisation and use of technologies. The SGAC programme is implemented by the UNCDF and will facilitate policy development, access to public and private funds, as well as enhance cooperation between cities within ASEAN, and between ASEAN and European cities.
	The Japan External Trade Organization (JETRO) and the United Nations Development Programme (UNDP)	The popularity and relevance of the ASCN was apparent, as five partnerships in the form of Memoranda of Understanding (MOUs) or Letters of Intent (LOIs) were announced within a matter of weeks of the ASEAN Smart Cities Governance Workshop and signed at the Inaugural ASCN Meeting. The partnerships were between on activities for the ASCN.
Regional organisation	The ASEAN Secretariat	The ASEAN Secretariat supports the ASCN through its Integration and Monitoring Directorate. It helps the ASCN to hold different conferences and put forward the projects among the whole region.

3. Way Forward: Future of Asia and the Pacific Cities – Pathways and Actions for Smart Cities

Our future pathways are defined by the Future of Asia and the Pacific Cities report, which was the result of extensive engagement with a wide range of stakeholders in the urban arena in Asia and the Pacific. (UNESCAP, 2019). ESCAP's extensive engagement has resulted in a robust framework and action plan to build the sustainable future of Asia and the Pacific cities. With its 4 key pillars towards the future of sustainable urbanization in the region: Urban and Territorial Planning, Urban Resilience, Smart Cities and Urban Finance, the framework delivers pathways and actions that are addressing the challenges and opportunities of cities in the region, including those that incorporate recommendations related to health crisis (drawn from the COVID-19 pandemic).

Within the Smart Cites Pillar, the following five policy pathways are identified which will help to shape the future of cities in Asia and the Pacific:

1. Improve **smart city governance** across urban systems, institutions and actors to overcome inequalities and make more informed and integrated planning decisions;
2. Encourage **technology firms to become more civic-minded** and create sustainable smart city solutions with social enterprises;
3. Adopt **cybersecurity safeguards** in both digital and physical urban infrastructure development planning;
4. Develop **smart mobility investment plans** that prioritize sustainable urban mobility options for citizens;
5. Expand viable **smart city funding mechanisms** by enabling cross-sector partnerships and business matching platforms.

Our efforts under the Smart Cities Innovation Lab are focused on Pillar 5 – *expanding viable smart city funding mechanisms by enabling cross-sector partnerships and business matching platforms.*

To integrate COVID-19 considerations within the application of Smart City policy pathways, the following specific recommendations are suggested (UNESCAP, 2022):

• Improve **smart city governance for health institutions and actors** to overcome inequalities and make more informed and integrated urban health decisions;

• Accommodate a **peer-to-peer learning network** amongst cities in the region;

• Develop **two-way open data dashboards** that allow health data monitoring in real time, thereby respecting principles of privacy and containing cybersecurity safeguards.

Transparent data-sharing frameworks are required to harness the positive possibilities of 'digital epidemiology', the real-time assessment of public health through technology;
•   Invest in **public, evidence-driven communication campaigns** to create civic trust and increase shared literacy on technology-driven health strategies;
•   Develop **shared, sustainable, and active transportation solutions** and investment plans for citizens.

Key Findings for the Smart City Agenda

Based on the landscape review the following observations have emerged:

Embedding sustainability principles within a process of digitalisation provides a critical opportunity to integrate low carbon sustainability gains within urban development. Continuous urban growth is fuelling economic progress but also sustainability trade-offs such as air pollution, improper waste management and greater climate vulnerabilities particularly when infrastructure and services cannot keep up with the pace of development. Actors from every sector operating within cities are increasing turning toward digitalisation to provide enhanced efficiencies and improved urban management solutions to sustainability challenges. Integrating sustainability principles ensures low carbon sustainability gains are captured early on to avoid lock-in of unsustainable practices.

The digital revolution sweeping across Asia must be harnessed in urban development to optimise infrastructure and services and align with the 2030 Agenda. Cities in South East Asia are well positioned to take advantage of new technologies under the smart cities sector. With widespread levels of digital literacy, smart phone penetration and ICT infrastructure to underpin smart solutions. Smart sustainable cities therefore represent a critical opportunity to accelerate much-needed progress on implementation of the Sustainable Development Goals, particularly vital in the post-pandemic recovery period. It is also important to take proactive action to collect data that is disaggregated by sex, by disability or by income groups, to better understand and address challenges faced by vulnerable groups. The recent acceleration of digital solutions during the COVID-19 pandemic can be harnessed, to help transition to low-carbon and resilient solutions across a greater range of sectors and services.

Smart city policy goals are becoming mainstream in South East Asia. National and local governments across the region have recognised the strategic importance of smart cities and the opportunities they provide. As a result, national frameworks exist in all South East Asian countries to support smart city development, though this varies between countries and cities. Smart city plans in the region are typically driven by the public sector as part of institutionalised smart city strategies. These strategies often involve high levels of government participation at both national and local levels and are typically aligned with political agendas.

There is a lack of supply in innovative smart city products, services, and business models. Mature partnerships between government, industry, and academic sectors are needed to realise smart city innovation and implement at scale. At present, there is varied levels of coordination on smart city development in the region depending on the country or even city. Regional opportunities remain for new business models to link demand and supply of smart solutions (goods & services) and to create new partnerships linking cities, entrepreneurs, large companies, and development actors to collaborate on the implementation of their smart cities action plans.

Priorities for the Smart Cities Innovation Lab

The landscape review has confirmed three essential priorities for the Smart Cities Innovation Lab project:

1. **Pilot integrated digital solutions to accelerate action on the 2030 Agenda.** With a focus on key urban and environmental challenges as defined by local governments, such as waste management, air pollution, climate change, urban mobility, traffic management and increasing access to basic service, SCIL can model an integrated approach to implementation (vertical and horizontal) to embed sustainability within the ongoing digital revolution. This approach to piloting solutions can help work through challenges and opportunities to understand the bottlenecks and governance issues that merit investment and substantive capacity building efforts. If cities in South East Asia manage the vertical (multi-tier govt) and horizontal (cross-sectoral) integration of their governance structures to successfully implement their national smart city frameworks and policies, they will set themselves up for accelerated implementation of the 2030 Agenda. The learning from the innovation in governance structures to implement smart cities can also help cities tackle other socio-economic and environmental priorities to achieve their nationally agreed SDGs.

2. **Build on emergent smart city policies.** Smart city policies and action plans are being developed for many cities across South East Asia. The Smart Cities Innovation Lab series has an opportunity to leverage this existing policy focus within the region at both nation and local levels to support the operationalisation and implementation of existing plans. There is also a need to reinforce cooperation at the ASEAN level, and for ASEAN Member States to follow the ASCN guidelines and platforms to promote cross-border collaboration, harmonization of policies, strategies, harness cross-border investments, data sharing, data privacy and security issues, and capacity building.

3. **Test different models for smart city delivery.** Based on ESCAPs research and extensive consultation it is recognised that new partnerships are required and needed to implement existing smart city action plans. Ensuring digital initiatives are financially sustainable in the long run is an equation that is often difficult to reconcile as smart city initiatives are often expensive to deploy and maintain and have a public service focus (Arup, 2021). The Future of Asia and the Pacific Cities report identifies various policy

pathways to support smart sustainable city development including the **expansion of viable smart city funding mechanisms** through enabling cross-sectoral partnerships and business-matching platforms.

4. **Promote scalability and enhance sustainability eco-system.** Many cities in the region have already started their smart cities transition. To showcase best practices and benefit more cities in the South East Asia region, scaling up ESCAP's Smart Cities Innovation Lab will be considerably significant and valuable for all stakeholders in smart cities initiatives within the region. Meanwhile, start-ups are particularly tech-oriented, innovative, and rapidly growing. Alongside tech enterprises, city governments, and academia, involving new entrepreneurs in the sustainable innovation eco-system for smart cities development will not only accelerate start-ups' business operation but also enable a long-lasting sustainability innovation eco-system.

The SCIL project can use the Innovation Lab to support **new business models** for smart cities, linking innovation with scalability. **Promoting partnering** between local government, tech companies, entrepreneurs/start-ups, and development actors. It is particularly important to **support entrepreneurs** to drive solutions in rapidly developing digital economies, by enabling partnerships and promoting private sector innovation to harness frontier technologies such as Machine Learning and Big Data for more informed urban planning.

Technology companies are leaders in techniques that optimize smart city solutions. These companies are shifting from providing support through token Corporate Social Responsibility programmes to mainstreaming sustainability into their core business strategy. Companies are also increasingly supporting intrapreneurs - employees with innovative solutions to develop their ideas in-house to retain employees. One example where SCIL can support is through partnerships and business matching platforms that link large corporate intrapreneurs – who have access to the company capabilities – with start-up entrepreneurs – who have potentially game changing solutions but lack the institutional business support and backing of a large corporate.

SCIL can also generate partnership insights for development agencies that can support the coordination of smart city innovation efforts and draw learnings to address systemic barriers to innovation efforts of all actors. For example, many development agencies are implementing both innovation and smart cities programmes separately within their development portfolios. There are **inefficiencies for operating in silos**, e.g., each programme manager must undertake similar time-consuming tasks, like sourcing applicants through innovation networks, determining mechanisms for due diligence, and 'after-support' once start-ups graduate. This absorbs time and finances from organisations that could be channelled into substantive tasks. There is also a **lack of coordination** (and hence optimisation) of which development agency is best placed to support innovation and in which way. Financial institutions provide much needed capital are well placed to support advanced innovative solutions but are less able to tolerate risk involved in incubation and accelerators. Technical institutions are well equipped to nurture nascent ideas and invest in capacity building to support marginalized groups under inclusive growth paradigms, but less well placed to handle **intensive due diligence needed for large investments**.

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