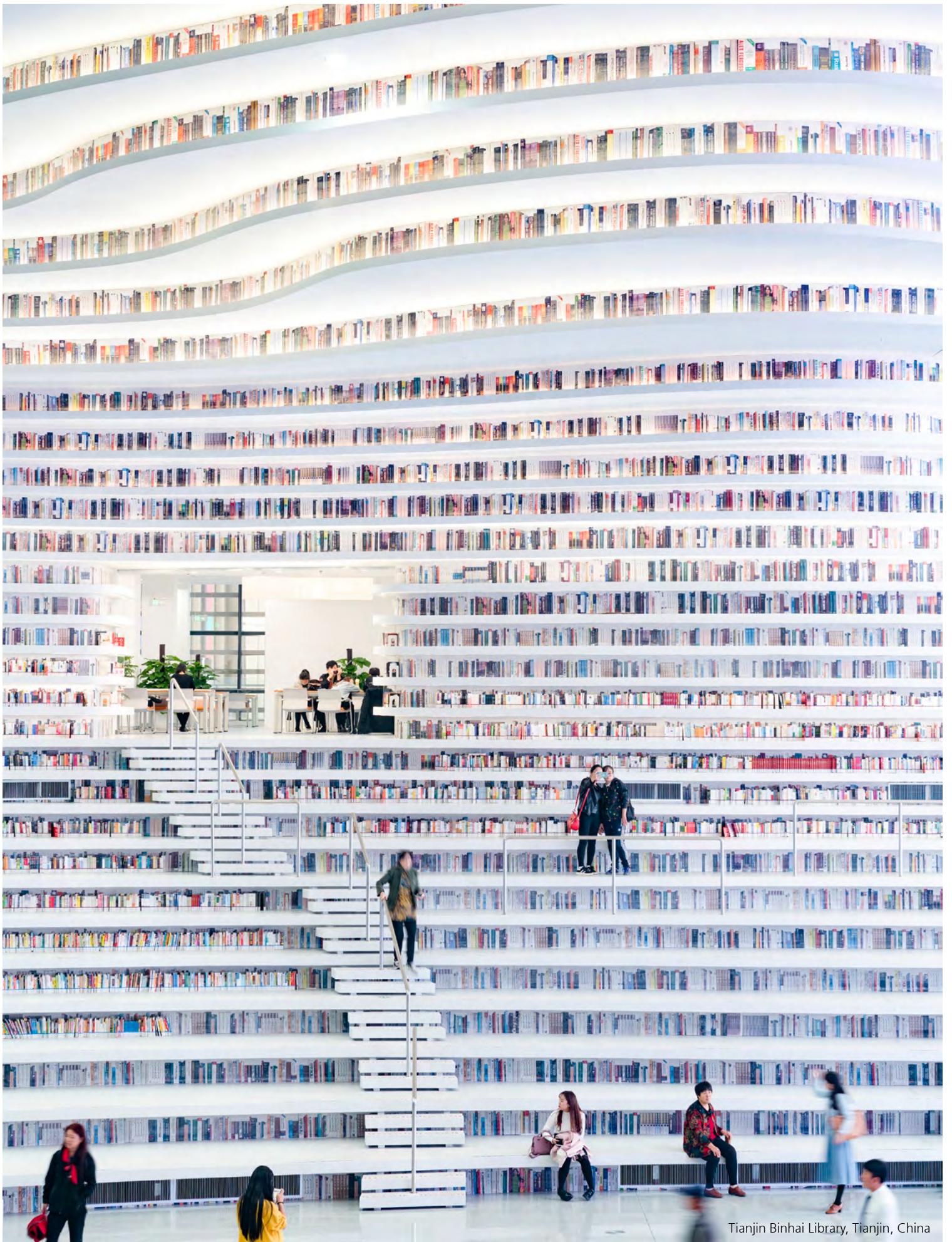


Smart cities

Shifting *Asia*





Tianjin Binhai Library, Tianjin, China

Editorial

Dear reader

The greatest case of human migration has been going on in Asia over the past decades. People have been moving from countryside to city by the hundreds of millions, hoping to take part in the rapid economic progress that has turned the region from agricultural backwater to industrial powerhouse. And this trend will continue for the foreseeable future – the UN expects the percentage of people living in Asia’s urban areas to rise from 50% today to 75% by 2050.

Now accounting for over half of the world’s megacities, Asian cities are grappling with the challenge of having to balance sustained population growth with strained infrastructure, depleting resources and finite space. But with the fourth industrial revolution powering ahead, “smart cities” – the integration of cutting-edge information and communication technologies with urban planning – offer a compelling answer to this dilemma. Indeed, the potential benefits of smart cities to urban livelihoods are significant, as is the investment opportunity.

Welcome to the latest edition in our Shifting Asia thought leadership series. This issue dives into the booming world of smart cities in Asia, where public and private investment is mixing to spark waves of innovation and ambitious plans are transforming the relationship between governments and citizens. In this report, we feature interviews from local authorities and business leaders on the topic and bring the story closer to home through individual country analyses.

The interpretation of smart cities varies, but generally consists of six major pillars - connectivity, governance, services, automation, health and mobility – and employs key technologies like artificial intelligence, big data, cloud computing and robotics. As the urgency to ensure sustainability mounts, Asia’s governments have launched ambitious initiatives to make their cities and nations more intelligent. Yet the resultant

surge in connectivity also brings with it a downside – an increase vulnerability to cyberattacks. Accordingly, cybersecurity will have to be incorporated as a key building block of each nation’s approach, and form an integral part of the region’s smart city journey.

This is an exciting topic because, among other reasons, it touches all of our lives. In Singapore, for instance, we’ve become accustomed to filing taxes online, monitoring subway schedules on mobile apps and connecting to personalized government sites through soft tokens. These are just a few examples of how cities are becoming smarter. Others include the rollout of a nationwide 5G network in China, integrated area developments and traffic management systems in India, and an autonomous bus network in Tokyo.

Each country has their own set of challenges, including overbearing bureaucracy and logistical and resource constraints, and achieving their grand visions for the future will require an unwavering commitment that spans different administrations. But with the current momentum, we estimate Asia’s smart city market, led by China, could reach USD 800bn in 2025, creating sizeable growth opportunities for local economies along the way.

Such rapid growth should yield attractive investment opportunities. Investors keen to participate in this area should target companies exposed to faster-growth segments like fintech, 5G, smart mobility and healthcare. Conversely, those engaged in antiquated urban operating systems are at risk of becoming outdated.

We hope you enjoy reading about this special topic on Asia’s future. As always, please don’t hesitate to reach out with any feedback or questions.



A handwritten signature in black ink, appearing to read 'Min Lan Tan'.

Min Lan Tan
Head of APAC Investment Office

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UBS Shifting Asia

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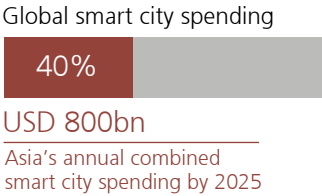
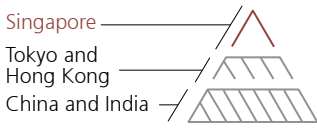
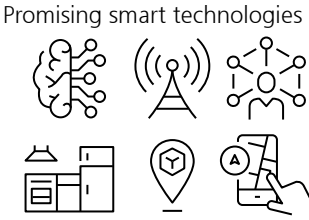
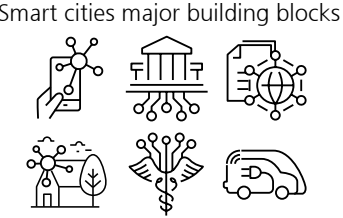
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Executive summary

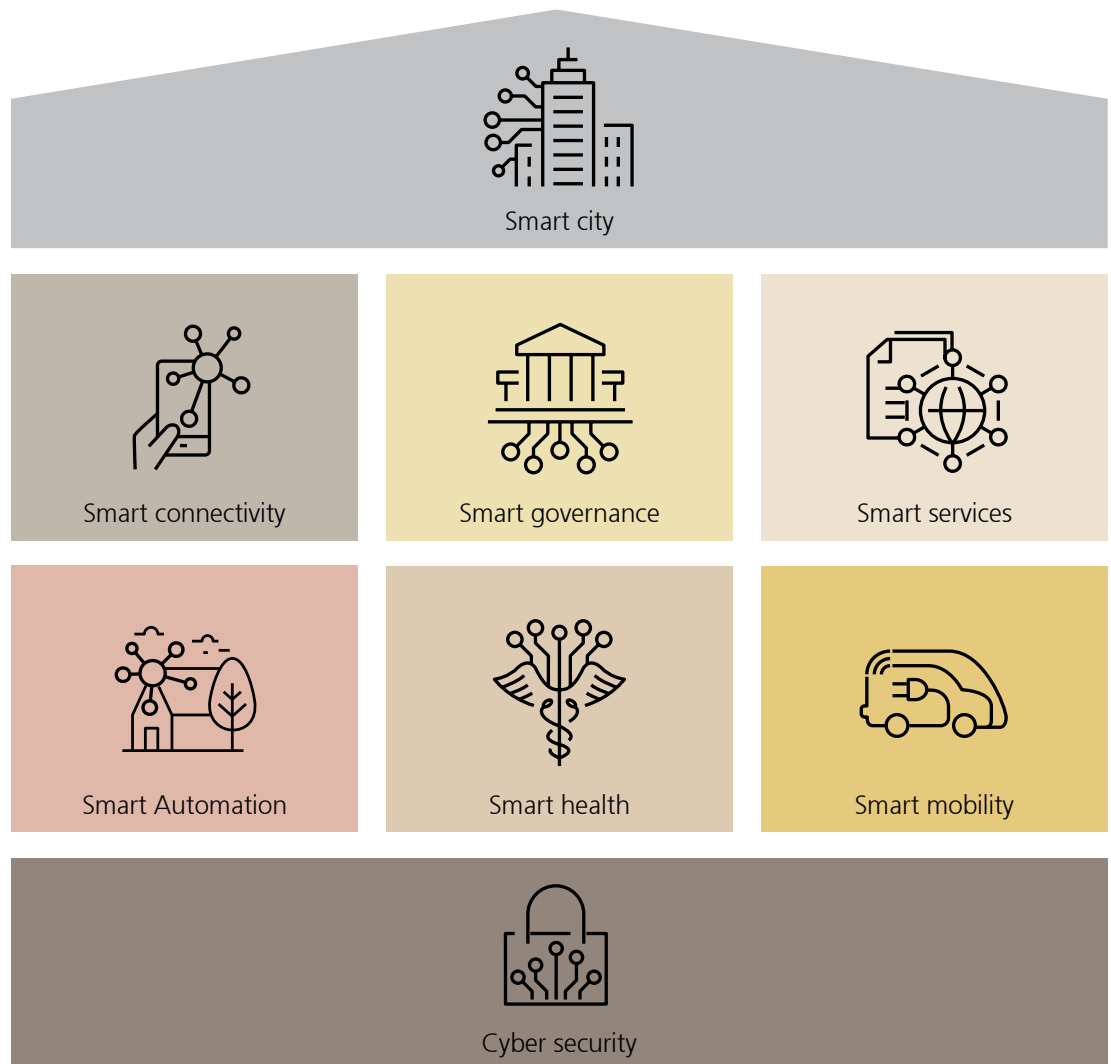
- Asia is home to 16 of the world's 28 megacities (populations above 10m), and the United Nations forecasts their cumulative population will double by 2030 from their 2010 total. This mass migration from rural to urban areas is occurring as the "fourth industrial revolution," a period of rapid technological innovation, transforms the way we live.
- To balance the costs of depleting resources with rapid urbanization and sustainable growth, many Asian cities are laying the groundwork to become "smart cities" over the next decade. This entails integrating the six major building blocks – smart connectivity, smart governance, smart services, smart automation, smart health and smart mobility – with cybersecurity forming the foundation of each smart city.
- Promising smart technologies that can facilitate this transition include 5G and the Internet of Things in connectivity, digital repositories and sandboxes in governance, fintech and smart utilities in services, artificial intelligence and facial recognition in automation, big data and remote monitoring in healthcare and autonomous driving, and ride hailing in mobility.
- In Asia, Singapore is arguably the furthest along the smart city journey. As the host, Tokyo will likely showcase interesting smart solutions during the 2020 Olympic Games. And with strong government initiatives and vibrant technology ecosystems, China and India show significant promise for the future.
- We expect Asia's smart cities to generate trillions of dollars in economic value over the coming years as annual combined smart city spending climbs to USD 800bn by 2025, according to our estimates, about 40% of global smart city spending. Contributing USD 320bn, China should lead the region in smart city spending over this period.
- Given the huge revenue potential, we see significant investment opportunities for investors. In particular, we believe companies exposed to faster growth segments like fintech, 5G, smart mobility (e.g. electric vehicles and autonomous driving) and healthtech are in a sweet spot thanks to strong demand and regulatory support. Conversely, companies exposed to traditional urban operating systems will be at a risk of becoming redundant.



What is a smart city?

Sundeep Gantori, Analyst

Definitions and scopes of smart cities differ from country to country. We believe smart cities in Asia consist of six major building blocks – smart connectivity, smart governance, smart services, smart automation, smart health and smart mobility – with varying levels of digitalization. Cybersecurity, meanwhile, forms the foundation of each smart city. Let's dive into these sub-segments.





Hong Kong. Photos by Martin Ruetschi



Smart connectivity

Driven by a desire to stay connected all the time and the need to efficiently multitask throughout a busy day, most of us have become “digital omnivores” and see connectivity as a basic necessity rather than a luxury. Just as how all cities are built on strong infrastructure like high-rise buildings, roads and public transport systems, smart cities are founded on robust technology infrastructure – which begins with smart connectivity. The combination of key enabling technologies, like 4G/5G, fiber broadband and WIFI/Bluetooth, with connected devices, smartphones and sensors allows governments, corporations and the public to fully exploit the potential of technology for everyday services. The Internet of Things (IoT), which connects everyday objects such as home appliances to the internet, is particularly capable of empowering connectivity, as multiple smart touch points throughout one’s day can not only deliver innovative services but also collect data for further analy-

sis. Applications of IoT include weather and water monitoring devices as well as other sensor-based devices like public lighting and traffic lights. Such devices can be remotely controlled, thus driving significant efficiency gains. While densely populated cities with high-rise buildings often face connectivity problems, we believe the extensive use of WIFI and the upcoming 5G technology, which significantly reduces latency, should further bolster smart services. Most telecom operators in Asia will launch 5G services over the next few years, with those in Australia, China, Japan and Korea set to do so in 2019. According to Ovum and Bloomberg Intelligence, 5G subscribers in Asia should reach almost 200m by 2022, with a mid-single digit penetration rate. With 5G services expected to be rolled out in developing Asia during the next decade, we see significant growth opportunities in the 5G era.



Smart governance

Smart governance is the use of information & communication technology (ICT) by the government for better urban planning and decision-making. The point of smart governance is to use various technologies to connect government agencies with businesses and the public in order to improve transparency and institutionalize trust. Examples include digital repositories (for land records, for instance), unified services like citizen services or online tenders managed through a government-issued identity, and agency-wide web portals or mobile apps (e.g. for departments like police or income tax). While government-to-citizen (G2C) smart governance models get more attention, gov-

ernment-to-business (G2B) or government-to-government (G2G) models can drive significant efficiency gains and improve transparency. In fact, most progressive regulators across Asia are currently partnering with startups that leverage smart governance models like online fast-track approvals or sandboxes to fuel innovation. A sandbox is an entity endorsed by regulators that allows limited-scale testing of a new product, during which the government temporarily relaxes regulatory requirements. The aim is to assess the potential benefits and risks of a new product before its full-scale launch.



Hong Kong. Photo by Martin Ruetschi



Hong Kong. Photo by Claudio Bader



Smart services

Thanks to smart connectivity and smart governance, smart city administrators can take advantage of digital technologies and deliver everyday services smartly. These include both public and private services like digital payments, smart grids, smart utilities including metering and many more. Cloud computing is at the center of smart services as the technology allows access to everyday services anywhere and on any device. Given fintech's ability to offer financial inclusion through mobile payments and internet finance, many regulators in Asia are supporting fintech services by building strong ecosystems. For example, since the recent demonetization of large banknotes in India, cashless payments for goods and many public services have become more popular. Smart grids, which reduce energy consumption and CO2 emissions, are

another area where digitalization can revolutionize everyday services. With smart grids, households can be more than just consumers; they can consume electricity according to their needs, and in the future even sell back the surplus stored in batteries. This fundamentally disrupts the supply-demand dynamics in the electricity market, providing both parties (utility companies and customers) an advantage and improves energy efficiency. For instance, utilities can temporarily store volatile power generation (such as wind, solar) in batteries and supply networks with the excess energy when needed. Smart metering in another such service provided by utilities; it allows consumers to manage their utility consumption and affords providers the flexibility of dynamic pricing, which is essential during peak loads.



Smart automation

Smart automation greatly helps cities become truly smart. The most commonly used applications of smart automation include smart buildings and smart homes as well as artificial intelligence (AI) applications like robots, machine learning, chatbots, etc. Many Asian cities are widely adopting smart building technologies, for example, which use automated processes to manage typical day-to-day building operations like lighting, air condi-

tioning, lift management and heating. Similarly, smart homes can automate many functions, like security, entertainment and appliances, thereby improving efficiency. With AI at the center of the fourth industrial revolution, we believe smart cities can significantly leverage AI through, for instance, AI-based surveillance camera systems, which use facial recognition technology, to boost security or chatbots to improve public feedback systems.



Photo by Claudia Link



Photo by Ailine Liefeld



Smart health

Smart health, or healthtech (as addressed in our recent theme), refers to the evolving use of information technology to address inefficiency and cost constraints in public healthcare systems. With stress levels much higher among city dwellers, there is an increasing need for smart health services. We see four ways in which the healthcare industry can be redefined by smart health services:

- Software, artificial intelligence and big data: With the healthcare industry accounting for 5% of all data generated globally, new developments in AI and data-handling technologies as well as improvements in connectivity suggest the industry may finally be reaching a tipping point for increased adoption.
- Telemedicine and remote monitoring: With most Asian cities still lacking an adequate system for primary care provision by general practitioners (GPs) and suffering a geographical mismatch between the demand for and supply of healthcare (concentrated in rich coastal provinces), remote monitoring through apps or wearables should improve overall healthcare service levels. Wearables also provide opportunities for data collection and analysis as they allow people to regularly track their health and other lifestyle data. While wearables are currently mostly used for general fitness tracking, greater incorporation of medical-grade sensors could support various remote-monitoring and treatment services.
- Applications of technology in drug development: Most pharmaceutical companies have been using technology as a means to incrementally improve operating efficiencies, rather than using digital technologies to drive wholesale changes in the research process. But this may change in the future, as we expect healthtech to address several issues in the drug development process, including reducing data gathering costs, improving analysis and streamlining the overall trial management process.
- Imaging, image-guided therapy and robotic surgery: The imaging market provides a practical example of how advanced software and artificial intelligence are already being used to create efficiencies in healthcare delivery by combining image data with software. Image-guided and robotic surgery techniques also have the potential to cut healthcare costs by reducing surgical complications and shortening hospital stays.



Singapore. Getty images



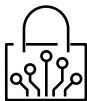
Japan. Getty images



Smart mobility

We define smart mobility as a combination of smart powertrains (electrification), smart technology (autonomous driving) and smart use (car-sharing/car-hailing) – which, in our view, should redefine urban transport over the next few years. Tougher regulations in the region to reduce CO2 emissions and fuel consumption will likely lead to a significant increase in the electrification of powertrains in the form of hybrid, plug-in hybrid and battery electric vehicles. Furthermore, sustainable investment aspects like safety, better fuel efficiency, lower emissions, the rise of millennials and increasing mobile

connectivity are accelerating the demand for smart mobility solutions in Asian cities. Autonomous technology helps reduce traffic jams and the huge losses in both time and energy they cause. In many areas in Asia where roads and parking spaces are stressed to the limit, autonomous driving initiatives and smart parking solutions are rapidly gaining traction as a way to solve these major transport problems. Similarly, commercial drones or unmanned aerial vehicles (UAVs) could make cities smarter through smart policing, regular traffic updates, e-commerce delivery, city monitoring and surveying, etc.



Cybersecurity as a foundation to smart cities

While smart cities are centered around the above six building blocks, cybersecurity provides a key foundation for smart cities, as secure or digitally safe cities can give confidence to citizens, corporations and governmental organizations and enable digital transformation.

The interconnection between the physical and virtual infrastructure in a smart city adds significant layers of complexity and creates vulnerabilities. Imagine a smart city network getting hacked, exposing sensitive data about citizens or organizations, or other attacks bringing the entire city infrastructure to a standstill.

Cybercrime has broader consequences than merely exposing the vulnerabilities of the affected party; it also damages trade, competitiveness and innovation at the macro level. According to Ponemon and Bloomberg Intelligence, the global average cost of a security breach is high at USD 3.6m per breach.

Despite the broad-based implications of cybersecurity risks, businesses are ill-prepared for them, in our view, as the rising number of threats clearly indicates. What do these developments mean for the cybersecurity industry? For one, that security is no longer merely a concern of IT managers, but a key boardroom topic, as governments and enterprises have to recognize its strategic importance.

The topic becomes even more important for smart cities, given that increased connectivity including usage of smart and IoT devices has raised overall vulnerability to cyber threats. The good news is most Asian smart cities have realized the importance of cybersecurity, with all the major countries prioritizing investments in this area. Furthermore, Asia as a region can also take advantage of some of the best global practices in the world, like the recent regulations in Europe and the US, to further beef up its smart city infrastructure.

Chapter 2

The need for smart cities in Asia

Carl Berrisford, Analyst

“Urbanism works when it creates a journey as desirable as the destination”

Paul Goldberger
Pulitzer Prize-winning architectural critic



Mumbai, India. Photo by Martin Ruetschi



Singapore. Photo by Chuttersnap



Tokyo, Japan. Photo by Florian Löbermann



Hong Kong. Photo by Claudia Link

The proportion of people living in cities across the world will rise from 50% now to three quarters by 2050, according to the United Nations. An estimated 2.7bn people in developing economies will move into cities over the next three decades, with most of this shift taking place in emerging Asia. Asian infrastructure investment needed to stay abreast of urban growth will result in a spending gap of USD 2.2 trillion per year until 2025, according to the UN. By 2025, emerging Asia is expected to account for 50% of global infrastructure spending.

This mass migration into cities in Asia is occurring against the backdrop of the so-called “fourth industrial revolution,” a period of rapid technological innovation driven by digitalization which impacts and shapes the lives of all urban inhabitants. It is also happening at a time of rising resource

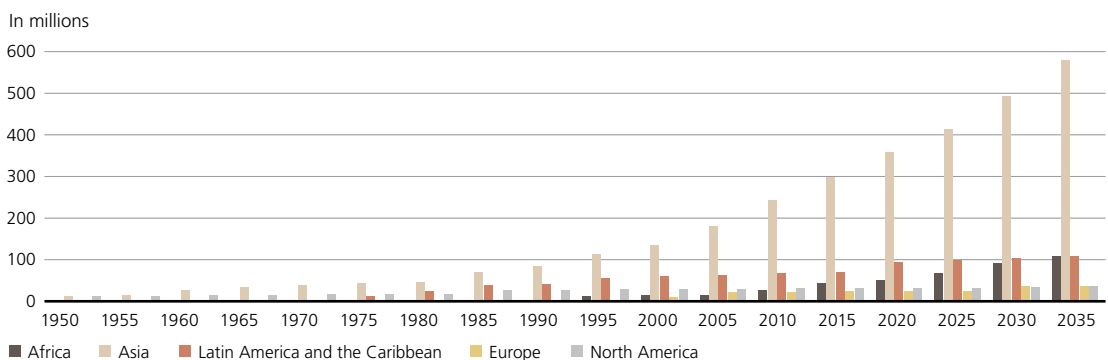
conservation and concern over the environment and climate change.

Asian urbanization’s “late-mover advantage” should provide plenty of room for investment in smart city technologies, in our view, from smart energy to smart mobility to smart healthcare. In Asia, scalability for these technologies is real due to the proliferation of large sized and densely inhabited urban spaces that have often grown haphazardly. They face an array of basic infrastructure and environmental challenges that we anticipate will be increasingly addressed through the application of rapidly maturing smart city technologies.

Asia’s cities are characterized by their large population and high population density. So it’s not surprising that 16 of the world’s 28 megacities (cities with population exceeding 10m) are in Asia. The

Fig. 1

The number of people living in cities with populations over 10m will double in Asia from 2010–2030



Source: UNPD, 2018



Mumbai, India. Photo by Martin Ruetschi



Jakarta, Indonesia. Getty images

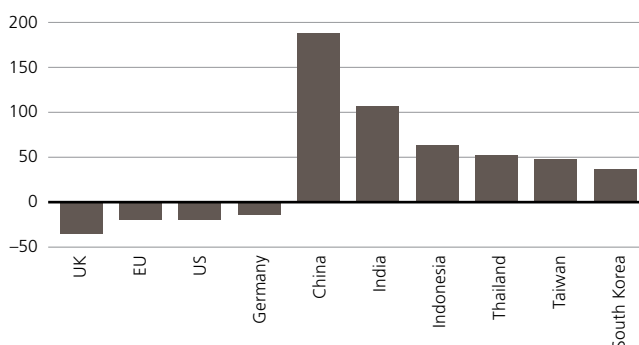
United Nations forecasts that the urban population of Asia's megacities will double by 2030 from 2010. Similarly, eight of the world's largest cities with highest population density are located in Asia. Rapid urban growth translates to rising income growth and lifestyle changes, which are stretching the infrastructure and resources of cities, particularly in emerging Asia.

The benefits and efficiency gains of smart city solutions in Asia's populous, chaotic and fast growing cities should drive sustainable demand growth for smart technologies. In the same way that smartphones have become indispensable to Asian consumers, we believe investing in smart city technologies will become an increasing necessity for Asian governments and municipal authorities to raise productivity and spur economic growth.

The rise in private vehicle ownership in Asia, which roughly doubles every five years in Asian cities, is a major cause of CO₂ emissions, deteriorating air quality, noise pollution, and grid-locked traffic in many of Asia's leading cities. Asia is forecast to account for one third of global transport-related CO₂ emissions by 2030, almost double the 17% level in 1990 (source: Emissions Database for Global Atmospheric Research). China, which has relatively low per capita car penetration, is expected to see an increase of 220m cars between 2010 and 2025, based on our forecasts. This is a key reason the Chinese government has taken the initiative with "smart mobility" and an early migration to electric vehicles. Smart operation sensors to regulate traffic flows and traffic lights and other solutions to address traffic congestion are already in use in many Chinese cities.

Fig. 2

Comparative growth of per capita CO₂ emissions CAGR (1995–2015), in %



Source: Emissions Database for Global Atmospheric Research, European Commission, 2017

Asia's rapid urban growth is a key reason why a big jump is expected in the waste produced by world cities – to 2.2bn tons a year by 2025 from 1.3bn tons a year currently. In China, 70% of the waste is disposed in landfills occupying 500 square meters of land and generating annual costs of CNY 30bn (source: Deloitte, 2018). Smart waste management, the application of Internet of Things (IoT) for waste collection and for tracking garbage segregation, as well as IoT-enabled transportation to manage the carbon footprint can go a long way towards improving efficiencies and reducing the impact on the environment.

High population density in most of Asia's major cities has led to high-rise living due to a shortage of space and high land costs. According to the International Energy Agency, buildings consume



Tokyo Japan. Photo by Sven Hagolani



Mumbai, India. Photo by Martin Ruetschi

40% of energy in most countries, but in Asian city states like Hong Kong and Singapore, buildings consume up to 90% of the national electricity. In such cities, resource conservation can be considerably increased by applying smart building automation to lighting and thermal regulations, as well as changing the behavior of residents through the use of smart electricity meters which feed back to the smart grid.

Increasingly, many of these smart technologies revolving around automation, sensors and big data will be applied to power supply, water and waste, healthcare services, affordable housing, rail infrastructure and public transport systems across Asia. With China and India topping the global tables with the most cities with >1m population at 102 and 46 respectively, the potential for scalability from replicating and rolling out smart city concepts is considerable in these two countries.

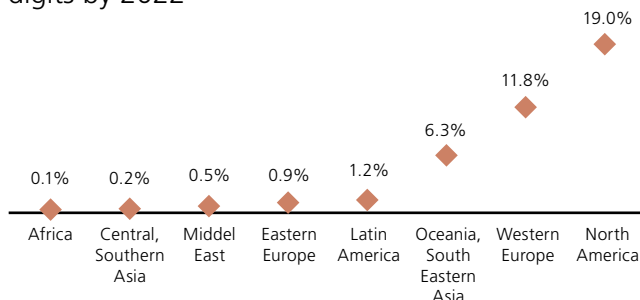
High internet penetration across Asia and the roll-

out of 5G networks in at least four Asia-Pacific countries by 2020 will become a powerful catalyst for Asian smart city development. We expect select Asian cities with 5G networks to leverage sensor networks and big data to identify and rapidly respond to challenges in the urban environment. China's push in robotics and AI will also establish a regional base for automation and big data to smart city concepts. Furthermore, China's infrastructure drive across emerging Asia, via the Belt and Road Initiative (BRI), offers channels to transfer smart city technology to less developed neighboring countries where it is investing in power, rail infrastructure, residential real estate and data centers.

Several developed Asian countries, like Singapore, Hong Kong and Japan, and Australia have been significantly ahead of the curve, piloting many Asian smart city concepts over the last twenty years. They offer blueprints for emerging Asia cities, particularly those with shared socio-demographic features like rapidly ageing populations. The efficiency of city-state governments like Singapore and Hong Kong often facilitates the rapid adoption and execution of smart city technologies. Indeed, rapid progress with smart city solutions in the cities of Asia's two most populous countries, China and India, can be attributed to the fact that smart city frameworks, guidelines and funding are often made at the national government level and implemented locally.

Fig. 3

Asia's 5G penetration expected to reach mid-single digits by 2022



Source: Ovum, Bloomberg intelligence, UBS, as of Feb 2019

How big is the smart city opportunity in Asia?

Sundeep Gantori, Analyst



CCTV Tower Beijing China. Photo by Martin Ruetschi

In this section, we cover the addressable market for Asian smart cities and the investment implications.

Addressable market

We believe smart cities will be at the center of Asia’s fourth industrial revolution, adding trillions of dollars of economic value over the next decade through the revenue generated from the six building blocks. According to Frost & Sullivan and Bloomberg Intelligence, the global addressable market for smart city projects should grow from USD 900bn in 2016 to USD 2trn in 2025 and the addressable market for China’s smart city projects should reach USD 320bn by 2025. We estimate Asia accounts for 40% of the addressable market, so based on these forecasts, the region’s smart city market could reach USD 800bn in 2025.

By segment, we expect smart services to lead Asia’s addressable market by 2025, followed by smart governance, smart healthcare, smart connectivity, smart automation and smart mobility in that order (see Fig. 5).

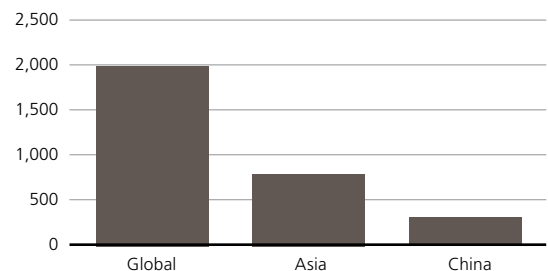
Investment implications

Given the huge revenue potential for Asia by 2025 (USD 800bn), investors can participate in this growth trend through various avenues. In particular, we believe companies exposed to faster-growth segments like fintech, 5G, smart mobility (which includes electric vehicles and autonomous driving) and healthtech are in a sweet spot given the confluence of strong demand and regulatory support. We believe a combination of both Asian corporations with strong exposure to the above trends and global leaders with strong technology leadership should benefit from the robust growth opportunities to come in Asia’s smart cities. Conversely, those engaged in antiquated urban operating systems are at risk of becoming outdated.

Fig. 4

Smart city addressable market in 2025*

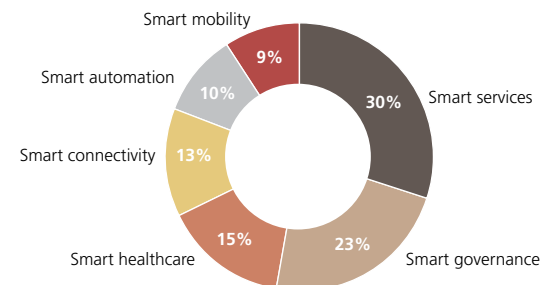
In USD bn.



Source: Frost & Sullivan, Bloomberg Intelligence, UBS estimates, as of February 2019. *Forecast

Fig. 5

Smart city addressable market by segment in 2025*



Source: Frost & Sullivan, Bloomberg Intelligence, UBS estimates, as of February 2019. *Forecast

Chapter 4

Regional deep dive

In this section, we cover key countries in the region that are leading Asia's smart city journey.

China

India

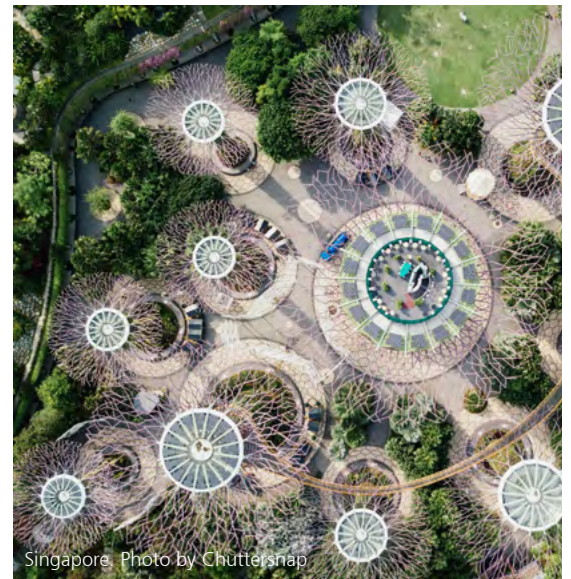
ASEAN

Singapore

Hong Kong

Australia

Japan





Hong Kong. Photo by Claudia Link



Tokyo, Japan/ Photo by Tanaphong Toochinda



Singapore. Photo by C. J. Wadhwa



Khwaeng Suriya Wong, Thailand.
Photo by Flowdzone Creativity



Guangzhou Shi, China. Photo by Holger Link



Beijing, China. Photo by Martin Ruetschi

China – tech titans lead the smart city drive

Elaine Zhou, Analyst

“Ultimately everything in cities will depend on computing power, in the same way they depend on electricity”

Wang Jian, Former Chief Technology Officer of Alibaba

China aspires to become a global leader in strategic industries like 5G, autonomous vehicles and IoT, so the government strongly incentivizes the development of smart cities through homegrown technology. China exemplifies the Asian government-driven smart city model, which lays down frameworks, guidelines and funding. China invested CNY 500bn in its national smart city program during the 12th Five-Year Plan period (2011–2015), leading to the launch of over 90 pilot smart cities. By 2017, there were 500 smart cities at various stages of development with an estimated market size of CNY 650bn.

The key technologies being employed in China’s smart cities include the IoT, Big Data, cloud computing and other smart systems. The unique part of China’s smart city model is its drive to leverage and encourage domestic innovation by working closely with Chinese technological leaders Alibaba, Tencent and Baidu. The technologies developed by these companies are primarily being applied to e-government, smart transportation and smart living, all of which cover a broad array of smart concepts.



Photo by Claudio Bader



China’s technology leaders drive smart city innovation

According to Alibaba, building a smart city has to look beyond technology hardware. For example, electric vehicles cannot operate effectively in a city without the necessary charging infrastructure. As a result, the company is using real time and large-scale video analysis and artificial intelligence (AI) to integrate industries and enhance government and service models. This method is being rolled out to first-tier cities across China.

In Hangzhou, for example, the management of utilities like transportation, power supply and water supply has been digitized since 2016. The results are telling: the digitalized operation of 128 traffic lights reduced road crossing times by 15% and saved highway driving time by an average 4.6 minutes per trip. In the Xiaoshan area, the time taken by ambulances to reach accident sites has halved (Source: Citi Research, 2019).

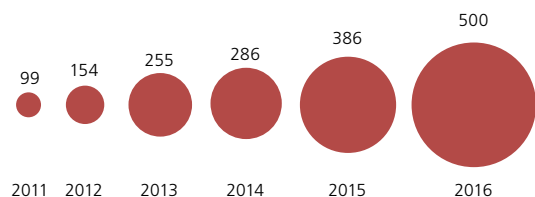


China advances in autonomous driving

Autonomous driving has already taken off in China, with companies leveraging online mapping capabilities and cloud technology integrated with artificial intelligence (AI). The first step towards mobile autonomy has been the development of intelligent screen monitors on car windscreens to aid navigation. A major initiative is also underway in Xiongan New Area of Hebei province to employ Big Data, video monitors and AI to free up traffic congestion through an intelligent traffic management system. The next step will be to introduce self-driving private vehicles in the city. In the longer term, plans are afoot to operate 100 self-driving buses in Beijing and Shenzhen.

Fig. 6











Number of smart cities in China



Source: Zhihuichengshi, Deloitte, Citi Research, as of November 2018

Fig. 7

China’s smartest cities and their strengths

City	Theme	Details
Beijing	 Big data and smart economy	Widespread broadband facilities and smart IT-based applications promote development of IT and IoT
Tianjin	 Smart living	E-government, accessible IT and hardware construction
Shanghai	 IT and smart infrastructure	Information infrastructure and cybersecurity, real-time collection of public transport data
Hangzhou	 IoT and big data	Cloud computing, Big Data industry, IoT, internet finance, smart logistics and digital content industries
Nanjing	 IoT platform	IoT is applicable in a range of municipal projects to promote government datacenter and resident cards
Wuhan	 Smart living	Efficient transmission of and intelligent response to city info
Chongqing	 IT and smart infrastructure	Citywide sensor infrastructure, public info platform and strong network coverage
Chengdu	 Smart transportation	Partnerships with Didi and Microsoft for cloud and IoT technology
Shenzhen	 IoT platform	Link up different sectors including transportation, logistics and community life
Guangzhou	 Smart transportation	The smart transportation sensor platform covers core districts, primary and secondary trunk roads, and city entrances and exits to achieve real-time monitoring and control of passenger traffic volume and flow

Source: Zhihuichengshi, Deloitte, Citi Research, 2018



Smart governance: digitalizing governmental services and networking

The prevalence of mobile messaging in China establishes a ready platform to offer governments, enterprises and citizens payment and location services. Again, AI will be central to managing the connection between devices and different services. Smart city networks currently cover over 150 cities in China and are used for policing and road traffic management as well as in retail, healthcare and education services. In southern China, particularly Shenzhen, the telecom sector has been especially active with digital service providers to support the creation of digital governments, e-government basic infrastructure and various data solutions including data integration and security systems.



Smart payments: cashless society

China is the world’s biggest cashless marketplace. Citizens can pay for almost anything, anywhere, from convenience stores and shopping malls to fine dining, by scanning QR codes. Mobile payments are even the norm to pay for items from small vendors like vegetable stalls and street food. The mobile payment market is dominated by two apps – Tencent’s WeChat Pay and Alibaba’s Alipay – with hundreds of millions of active monthly users. Two years ago, bank cards ranked as the most preferred payment system in China, according to the Hurun Report. But last year Alipay, followed by WeChat Pay, topped the list, reflecting the rise of mobile payments in China. (For a more detailed discussion of the rise of cashless payments in Asia, please refer to the “Shifting Asia: The Road to Cashless Societies”). China is seen as the first nation to move towards a completely cashless, or cardless society, significantly lowering risks from robbery and counterfeit money.



Huangpu Qu, China. Photo by Jing Xiu



Beijing, China. Photo by Martin Ruetschi



Smart retail: the rise of e-commerce and smart logistics

While China's e-commerce sector has experienced unprecedented growth over the last decade, the penetration of e-commerce within China's retail industry is only around 20%, leaving huge room for on-line players to expand. The integration of e-commerce and offline retail remains an ongoing trend for online players; for example, by creating platforms for offline merchants and brands to operate online. Doing so could help merchants better anticipate future demand, manage logistics and build up supply. The wealth of retail and customer data captured by e-commerce players through increased transactions allows better control over consumer behav-

ior and logistics, positioning for better penetration and future growth. While competition has intensified among leading players, we expect the rivalry to help advance e-commerce and smart retailing in China.

Alongside the fast expansion of e-commerce, China's logistics industry is growing rapidly – daily package volume surged from 38m in 2014 to 110m in 2017. Accordingly, a logistics leader has seen its volumes triple in the past three years to 70m packages a day, versus 36–37m for the US leader. Logistics costs are currently 14.6% of China's GDP, with the industry targeting to reduce this to 5% through the use of smart solutions.



Smart Internet: 5G network roll-out

China is racing ahead of the world with its 5G roll out. The next generation of wireless technology promises much faster speeds while using less power, making it a top priority for Beijing. Unlike previous generations of mobile technology, which tended to introduce a single novel feature for users – i.e. 1G allowing users to walk and talk, 2G to text, 3G to surf the internet, and 4G to stream and watch videos – 5G will simply deliver more comprehensive and dramatic improvements to existing features. By employing new wireless infrastructure, which promises speeds up to 100 times faster than 4G, it should virtually eliminate processing delays. It will also help to fire up the IoT industry, facilitating the connectivity between billions of machines, appliances and sensors, taking smart cities and smart living to the next level.

5G's central role for development of smart cities is a key reason the Chinese government has been so relentless in its pursuit. In its 13th Five-Year Plan, the government describes 5G as a "strategic emerging industry" and "new area of growth," while Made in China 2025 outlines China's goal to become a global leader in 5G as a major step forward in the development of smart cities. China Mobile and China Telecom have already established 5G test networks in several cities. Local authorities have encouraged developers to create 5G-based applications for telemedicine and urban infrastructure. Leading players, such as Huawei, have achieved advanced 5G technologies and innovation that are at least 12 months ahead of global competitors.



Smart cloud computing

China's smart cloud computing market is characterized by a duopoly that controls just over half of the total market. Consolidation continues in this market with small players gradually being squeezed. Market leaders will continue to lead technology improvement in the coming years through the upgrade of cloud services, which will fully integrate machine learning, algorithms, database and technical infrastructure platform. These new cloud services will largely target medical, transport, education, energy and manufacturing, to raise efficiencies via digitalization, enhancing both corporate productivity and profitability.



Photo by Tadej Pibernik



Hyderabad, India. Photo by Arihant Daga

India – smart leapfrogging

Sundeep Gantori, Analyst

“Digital India is an enterprise for India’s transformation on a scale that is, perhaps, unmatched in human history”

Narendra Modi
Prime Minister of India

In 2011, according to census data, cities accounted for 31% of India’s population and contributed 63% to its GDP. By 2030, the government expects cities to account for 40% of the population and 75% of GDP. Such a huge transition will require an enormous expansion of physical, institutional, social and economic infrastructure, making the development of smart cities an integral part of the country’s future. While most emerging markets are investing in smart cities, India’s diverse cultural and geographical background is making its smart city journey a unique one. On the positive side, India has the benefit of a healthy demographic dividend (i.e. it has a youthful population) when compared to advanced economies. And such favorable demographics should ultimately yield vast opportunities for the country through increases in productivity and GDP per capita over the long term. But this also means increased pressure on current urban centers as to how they can accommodate a rapidly growing population in terms of employment, housing and other basic infrastructure.

The push for smart cities also means sizeable investment sums to rejuvenate existing cities or to develop new projects – a costly but much-needed makeover. Due to poor urban planning and decades-old infrastructure, India’s big cities lack basic amenities like sanitation, clean water, proper public transportation networks, etc. For example, cities like Bengaluru and Hyderabad, which are dubbed the Silicon Valley of India, have evolved into megacities because of technological advances and digitalization, but they remain far behind the developing world’s standards for living and infrastructure.



Mumbai, India. Photo by Martin Ruetschi

To be part of the new-age class of cities, India has no other option but to leapfrog ahead to invest in smart cities and to make them future proof. This means incorporating smart technologies on par with some of the most developed cities in the world. To solve its urban challenges, the Indian government (under the Ministry of Urban Development) announced a grand project called “Smart Cities Mission” in 2015. This initiative seeks to identify, assist and develop 100 Indian smart cities through retrofitting, redevelopment and greenfield development. The core structure of the Smart Cities Mission mainly revolves around e-governance and citizen services, efficient urban mobility and transportation, sustainable living and affordable housing, smart water and utility management, IT connectivity and digitalization, sanitation and solid waste management, smart classrooms, video crime monitoring, and more.

The list is expansive, so every city identifies one or two pan-city issues that it would like to address as a priority. For example, in 2016, during the first phase where 20 cities were selected and labelled as “lighthouse cities,” the top three core issues identified were centralized command and control centers by 13 cities, smart parking systems by 11 cities, and traffic operations and management systems by 10 cities. The cities that got selected had

extensively engaged with their citizens and tried to get real-time feedback through surveys. They have involved their citizens from the beginning so that they can maintain bilateral communication, which will be needed for support during the later stages when the tasks are nearing completion.

As part of the Mission, 100 cities were nominated to take part in the initiative. The cities had to first compete with other cities in their states, which do the nominating, to be selected. The shortlisted cities receive capital injections of INR 2bn per year, split 50:50 by the central and state governments. The

Fig. 8

Snapshot of India’s Smart Cities Mission

	Round 1	Round 2	Round 3	Round 4	Round 5
Number of selected cities	20	40	30	10	10
Period of selection	Jan 16	May to Sep 16	Jun 17	Jan 18	
Total number of projects	829	1,959	1,891	472	5,151
Investment (INR crores)	48,064	83,698	57,393	15,863	205,018
Average SCP size (INR crores)	2,403	2,092	1,931	1,586	2,050

Note : Shillong selected as 100th smart city in June 2018; 1 crore = 10 million
Source: Ministry of Housing and Urban Affairs, India, UBS, as of December 2018



Bhopal, India. Photo by Rohit Tandon



Old Delhi, New Delhi, India. Photo by Annie Spratt

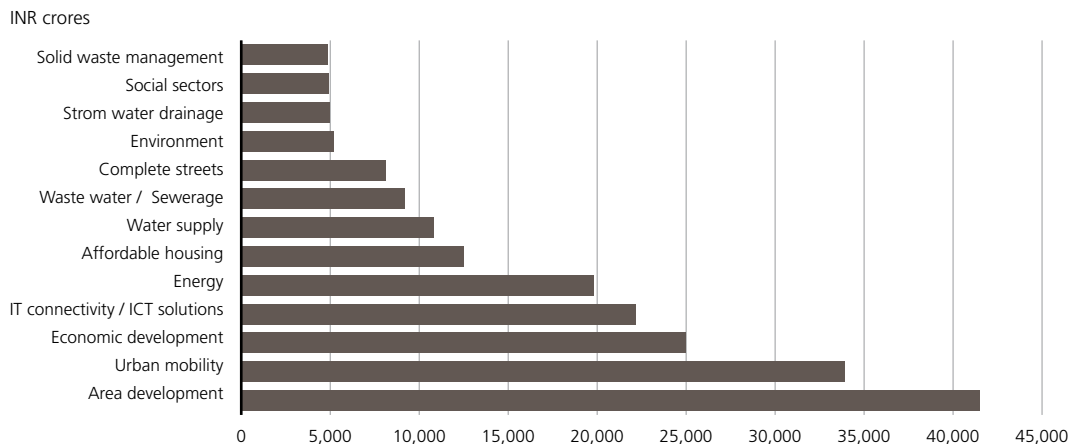
initial capital grant is given to a Special Purpose Vehicle (SPV), which is headed by full-time smart city CEO. To raise additional capital, the SPV can source funds through public-private partnerships, joint ventures, issuance of municipal bonds, land monetization and other areas like user charges.

The main motto of the Smart Cities Mission is “infusing technology” to build smart cities, but the

idea is also to think about development holistically. Each city, under the expert guidance of the SPV CEO, comes up with projects that aim to improve living conditions or address core issues like sanitation, congested traffic conditions, recreational areas and solid waste management. For example, Bhopal, a city in central India, sought to retrofit its city through integrated area developments, integrated traffic management systems, smart road

Fig. 9

India’s smart city projects by key sectors



Note: 1 crore = 10 million

Source: Ministry of Housing and Urban Affairs, India, UBS, as of December 2018



Chennai, India. Photo by Prashanth Pinha



Surat, India. Photo by M Nagarajan

lanes with spaces for cycles and pedestrians, a bi-methanization power plant, and apps for citizen services and e-governance.

While it's early days, India's unique smart city plan has made decent traction so far. The initiative, being the first of kind in India, initially failed to attract private players, but more cities are forging public-private partnerships to accelerate the pace of project implementation. The government has also started to rank the smart cities under an Ease of Living Index, using certain minimum standards for cities to compare and evaluate their progress. Under the program, India's Ministry of Housing and Urban Affairs has developed a set of Ease of Living Standards. A total of 78 indicators – 56 core indicators and 22 supporting indicators – are covered. These have been grouped under 15 thematic categories, which in turn form the four pillars of urban development: institutional, social, economic and physical.

While India is heading in the right direction in its smart cities vision, there are many hurdles to be overcome. India is known for being home to some of the biggest slums in the world, and it will be a mammoth task for the government to accommo-

date the urban poor with proper alternatives and to evict them without any coercion. Financing smart cities is another challenge – governments traditionally provide aid grants for such huge infrastructure projects, but for the Smart Cities Mission, it's the SPV's responsibility to raise funds. While big cities with strong income sources can more easily implement these projects, small cities and green-field projects may find it more difficult to secure investment. Finally, like in any country, coordination among various government departments and citizen participation remains a challenge in India.

Nevertheless, we believe smart cities can transform India and its urbanization journey. The recent progress India has made in the digital space, such as increasing internet and smartphone penetration and fintech adoption, following the 2016 demonetization program sets the stage for India to transform into a smart nation.

Interview

M Nagarajan
District Collector, Arvalli



M Nagarajan is an Indian Administrative Services officer and currently the District Collector of Arvalli, Gujarat, India. Until recently he was leading the Surat Smart City Mission as CEO of the Surat Smart City Development SPV. Under his leadership, Surat was recognized by the Indian government for having the highest momentum in smart city implementation. Smart transportation, ICT, renewable energy and open data are some of his key priorities. He has a Masters in Public Policy and a Masters in Economics. M Nagarajan has received an award for Innovative Use of Technology in Elections by the Election Commission of India.

1. How unique is India's Smart Cities Mission project compared to the rest of the world?

The core mission of smart cities is to optimize the efficiency of city operations and services and to connect to citizens. The approach world over is to use different types of electronic data collection sensors to collect information, which is used to manage assets and resources efficiently.

The data is collected from citizens, devices and assets and is processed and analyzed to monitor and manage traffic and transportation systems, power plants, water supply networks, waste management facilities, law enforcement, information systems, schools, libraries, hospitals and other community services.

Urban India is faced with the task of building basic infrastructure and services and becoming a smart city at the same time. The former is the bottom line for urban governance, and smart cities are the topline part of it. India's smart cities mission tries to balance both requirements.

Projects like retrofitting existing areas to improve roads and signage, create cycle tracks, utility ducting and developing roads up to national and international standards with an emphasis on walkability

set the minimum standards for being a smart city. On the other hand, information and communications technology (ICT) projects with a focus on city command and control centers, transportation systems, enterprise resource planning (ERP), geographic information systems (GIS), fiber optic and fiber-to-home connections are topline smart features that are now being implemented in India's smart cities. In Surat, out of the total smart city plan of INR 2,597 crores (USD 365m), 700 crores (USD 98m) were earmarked for ICT.

Another standout feature of India's Smart Cities Mission is the clear focus on public-private partnerships (PPP) and improving governance by using technology. The choice is given to the city to choose priority themes and projects as per the city's future vision and citizen feedback. The unique feature is this bottom-up approach to planning.

2. How is India leveraging various digital technologies for its smart city projects?

The first step of digitalization under India's smart cities is the creation of an integrated command and control center to streamline operations, which oversees integrated transport management systems (ITMS), integrated traffic control systems (ITCS), ERP and GIS systems.

Smart streetlights with centralized control and monitoring systems (CCMS) have led to efficient energy use and maintenance. Smart parking and intelligent parking systems and management are also helping cities to manage traffic better and plug leakage of revenue. Use of GPS tracking for emergency and non-emergency vehicles and the integration with the command and control center provide valuable tools and information for city managers to respond and coordinate day-to-day activities and to manage incidents effectively.

Various operational points like water heads, pumping stations for water and sewage, and distribution networks are also monitored, while smart water meters for water supply are also being implemented. Laying out citywide fiber-optic networks for city operations and public wifi using smart poles are other examples.

All such systems are seamlessly integrated into the command and control center, which provides a convergence of emergency, non-emergency services, transport and civic operations in one nerve center for the city. Surat is building one such center, which will be inaugurated shortly.

3. What have been some low-hanging fruit in terms of smart city implementation, and what are the key focus areas for the next few years.

The integrated command and control center and retrofitting projects in area-based developments offer quick wins in terms of value and citizen satisfaction. Smart parking and intelligent traffic management systems promise immediate gains and impact on services. Others include the Surat city's live bus schedules, which are integrated with Google services, allowing citizens to plan their journey with their smartphones. Further, ERP and GIS systems improve overall city operations and reduce costs.

4. Where do you think are the biggest challenges?

The biggest challenge is meeting the vision of the Smart Cities Mission within the proposed tight deadlines. Also, the modeling of PPP projects to ensure market interest and sustainability is a major challenge for cities. For most cities, a PPP project of this scale would be a first experience.

The long gestation and the tenure of the projects, typically 15 to 20 years, make the market players jittery about predictions. For example, the citywide fiber optic and fiber-to-home projects have not elicited market responses due to risks in data usage in a city-based network. Also, the rollout of 4G and 5G increases the risk of market obsolescence. Hence, the bids are too high or none at all.

Building cyber-security thinking and standards in the entire approach to smart cities is important; neglecting to do so could create an inherent risk in India's Smart Cities Mission.

5. Financing smart city projects has always been a point of contention globally. How are you able to address those challenges?

Recently Pune, Ahmedabad and others have gone the route of issuing bonds and have had an enthusiastic response from the market. This is only going to improve. Other cities are working on increasing compliance and ratings to get ready to go to market.

PPP models come in all flavors based on local requirements and business potential. Highways have been a major avenue of PPP projects in India. But with smart cities, the market players are working on creating sustainable projects. Value-capture financing is being explored in a big way for financing smart cities.



Kuala Lumpur, Malaysia. Photo by Sadie Teper

ASEAN smart cities – a solution for sustainable urbanization

Valerie Chan, Analyst

“ASEAN must respond to the Fourth Industrial Revolution as a region...”

Nguyen Xuan Phuc,
Prime Minister of Vietnam

Rapid urbanization a common concern

Southeast Asia is steadily urbanizing, with an estimated 49% of the region’s population already living in cities and towns. As the region pursues strong economic growth, it will see the pace of urbanization rising rapidly in the coming decades. The United Nations World Urbanization Prospects estimates that the region will achieve 56% urbanization by 2030 – i.e. an incremental 84 million people will be living in cities by 2030. The pace of urbanization has to pick up in the lagging Association of Southeast Asian Nations (ASEAN) economies in order to achieve greater wealth and higher purchasing power, but in the process the population of the region’s cities will balloon.

Urbanization however raises concerns about sustainability. Cities have a tendency to prioritize economic growth at the expense of environmental and social deterioration. Cities in the Philippines, Indonesia and Thailand, for example, are notorious for their heavy traffic congestion, inadequate infrastructure, poor living conditions and environmental issues. Thankfully, local governments have been taking more proactive measures in recent years to manage existing and potential problems in urban areas. Still, more can be done.

Smart cities network – Pilot cities

Association of Southeast Asian Nations



Source: Government of Singapore, UBS, as of March 2019

ASEAN smart city initiative – opportunity for joint efforts

In 2018, 26 cities across the 10 ASEAN countries were earmarked in the ASEAN Smart Cities Network (ASCN) pilot. The aim of the network is to help cities to collaborate and achieve the goal of smart and sustainable development. So far, member states have designated cities (and provinces) as smart cities. Member states are guided by a joint non-binding framework that can be suited to a city's specific needs and potential.

Key focus areas in the framework include civic and social welfare, health and well-being, safety and security, quality environment, infrastructure, and industry and innovation. Regardless of each country's focus, the deployment of technological and digital solutions aims to improve optimization and resource efficiency. This could help balance the costs of depleting resources versus economic growth, and ultimately improve living standards.

For example, cities can utilize innovative ways to deliver public services (i.e. smart government); use tech solutions to provide key services, such as healthcare, housing and education, to optimize the use of public resources and improve the welfare of citizens (i.e.

smart health); and increase competitiveness by encouraging businesses to innovate and automate (i.e. smart manufacturing). In about a decade, as adoption picks up from current low levels, the region's manufacturing sector could see greater adoption of industry 4.0 technologies; this trend should benefit manufacturing-based economies such as Indonesia, Thailand, and Vietnam the most. On a social level, individuals and businesses can seamlessly access more public services on digital platforms.

Together as a region, the ASCN enables further collaboration within the region and between the region and its global partners. This could draw additional resources, such as investments, knowledge sharing and collaboration platforms, that support the development of smart cities in the ASEAN bloc. For example, ASEAN is pushing for the development of the ASEAN Single Window (ASW) digital system, which integrates different national single-window systems and enables electronic exchange of trade documents to speed up cargo clearance and encourage more cross-border trade. With the common goal of building a resilient and innovative ASEAN, and ultimately to improve the lives of everyone living in the region, member countries are also encouraged to have an integrated masterplan for smart city development.



Bangkok, Thailand. Photo by Domepitipat

Smart city developments – Thailand and Indonesia

Smart cities is not a new concept in the region – countries like Singapore, Thailand and Indonesia have embarked on their own smart city projects, usually as a part of the nation’s broader economic development plan.

Thailand – building its first S-curve industries

Thailand will likely face structural issues in the medium term as it loses its competitiveness as a manufacturing hub to its regional peers. A more innovative economy encompassing the smart city concept could move the nation up the value chain and reinvigorate the economy. Establishing smart cities is a key topic in the Thai government’s Thailand 4.0 initiative, which aims to revamp large cities into technology hubs. In total, the government aims to develop 100 smart cities – in areas such as smart economy, smart mobility, and smart energy and environment – over the next two decades to improve the quality of living.

So far, Phuket was included in the first phase which began in 2016, while Chiang Mai and Khon Kaen were included in 2017. The basis of selection depends on the city. Phuket was selected based on its potential to become a regional digital services hub to attract more tourists and investors as well as its existing technology infrastructure. Likewise, for the ASEAN, popular tourist destinations were selected given that the travel and tourism sector accounts for about 12% of ASEAN’s GDP and is expected to play an even bigger role in regional economic growth in the years to come. Mean-

while, Chiang Mai was chosen to develop smart agriculture. Khon Kaen aims to become a smart healthcare hub, while a smart bus project is planned to improve connectivity in the city.

In the next stage, there are plans to develop Chonburi, Rayong and Chaochengsao. These cities and provinces are part of Thailand’s Eastern Economic Corridor (EEC) special economic zone. The EEC could become a leading economic zone in ASEAN once key infrastructure investment projects are completed in the next five or so years. The initiatives for these cities in the EEC are geared toward an innovation-driven economy with significant IoT adoption in order to build a digital economy. The Thai government is preparing to test 5G services in the EEC to encourage “First S-Curve” (next-generation automotive, intelligent electronics, advance agriculture and biotechnology, food processing and tourism) and “New S-Curve” (digital, robotics and automation, aviation and logistics, biofuels and biochemicals and medical hub) industries. As of 2017, about 588 projects were approved for investment in these ten targeted industries, amounting to a total value of THB 201.6bn (USD 6.4bn).



Jakarta, Indonesia. Photo by Daxiao Productions

Indonesia – rapid smart cities growth in 2019

The Indonesian government has led the way in the smart city path. The Ministry of Communication and Information Technology and the Ministry of National Development Planning (BAPPENAS) have initiated the 100 Smart City Movement – a program to develop 100 smart cities by 2019. Efforts include the deployment of surveillance cameras and other IoT devices in cities; these are practical applications that could ultimately be implemented in the rest of the country, using the first 100 smart cities as an example. Jakarta, Surabaya and Bandung are pioneers – Bandung has begun integrating data between the government and its agencies, while Surabaya has started monitoring traffic using surveillance cameras to deal with its traffic problem. Jakarta, the leader in the smart city ecosystem, has installed CCTVs across the city's roads. The city is now exploring smart city projects such as smart lighting, smart parking, waste management, connected manholes and smart electricity.

Meanwhile, the country is working on the Palapa Ring project, which aims to install 12,000km of fiber cables to serve as the national backbone for providing telecommunication and internet access throughout Indonesia. So far, the west and central packages are complete, while the east package will be completed around mid-2019. Speed tests

on the central package, which completed construction last December, saw the capacity of the central ring reaching 100 gigabytes per second. Further, the government aims to have its own satellite operational by 2022 to improve the telecommunications network.

The nation's improved connectivity and growing digital transformation has created a conducive environment for faster growth in the digital economy. Global cloud giants have taken significant interest in Indonesia; data centers are booming and large cloud players are entering the market. Alibaba Cloud opened its second data center this year, 10 months after the launch of its first in early-2018. Google Cloud and Amazon AWS have also announced their plans to expand their cloud footprint in Indonesia. The launch of these data centers is in line with Alibaba Cloud's ongoing commitment to support the Indonesian government's initiative to create 1,000 startups by 2020; SMEs and startups now have access to scalable and affordable cloud services.



Vietnam. Photo by Doruk Yemenici

Costly infrastructure – one of the challenges ahead

Technology and digital solutions can help resolve the issues cities are facing as a result of rapid urbanization and can drive sustainable economic growth and improve efficiency in different segments of the economy. For a country to fully enjoy the benefits of a smart city, infrastructure – and more fundamentally, network infrastructure – is the key. For now, financing is a major issue – are there sufficient funds to introduce 5G networks to more rural areas in a country, or to offer 5G networks in developing economies? For example, introducing 5G infrastructure may not look appealing now when one weighs the costs against the benefits. Regional telecom companies will face high investment costs when building the necessary infrastructure, and will have to consider whether

they will have enough customers to help defray the costs of building a higher speed network. This issue may delay telcos' decision to install 5G infrastructure, and prolong the time taken for 5G to be rolled out throughout ASEAN.

A study by Temasek and Google estimates that the ASEAN digital economy could grow to USD 200bn by 2025. Domestic and regional efforts to achieve the common goal of becoming "smarter" would open up new opportunities for the more developed ASEAN economies. While growth varies from country to country in ASEAN at the moment, the region's developing countries (CLMV: Cambodia, Laos, Myanmar, Vietnam) can adopt the higher-income countries' technological solutions to leapfrog into the next stage of economic development – a win-win situation for everyone in ASEAN.



Singapore. Photo by Adrien Olichon

Singapore – ahead of the curve in digital transformation

Valerie Chan, Analyst

“We are rebuilding the aeroplane
even as it is mid-flight”

Lee Hsien Loong,
Prime Minister of Singapore

Singapore is undergoing digital transformation to sustain the country's economic growth and competitiveness, even as rapid digitalization poses disruption risks to businesses, industries and economies. Adopting greater digital solutions is expected to help the city-state to improve the quality of living (through smart homes, a smart urban habitat and autonomous vehicles), and to ensure long-term sustainability through the use of technologies (such as water and waste management systems). In 2014, it launched the “Smart Nation” initiative to take advantage of the various uses of technology to build a cohesive nation and maintain its competitiveness among the world's top cities. The Smart Nation and Digital Government Office in the Prime Minister's Office was set up in the same year to coordinate the nationwide Smart Nation initiative. In terms of funding, Singapore's National Research Foundation (NRF) launched a national program on AI in 2017 with a SGD 150m investment over five years, focusing on applications in finance, city management solutions and health-care.

The government is leading efforts for a digital revolution that feeds through not only the public sector, but also the various segments of society (including private stakeholders) to ensure that they are able to fully harness digital technologies to their benefit. Singapore is well equipped to benefit from the Smart Nation initiative, in our view. In terms of digital readiness - Singapore's smart phone penetration (151%) is one of the highest in the world - it has one of the highest fiber-to-home penetration rates in the world according to PPC, and is second (after the US) in the IMD World Digital Competitiveness

Fig. 10

Milestones for Strategic National Projects

	2017	2018	2019
National Digital Identity (NDI)	Successful MyInfo bank pilot	NDI Sandbox	
	MyInfo Developer & Partner Portal launched	MyInfo 110 govt services and 90 private sector services	
	MyInfo Basic Profile implemented	Singpass mobile	
E-payments	PayNow	Govt agencies start using PayNow	Launch of account based ticketing
	Account-based ticketing pilot for public transport	SGQR payment standard	Rollout of 50,000 unified point-of-sale terminals
	E-payments in hawker centres	PayNow corporate	Non-bank FAST access
			Payment Services Act
Smart Nation Sensor Platform (SNSP)	Wireless sensor network trials in Orchard Road and selected areas	Personal alert button trials	Lampost-as-a-Platform trial
		Lampost-as-a-Platform tender	
Smart Urban Mobility	More timely public bus arrivals with Common Fleet Management System	Trial of on-demand autonomous shuttles	Trials for autonomous buses
	Launch of CERTANN AV Test Centre	Trial of hands-free ticketing technology	
		Trial of on-demand public bus services	
Moments of Life (MOL)		Pilot MCL app for families with young children	Expanded suite of services for families with young children

Source: Smart Nation Singapore, UBS, as of 13 December 2018

Ranking. In order to adapt to the changing world, and as other developed nations such as Japan, Korea and Australia also embark on the smart nation journey, it is necessary for Singapore to move forward and become a smart nation. According to the IDC, the APAC region accounts for 42% of total smart city investments (USD 158bn) worldwide, of which Singapore tops in spending.

The key pillars supporting Singapore's Smart Nation targets include the digital economy, digital government and digital society. Much has been accomplished since the nationwide initiative's launch (see Fig. 10). The government has come up with various applications, ranging from on-demand public buses that use autonomous technology and public transport data to help buses pick up passengers at specified bus stops, to real-time

parent-teacher portals and smart water meters that monitor and collect water consumption data and alert households of water-pipe leaks. Also in the works is a nation-wide grid of IoT sensors – i.e. smart lamp posts that can monitor everything such as traffic, temperature and humidity. This enables data to be collected that could help Singapore deal with future challenges such as climate change. Singapore's systematic pursuit of new applications of innovative digital technology to improve people's lives has brought Singapore to the top in the global smart city performance ranking, according to a survey by Juniper Research and resulted in Smart City award of 2018 at the Smart City Expo World Congress.

In 2020, a new national digital identity (NDI) system – one of the government's five strategic na-



Singapore. Photo by Annie Spratt



Singapore. Photo by Kevin Yulianto

tional initiatives – will become operational. The NDI underpins Singapore’s development as a safe and secure society. Using a soft token via smartphone rather than a hardware token, it is a sophisticated method for authenticating an individual’s identity online. A centralized biometric scheme, involving facial recognition, could also be included. For a start, the NDI brings to Singaporeans a simpler process to access e-government services. To allow the private sector to leverage on the NDI system, the government will extend the NDI to businesses in various industries, including the finance sector, with “software development kits and plug-ins” so that companies link their services to the nation’s centralized biometric platform as well as reach out to customers through smartphones. This is just one of the initiatives that can open up new opportunities.

Singapore has built up a reliable track record in implementing and coping with digital transitions, having launched six national IT masterplans since 1980. Over the years, the city-state has made significant progress in IT infrastructure, has raised the country’s competitiveness in the world, and has built a skilled workforce, among others. The government has constantly identified and prepared for long-term trends, which its neighbors in the region can take a leaf from. That said, Singapore has its own issues, being a small city-state (721.5km²) with a population of 5.6m. And as the rest of Southeast Asia becomes increasingly more urbanized, progressing to a smart nation will help Singapore ensure future sustainability.

Interview

Ng Chee Khern

Chairman

Government Technology Agency of Singapore
Permanent Secretary, Smart Nation and Digital Government
Prime Minister's Office, Republic of Singapore



Ng Chee Khern is Permanent Secretary for Smart Nation and Digital Government in the Prime Minister's Office (PMO) leading the Smart Nation and Digital Government Group formed in May 2017. In this role, he leads the government's efforts in driving the development of digital enablers for citizens and businesses, and applying digital and smart solutions to improve the lives of citizens in a Smart Nation.

1. What is Singapore's Smart Nation project about, and are there specific areas of focus?

Smart Nation is about transforming Singapore through technology. Our Smart Nation vision entails a leading economy powered by digital innovation, and a world-class city with a government that gives our citizens the best home possible and responds to their different and changing needs.

Other countries and cities are similarly looking to technology to transform themselves. Each will have a different focus based on their needs and developmental emphasis. In Singapore's case, our focus is on taking a whole-of-nation approach and on delivering tangible outcomes for citizens and businesses.

In support of Smart Nation, we plan to build a Digital Economy, Digital Government and Digital Society. The Economy is the key driver of Singapore's growth and competitiveness, the Government catalyzes that growth and innovation, and Society harnesses the digital technologies and benefits from them.

At the Smart City Expo World Congress held in Barcelona last November, we won the 'City Award' – one of the most prestigious titles in the smart city space – which recognized Singapore's ability to implement digital initiatives nationwide and our focus on placing citizens at the centre of our Smart Nation efforts. More recently, a satisfaction poll conducted in Singapore showed that there is an uptick in businesses' and citizens' satisfaction levels with the government's digital services.

While the government is putting concerted efforts into delivering tangible benefits to citizens and businesses, we recognize that we cannot achieve our Smart Nation vision on our own. We have to partner citizens, businesses and the community. For example, we have started to seek the public's views to co-create Smart Nation and digital government products and services. This is significant because we are involving citizens much earlier in the development process, and can incorporate their feedback to improve the design of services and policies in order to address and meet their needs.

2. How can Singapore benefit from being involved in the ASCN, and what can the country bring to the table?

We benefit by tapping onto the wider pool of talent, ideas, capital and opportunities across ASEAN and the world. This helps us build an ecosystem within Singapore, sustained by an open flow of talent and capital, excellent physical connectivity and digital platforms, and strong rule of law including a reliable IP regime.

Singapore brings to the table a trusted and thriving environment where entrepreneurs, companies and clients come together and build good companies and products. Grab's decision to be headquartered here is reflective of this. We are a gateway to the region, both in terms of talent and markets. We are also a source of investment, having attracted many venture capitalists due to the Monetary Authority of Singapore's investment-friendly policies. Singapore will also continue to build on initiatives to deepen people-to-people connectivity. For example, the Singapore-ASEAN Youth Fund was renewed in 2018 with a SGD 5 million top-up, to support initiatives by ASEAN youths.

3. What are the challenges that Singapore and other countries in the region are likely to face?

As Singapore faces challenges from the adoption of emerging technologies such as AI, we should play to our strengths and leverage our competitive advantage in key areas. Due to our single layer of government and small size, we are agile and can test bed ideas and products and implement them at speed at the national level. We have also established a global reputation as a trusted partner that is capable of scaling solutions for other bigger markets. On top of our structure and stature, we have also established strong foundations – in data and digital infrastructure, an established research ecosystem and traditional STEM capabilities – which position Singapore as an attractive global hub for AI and other technologies.

As we press on with our Smart Nation vision, I see two main challenges for Singapore: (i) creating the right environment to harness technology, and (ii)

attracting and retaining talent.

The first challenge involves building a conducive environment to harness digital technologies and promote cross-border collaborations. The government has been re-engineering to serve its citizens better. This is not only in terms of refreshing and revamping technical systems, but also adopting a paradigm shift to design digital solutions with a citizen-centric lens, rather than from the traditional perspective of agency silos. Part of the challenge is how we can continue to use data in a safe and responsible way to harness the benefits of digitalization. We are keen to work with regional partners to uplift data standards and facilitate cross-border sharing of data to benefit people. This should complement, rather than contradict, ongoing efforts to ensure ethical use of data.

The second challenge is critical in building an ecosystem in the digital age. We are keen to build deep engineering and technical capabilities across the entire ecosystem, so that different sectors can harness digital technologies to improve their products and services. As the next bound on the technological front will be how we harness AI to make a big, positive impact for citizens and businesses, talent in this field will be critical in supporting our Smart Nation goals. The Singapore government has stepped up efforts and we have started building up our own pool of technical talent. We are also continuing to attract foreign technical talent to boost our technical expertise across the board.



Hong Kong. Photo by Martin Ruetschi

Hong Kong – catching up

Dennis Lam, Analyst

“We have no time to waste – not if we want to turn Hong Kong into one of the world’s smart cities”

Carrie Lam, Chief Executive of Hong Kong SAR

When it comes to smart city developments, Hong Kong is playing catch up. Despite its world-class logistics capabilities and its role as an international financial center, Hong Kong seems to have lagged behind its global peers when it comes to efforts in digital transformation. According to a recent smart city report by the Eden Strategy Institute, Hong Kong is ranked the eighteenth smartest city in the world, far behind other international metropolis such as London and New York as well as its regional peers like Singapore and Seoul.

Why is this? Part of the reason may lie with Hong Kong’s early-mover disadvantage in terms of roll out of modern public transportation and building infrastructure, which is now starting to look dated and behind the technology curve. Cheap electricity in Hong Kong has also not spurred energy conservation as aggressively as in other cities. The motivation to “go smarter” is possibly also tempered by a perception of



Hong Kong. Photos by Claudia Link

high efficiency due to extensive and reliable transport links and high-rise living. It is not unusual to have retail, financial, medical and legal services all offered within one single story block. Hong Kong's long period of prosperity, through its reliance on property and financial services industries, has perhaps bred a certain level of complacency, which makes it less dependent on economic diversification and technological innovation.

However, Hong Kong is certainly stepping up its efforts on smart city development, as the city is increasingly facing a number of challenges including traffic congestion, pollution and an aging population – issues that could be largely alleviated with

its current initiatives in Smart City. Thus, the government published a "Smart City Blueprint for Hong Kong" in December 2017, which outlines its key focus areas over the next five years. The city's financial secretary set a record annual budget of HKD 50 billion in 2018 for innovation and technology development. The increased connectivity and integration with Shenzhen and other cities within the Greater Bay Area could potentially accelerate Hong Kong's technological advances. We believe Hong Kong has the necessary government support, funding, and infrastructure to drive large-scale digital transformation within just a few years.

Hong Kong can become much "smarter" by 2022.

The Hong Kong brand of smart city

A city, no matter how “smart,” is nothing without its people. Smart city initiatives must address the most relevant needs of its citizens, or the government might risk spending millions on technologies only very few can enjoy. Hence, the Hong Kong government has identified six key areas of focus in its “Smart City Blueprint for Hong Kong” – smart mobility, smart living, smart environment, smart people, smart economy, smart government – to tackle some of the city’s most pressing challenges, make the right technologies and applications accessible for its citizens, and make Hong Kong “greener, cleaner, more livable, sustainable, resilient and competitive.”



Smart mobility

Hong Kong has an impressive public transportation infrastructure. Hong Kongers take 12.6m passenger trips every day, mainly through an extensive railway network. Periodic traffic congestion is often common on the city’s roads, which boasts 354 licensed vehicles per kilometer of road, as well as road-side pollution.

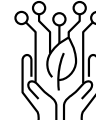
Thus, the government’s proposed smart mobility solutions aim to improve the efficiency of the traffic system by providing real-time traffic information and data analytics and to reduce pollution by promoting more environmental-friendly modes of transportation. Some of the initiatives include: 1) the installation of 1,200 traffic detectors to provide real-time traffic info by 2020, 2) the integration of all existing applications into an all-in-one traffic mobile app, and 3) the facilitation of new electronic payment systems for all public transportation.



Smart living

Hong Kongers are set to age rapidly over the coming decade, with the elderly 65+ age group set to exceed 30% of the population by 2036. Thus, healthcare and elderly care are two of the important needs addressed in the proposed smart living solutions, which calls for the greater use of technology and partnership with private sector healthcare providers to support the healthcare system. Some of the proposed solutions include: 1) the expansion of the existing electronic health-record-sharing system for better health management, 2) the establishment of a big data analytics platform to facilitate healthcare-related research, and 3) the launch of an HKD 1bn funding scheme for the trial use and procurement of technology products for elderly and rehabilitation service units.

In addition to healthcare technology, smart living solutions also include expanding the free public Wifi service, developing a “Faster Payment” system, and providing all residents a free electronic identity for authentication in all online commercial and government transactions.



Smart environment

Hong Kong is a densely populated urban city, with buildings accounting for around 90% of electricity consumption. Hence, to meet Hong Kong’s Climate Action Plan 2030+ target to reduce carbon intensity by 65–70% of 2005 levels by 2030, the government’s smart environment proposals begin with the promotion of energy efficiency and conservation of buildings, such as constructing more “green” buildings or retro-fitting existing ones with smart technologies. Other initiatives include gradually replacing coal-fired electricity generation with natural gas and non-fossil fuels, increasing the use of remote sensors to monitor pollution and the cleanliness of streets, and introducing a charging scheme for municipal solid waste.

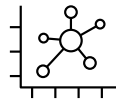


Hong Kong. Plain picture



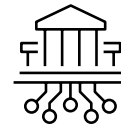
Smart people

The smart people initiative primarily focuses on growing the next generation of STEM talents and cultivating an innovative and entrepreneurial culture which characterizes some of the most successful smart cities. That includes boosting the STEM curriculum, training the next generation of STEM educators, and providing financial and non-financial support to entrepreneurs and startups.



Smart economy

For Hong Kong, as a major financial center and tourism hub, the promotion of fintech and smart tourism are crucial to future economic development. The smart economy initiatives focus on different measures to accelerate such developments, including the introduction of virtual banking and various fintech applications (trade finance, e-payment, cross-border transactions, etc.), smart airports, and tourist facilitation services in major transportation hubs. In addition, the government will seek to promote R&D and re-industrialization in Hong Kong through a data technology hub and an advanced manufacturing center.



Smart government

Hong Kong's smart city efforts begin with the government, which sets the top-level policy directions, provides incentives and funding, and encourages cooperation and partnership between the public and private sector. In addition, the smart government initiatives primarily focus on: 1) making public and private sector data accessible for research and digital applications; 2) providing and facilitating the necessary smart infrastructure such as 5G network, smart lampposts, and government cloud infrastructure; and 3) adopting smart technologies in the public sector.



Hong Kong. Photo by Martin Ruetschi

Greater Bay Area – Integration brings opportunities

The Guangdong-Hong Kong-Macau Greater Bay Area (GBA) initiative refers to the government's proposal to strengthen cooperation and integration between the Hong Kong SAR, the Macau SAR, and nine cities in Guangdong Province, namely Guangzhou, Shenzhen, Zhuhai, Dongguan, Huizhou, Zhongshan, Foshan, Zhaoqing and Jiangmen. The plan was first proposed in the 13th Five-Year Plan and received greater attention during the 2017 National People's Congress (NPC) meeting, when Premier Li Keqiang endorsed it. By combining the strengths of different cities – Hong Kong as a global trade and financial center, Macau as a tourism and entertainment center, Shenzhen as a technology hub – as well as the manufacturing capabilities of Guangdong Province, the GBA can become a globally competitive, world-class metropolis that rivals the other prosperous “bay areas” in San Francisco, New York and Tokyo.

We expect the government to gradually roll out more supportive policies for the GBA with a focus on facilitating the cross-border flows of people, capital, trade and information. The GBA is different from other world-class bay areas in the US and Japan as it involves three separate administrations

and borders within a single country. While government policies are important to support cross-border connectivity, the key challenge lies with the technology to implement the seamless integration, which government leaders have envisioned. Thus, according to China's Ministry of Industry and Information Technology, the Guangdong province and Hong Kong will work together to accelerate the establishment of a smart city cluster to support the integration efforts of the GBA.

We believe the GBA initiative will immensely benefit Hong Kong's economic growth. We see Hong Kong's role as an international financial center being enhanced by the GBA initiative, as improved connectivity should result in accelerating two-way capital flows. We expect Hong Kong to remain a major gateway for investment in China and to potentially become a venture capital hub supporting the technology industries of the GBA. In addition, we foresee many Chinese firms capitalizing on Hong Kong's strengths and expertise in professional services and its deep pool of international talent to springboard their overseas expansion plans.

Hong Kong will also benefit from the innovation and technology development of the GBA. For instance, Hong Kong could co-develop many of the



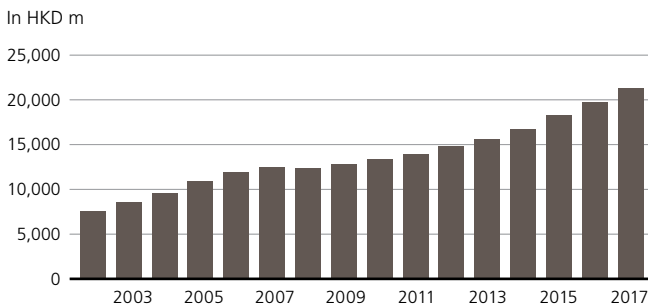
Hong Kong

technologies required for cross-border connectivity in areas such as fund transfer/payment, immigration, telecommunications and data transfer. Hong Kong could also leverage the expertise of its neighboring cities in smart city development – Guangzhou, Shenzhen, Foshan, and Zhuhai are all ranked top 10 for smart city governance in China, according to a 2017 report by the National Development and Reform Commission (NDRC).

The governments of Shenzhen and Hong Kong have agreed to develop the Hong Kong/Shenzhen Innovation and Technology Park (HSITP) in Hong Kong. The Hong Kong government has allocated HKD 20 billion toward the first phase of construction and development of this 87-hectare technology business park, which is expected to house a number of academic and research facilities and technology companies. Given its proximity to Shenzhen, the HSITP has the potential to accelerate cross-border collaboration in technology R&D and become a key incubator for technology startups.

Fig. 11

Hong Kong R&D expenditure has accelerated in recent years



Source: HK Census and Statistics Department

Key challenges

The road to large-scale digital transformation is long with many windy turns. Hong Kong’s smart city initiative has its fair share of challenges – chief among them is the availability of data. Data is the foundation of a smart city. Although the government has vowed to open up more data for innovation, research and digital applications, there is wide belief that many companies are still reluctant to share data and many citizens are still weary of privacy concerns when it comes to sharing personal details such as healthcare information.

A dearth of talent is another challenge for Hong Kong’s technological development. According to a survey by Google, only 14% of residents believe that Hong Kong is successfully developing digital talent who can apply technology and science in practice. Such belief seems to tie in with Hong Kong’s dependence on the finance and property sectors, which have driven the city’s prosperity over the past several decades. On the other hand, schools are placing greater emphasis on STEM education (Science, technology, engineering, and mathematic). The success of many technology companies globally, and in particular the rapid growth of nearby tech-led Shenzhen, has begun to alter the mindset of many Hong Kongers, which should encourage more students to choose information technology as a vocation.

Conclusion

In the realm of smart city development, Hong Kong is rapidly catching up to its more advanced peers. The next several years will be critical as the government executes a well-funded blueprint of digital transformation for both its citizens and for Hong Kong’s connectivity with the rest of the GBA. We are confident that the city will make some meaningful progress – it’s just a matter of how much “smarter” Hong Kong will become by 2022.

Interview

Albert Wong

CEO of HK Science and Technology
Parks Corporation



Albert Wong joined Hong Kong Science and Technology Parks Corporation (HKSTP) on 1 February 2016 as the Chief Corporate Development Officer and was appointed the CEO on 1 August 2016. Albert holds an Engineering Degree from the University of Hong Kong, and an MBA from the Chinese University of Hong Kong. Albert has over 30 years of commercial experience with various multinationals, including Schlumberger, Caterpillar, Emerson Electric and General Electric. Before joining the HKSTP, Albert was the CEO of ATAL Engineering in Hong Kong. Prior to that, Albert spent 15 years with GE in the US headquarters, Asia-Pacific and China as China CEO of GE Oil & Gas and Asia CEO of GE Industrial Solutions.

1. The Hong Kong government published a “Smart City Blueprint for Hong Kong” in December 2017, which outlines the key areas of development (mobility, living, environment, people, government, economy). Which areas require the most attention in the near term?

From our point of view, the first four areas (mobility, living, environment, people) are inter-connected, and many solutions are already under development at the Science Park. On near-term feasibility, we see a number of potential applications for these four areas.

Under the Smart City Blueprint, the Science Park is designated as a “Smart Region Living Lab” to support these developments. Currently, a number of potential applications are being tested, including smart bus stops, cashless payments, cashier-less stores and driver-less vehicles. These applications make use of the availability of data, connectivity and sensors at the Science Park to test new technologies such as 5G, facial recognition, and cashless payments. We have a community of 12,000 researchers, and we provide them with a smart

campus for testing and improving these applications and working out any glitches before mass rollout. For example, last year when we were testing smart light poles, we invited representatives from the highway department to work together on the configurations before rolling them out in the city.

2. The Greater Bay Area plan attracted a great deal of attention given the immense growth potential by integrating Hong Kong with Macau and nine other cities in the Guangdong province. How would such integration support Hong Kong’s development as a smart city?

The key for the Greater Bay Area is connectivity. The Greater Bay Area is different from other bay areas in San Francisco and Tokyo because it involves more than one legal jurisdiction. Thus, we have the additional complications of cross-border mobility of capital, goods, people and data. But I think this provides us with a good opportunity to test new technologies such as 5G network connectivity and e-payments under a cross-border setting.

The Science Park is a founding member of the Institute of Big Data Governance (IBDG) to govern the proper usage, sharing and protection of data and cross-border applications. Hong Kong can play a key role in leading and building the framework for cross-border data usage and sharing. Cross-border data flow plays a key role in the Greater Bay Area plan. The success can be duplicated in other Southeast Asian countries and in China's Belt and Road plan.

We believe one of the important developments within the Greater Bay Area plan is the construction of the Hong Kong-Shenzhen Innovation and Technology Park (HSITP) in Lok Ma Chau, within Hong Kong but right next to the Shenzhen border. The HSITP will be 87 acres of land with a focus on innovation technology and higher education. The HSITP will be able to leverage the competitive advantages of both Hong Kong and Shenzhen, including talent, research & development, and intellectual property protection, with close proximity to the supply chain and manufacturing capabilities in the Guangdong province. We believe the HSITP will become a key technology center in the Greater Bay Area, which will support the development of smart cities not only in Hong Kong but the entire Greater Bay Area.

3. What are some of the biggest challenges for Hong Kong in its development as a smart city?

Data availability has been a major challenge, as data is the foundation for smart city development, though the government has begun to make more data available for research and applications. Privacy of data continues to be a major concern. For example, HK citizens have a wealth of healthcare data but are, in general, reluctant to share due to privacy concerns. But today we have the technology to share data while retaining privacy. On this front, society's perception is gradually changing as we understand more about the benefits of data sharing as well as the technology for data privacy.

Another challenge is the high-level planning and implementation of smart city applications. Smart cities are not just about technology, but how the city operates after applying these technologies. The key question is: what does HK want to do? Take transportation for example: smart mobility is not only about when the bus will arrive but also about traffic planning and energy efficiency. Smart city planning is unique – it is about solving our own problems. We cannot just duplicate what New York or Barcelona has. It takes time to understand and implement such high-level planning. But I believe our direction is correct, and we are getting more support from the government in terms of funding and data availability.

According to a recent survey of business executives, the creation of an innovative culture will have the biggest impact on Hong Kong's smart city development. Do you agree?

First and foremost, I believe our education system is quite strong in STEM education (Science, technology, engineering, and mathematic). HK students have consistently scored well in math and science in international competitions. But over the past 20 years, we have somewhat fallen behind in the tech industry as we focused more on other industries such as finance.

Today, we all understand the importance of innovation and technology development. Hong Kong is certainly catching up. We have several very good universities that are ranked within top 100 globally. We have the young talent. The government has, over the past 3–4 years, devoted much more focus and resources to innovation and technology development. The difference has been immense. Over the next 5–10 years, there will be abundant opportunities for graduates in technology, engineering and medical sciences as we accelerate the development in those areas.



Sydney, Australia

Australia – steady and smart progress

Sundeep Gantori, Analyst

“I think at the centre of the need here is the provision of open data and analytics to transform all of our infrastructure investment...”

Angus Taylor
Australian Energy Minister

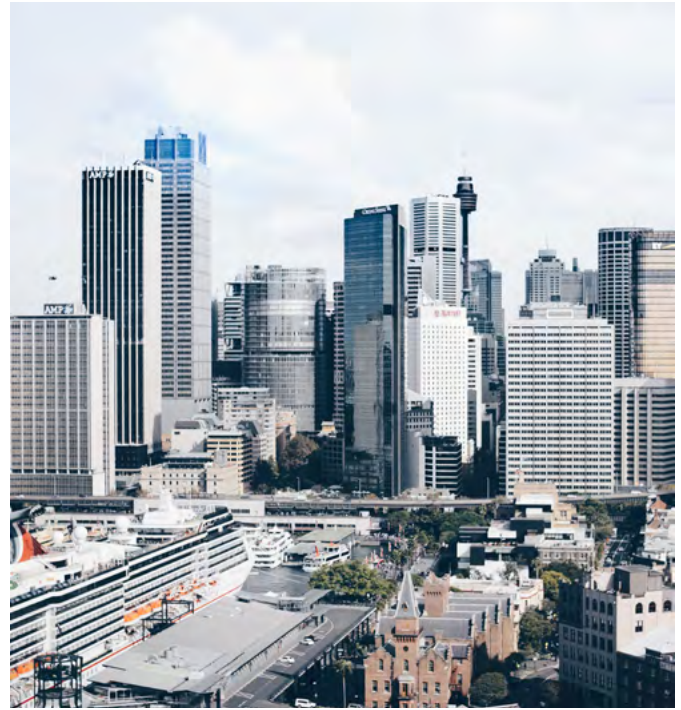
While Australia is known for its diverse regional characteristics and strong agricultural industry, 80% of its economic activities occur in its cities. So with Australia’s knowledge-based economy gaining in overall economic share, sustainable urban planning is the need of the hour.

In 2016, Australia released its “Smart Cities Plan” that highlighted three pillars – smart investment, smart policy and smart technology. The key objective of the plan is to prioritize projects that meet broader economic and city objectives, such as accessibility, jobs, affordable housing and maintaining a healthy environment. It also treats infrastructure funding as a long-term investment rather than a grant. The plan outlined some early commitments, including a) AUD 50m to accelerate planning and development works on major transformational infrastructure projects; b) to establish an infrastructure financing unit with integrated project teams from the private sector; and c) to invite state and territory governments to partner on city deals that provide common objectives.

It is interesting to note that the government is looking beyond the traditional route of providing grants to its smart infrastructure projects but considering partnering or investing (equity or debt) for financial returns. For example, the government has contributed AUD 370m in equity funding (plus land) for the Moorebank intermodal freight precinct. The government expects returns from these investments and expects to eventually sell them once they become a mature asset.



State Library Victoria, Melbourne, Australia. Photo by Agathe Marty



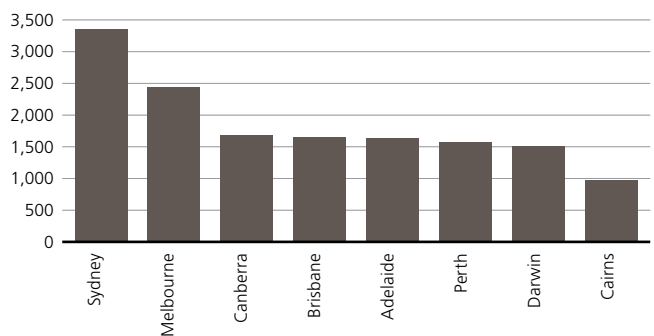
Sydney, Australia. Photo by Annie Spratt

We believe Australia’s Smart Cities Plan is on track with most cities in the middle of the transition. While there are still areas to improve, compared to other countries in the region, Australia is slightly ahead in the smart city journey, particularly on ownership and transparency matters. In this regard, it’s worth highlighting the online “National Cities Performance Framework” launched by the government in December 2017, which provides a snapshot of the smart city plans for Australia’s largest 21 cities. The online tool helps track performance of cities across six measures: jobs and skills; infrastructure and investment; liveability and sustainability; innovation and digital opportunities; governance, planning and regulation; and housing. This performance framework not only provides transparency but also helps cities compete and spur economic growth. Additionally, Australia, despite a slower start is making the right steps in fintech with the launch of the New Payments Platform (NPP), which facilitates real-time payments with a new fintech sandbox targeted for increased consumer and bank adoption.

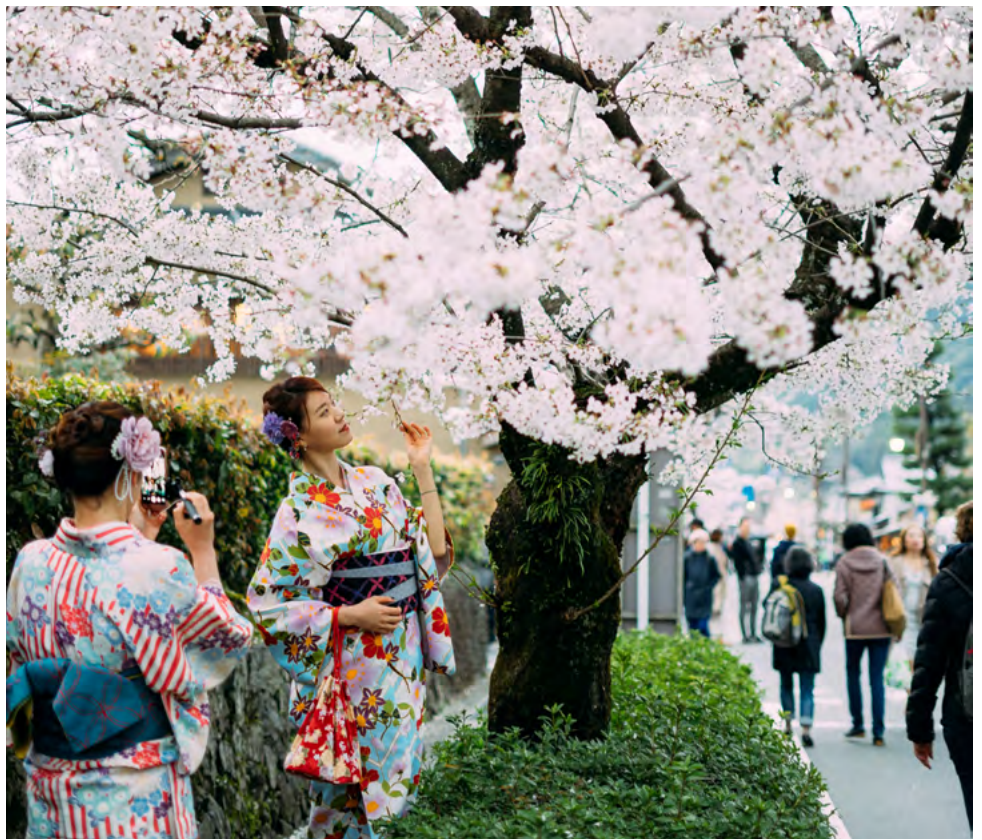
Fig. 12

Population density of key cities in Australia

Persons per square kilometre



Source: Commonwealth of Australia, UBS as of 2016



Tokyo, Japan. Photo by Bady Qb

Japan – showcasing for Tokyo Olympics

Toru Ibayashi, Analyst

“Tokyo 2020 is not just
about sports”

The official Tokyo Organizing Committee
of the Olympic and Paralympic Games

Tokyo’s business district was once known for being the most expensive office rental area in the world (see Fig. 13). But as a consequence of two decades of sluggish Japanese economic growth, office rents in Tokyo are now lower than in Hong Kong, Beijing and other major Asian cities. Tokyo’s rents are low not because the quality or the location of office buildings there is poorer compared to other cities, but because of an oversupply of office space over the last 20 years, in our view. Given that office space in Tokyo has doubled since 1987 (see Fig. 14) and the working population in Japan is declining by more than 0.6% a year, we think Tokyo is a good example of a “smart city” tackling two major issues: how to deal with a shrinking population and an aging society as well as how a city can add value to a country’s maturing economy. We believe information and communications technology (ICT) is key to transforming Tokyo into a “super city” and offering higher efficiency and more amenities to the people living and working in Tokyo. In this section, we will highlight how the Tokyo Olympic Games scheduled for 2020 can work as a catalyst to make Tokyo a smart city and explain some specific ways to bring about this transformation.

The first Tokyo Olympic Games in 1964 played an important role in rebuilding the capital city. The Olympic Games fueled the nation’s ambition to rebuild key infrastructure in Tokyo that was destroyed during World War 2. The Japanese government spent nearly JPY 1trn to host the 1964 Olympic Games. That was more than 3% of Japan’s nominal GDP at



Tokyo, Japan. Photo by Florian Löbermann

the time, and about 70% of the total budget was spent on infrastructure such as highways, high-speed trains (known as shinkansen) and subway lines.

For the 2020 Tokyo Olympic Games, we do not expect such a massive infrastructure investment. The total budget is expected to be around JPY 1.5–1.8trn, which is less than 0.4% of Japan’s nominal GDP today. Still, the 2020 Tokyo Olympic Games can be an important turning point just like the 1964 Tokyo Olympic Games for Tokyo. Prime Minister Shinzo Abe has directed the National Strategic Special Zones (NSSZs), which were established to spur economic growth by relaxing regulations in certain areas, to accelerate his super city vision. The super city is an advanced and evolved version of the smart city and aims at “not only verifying future key technologies, but implementing them” in the major cities of Japan, including Tokyo. Thus, the 2020 Tokyo Olympic Games will be a new opportunity to upgrade Tokyo into a next-generation city. More specifically, the super city vision expects three key technologies to take root in the near future: autonomous driving (initially only in limited areas), e-government (one-stop government services) and cashless payments (digital platform for transactions).

To upgrade Tokyo to the next level, the goal is clear: to improve the quality of life of the people living and working in Tokyo by innovating ICT to carry out the city’s functions. The point is that the economic and environmental value of the

Fig. 13

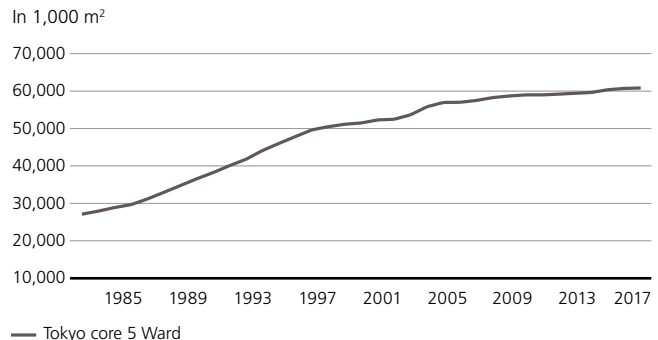
Office rental cost
In USD/sq.ft/annum

	1999		2018
Tokyo (Central area)	137	Hong Kong (Central)	306
London (West end)	119	London (west end)	235
Mumbai (Bombay)	98	Beijin (Finance Street)	200
Hong Kong (Central)	89	New York (Midtown)	183
New York (Midtown)	52	Tokyo (Marunouchi)	171
Shanghai (Puxi)	32	New Delhi (Connaught Place)	153

Source: CB Richard Ellis

Fig. 14

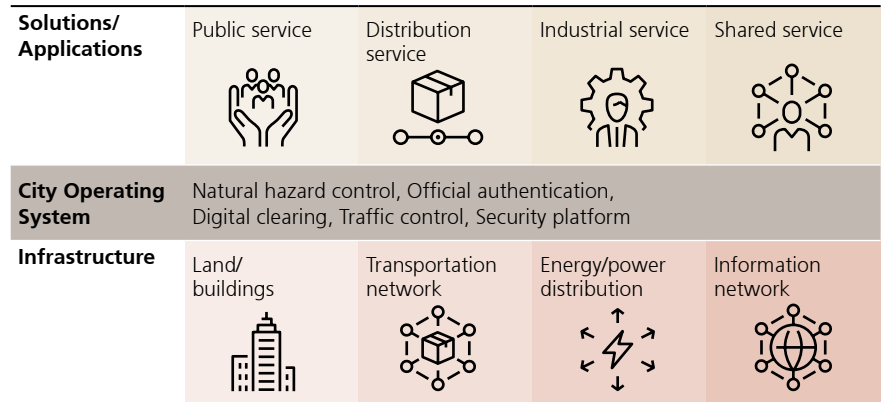
Office space in Tokyo metropolitan area
In 1,000 m²



Source: Tokyo City Government, UBS

Fig. 15

Three layers of smart city structure



Source: Cabinet office, UBS

major cities in Japan needs to be improved to boost the country's economy. This is difficult because the Japanese government, which is already burdened with the world's highest government debt, cannot afford to spend astronomical amounts of money to renew Tokyo's entire infrastructure in a short period of time. Perhaps Tokyo could upgrade its infrastructure and install new "smart" functions/services one suburb at a time. It would also make sense for private companies to provide some key city services and to participate in the planning of the new smart city.

Despite the Japanese government's funding limitations, Tokyo (as well as other major cities) is well positioned to transform itself into a smart city because the existing infrastructure, including energy supply, transportation, sanitary, water and information networks, is fully functional and on par with advanced cities elsewhere in the world. Thanks to its maintenance efforts, Tokyo can continue to use legacy infrastructure while trying out its super city vision on some suburbs in the city, fine-tune the city's plans for future services and apply them to other parts of Tokyo. However, time is limited and Japan could fail to increase productivity in the city and could continue to suffer from a sluggish economy. Smart city transfor-

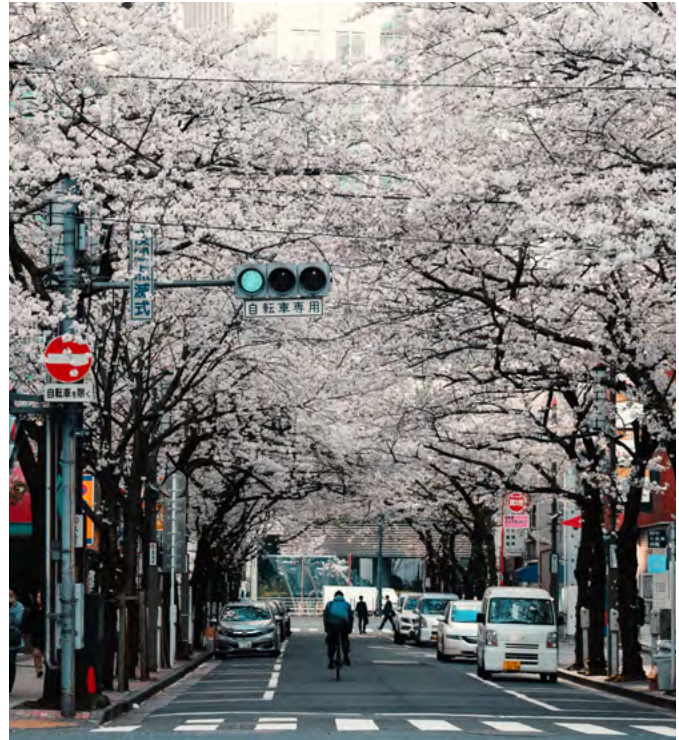
mation is one of several key solutions for the country's shrinking population and aging society, in our view.

To realize the super city vision, a three-layer framework (see Fig. 15) involving hardware, an integrated operating system (OS) and application layers, needs to be adopted. This is a structural concept often used in connection with computers, but can also be adapted for use for a city's functions. Cities are like a big machine that provides a wide range of services; and to do so efficiently, a common, integrated city operating system is needed. This concept of a city operating system includes official online authentication, a transaction clearing system and internet of things (IoT) sensor/camera management. These are common platforms across Tokyo and will be offered in an integrated form like FIWARE, which is already being used in several cities in the European Union (EU).

Hardware involves a city infrastructure, energy and water supplies, and transportation and information networks that Tokyo already has. Tokyo has been providing city services, whether public or private, based on these infrastructures. The problem is that there are many different municipal jurisdictions and procedures in Tokyo, and service require-



Tokyo, Japan. Photo by Satria Hutama



Tokyo, Japan. Photo by Agathe Marty

ments vary greatly depending on whether the area is a business district or a residential neighborhood. In a business district, there is higher traffic efficiency and a higher density of office space. Meanwhile, in a residential area, education, healthcare and nursery-care services may be prioritized. Tokyo (including parts of Yokohama and Chiba) is a large city and possibly the world's most populated city with a population of 37 million people (according to the UN's World Urbanization Prospects). To meet specific local needs, we need local solutions to be offered by local operators. There are different small suburbs and districts in Tokyo and the infrastructure available in each of them differs. Residents and other stakeholders decide how to transform their area and what city services are needed. But next-generation city services should be based on a common information platform (city operating system) which can bring economies of scale and assure flexibility so that local needs are met, in our view.

By the time the 2020 Tokyo Olympic Games begin, there will be autonomous buses in the Tokyo Bay area, where most of the Olympic Games will be held, and we believe this technological innovation wave will spread across Tokyo in the near future. At the same time, we believe it is important that To-

kyo's historical heritage is protected and preserved. For instance, the Nihonbashi area's renewal plan has much relevance for the future of Tokyo. Nihonbashi was once a commercial center of Tokyo and known for its historical heritage. In December 2018, the Tokyo Metropolitan Government (TMG) approved its renewal plan with a budget of JPY 316bn (about USD 3bn), including a historic decision to relocate the area's metro highway underground to regain the original streetscape and to renovate most of the buildings on the ground with leading ICT. A large part of this project will be financed by major property developers. The TMG supported the project by making necessary regulatory changes and by bringing together property developers and the national government. This project may take more than 10 years to complete, but it may be how Tokyo transforms to meet the demand for visitor-friendly access and create a more ecologically friendly technology-driven city. Transforming into a smart city should also be a major source of economic growth for Japan's mature economy as it can be more efficient and fulfill much of the unmet needs of Tokyo, which welcomes more than 530 million domestic and international tourists per year.

Interview

Mr. Hiroto Miyake

Executive Manager, Planning Group,
Kashiwanoha Urban Planning and Develop-
ment Department

Business Development Group and Venture Co-creation
Department
Mitsui Fudosan



Hiroto Miyake joined Mitsui Fudosan in 1989 and worked on several regional and urban development projects in Japan. He was appointed to the board of directors of Mitsubishi Fudosan Logistics REIT management in 2015. Since 2017, he has been leading the Kashiwa-no-ha smart city project, partnering with public, private and academic sectors to ensure the city continues to mature and develop. Furthermore, he established “Kashiwanoha IoT Business Co-creation Lab” with the aim of creating new businesses and resolving social issues by utilizing AI and IoT.

1. The Japanese government has given smart cities a leading role among initiatives to achieve Society 5.0. Can you first tell us your concept of what a smart city is and how it differs from conventional cities?

When you hear about smart cities, you may imagine an area with advanced technology, and radical and user-friendly social infrastructure.

In a rapidly aging society like Japan in particular, you would expect the concept of smart cities to be associated with health and longevity, where people of all ages enjoy active and secure lives. Of course, healthy living is an important part of the concept. However, smart cities such as Mitsui Fudosan are defined not just by new technologies and initial concepts. In contrast, they continue to

mature and develop autonomously. They thereby continually attract new people, acumen and investment that are crucial for ongoing growth. In addition, a smart city does not develop in isolation; it should be connected to a country-wide community that enables it to gather and integrate all information it may need and to generate new ideas for further development. In another words, a smart city is one which cares about the people living there and yet still attracts the next generation with further innovation.

2. How do you create the requisite mechanisms and society? What is the key to achieving this continuous development?

We first launched the innovative Kashiwa-no-ha smart city project in 2008. This drew on the partnership among public (local government and non-profit organizations), private (corporates and citizens) and academic (universities and research institutions) sectors to create an open platform to commit the continuous growth of the city and improve the work-life balance of those living there.

The three sectors jointly launched a community-based think-tank called Urban Design Centre Kashiwa-no-ha (UDCK). UDCK meets every month to promote basic investigation, analysis and research towards a new urban image and future of community. It constantly set goals based on actual practice and ties research back to community initiatives, plans and strategies in the Kashiwa-no-ha region. It is also proactive in demonstrating experiments which use advanced technologies led by the private and academic sectors. For example, a test run by a self-driving bus is planned in 2019, led by the University of Tokyo. Study groups led by entrepreneurs are held regularly and are open to public in an effort to energize and intellectually stimulate the region. It is vital that initiatives are led not just by one sector, government or private, but that all actively unite together and share the same goals to drive continuous growth and development.

It is important to note that the Kashiwa-no-ha smart city project is much less dependent on government subsidies than most other cities. Government-funded projects are helpful for the introduction of leading-edge technologies. However, if this funding consists solely of a one-off aid contribution, it is sometimes difficult to find applications in the real world, and there may not be continuity when the budget dries up. Mitsui Fudosan believes local government involvement is essential, but its commitment to long-term development and sharing its values and goals with other partners is even more important.

3. What are the city's next steps, what is it trying to achieve, and what are the opportunities?

The next step for the city is trying to leverage the data/information that we collect. Our smart city can collect and store regional living and environmental data. This big data is an asset to the region and should be attractive to corporations and research institutions. Mitsui Fudosan would like to utilize its unique strength to use this to attract more investment and corporations to the region. It is also considering building secure and distributed data platforms. The platforms will be accessible by individuals who are able to manage their own data/information and to decide which of their individual data is in line with the General Data Protection Regulation and can be available for public use.

4. Over the long term, what benefits are there for the three sectors – public, private and academic – and for Mitsui Fudosan as a corporation?

The project of smart city creates new value to regions. For example, Kashiwa-no-ha is the only region in its surrounding area where the population is growing. As a leading property developer in Japan, we believe the city developed under our smart city vision is proactively creating community and a mechanism to continuously add value to the region. We believe it makes sense from an economic point of view. Over the long term, the smart city projects driven by developers should increase asset value in the regions, which enables investors to recover their initial investment and generate recurring profit.



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