Asia Business Council

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INTRODUCTION

Asia is the most rapidly urbanizing region in the world. With the largest number of cities, the largest cities in terms of population size, and cities with the highest population density, getting urbanization right is important for the region's long-term growth (see Figure 1). Almost 60% of the world's population is projected to live in cities by 2030, up from about half currently. Urbanization is largely an Asian story, with 2 billion people currently living in Asian cities and more than a billion additional people expected to move in by 2030.[1]

According to the Asian Development Bank, the scale of urbanization in Asia is "unprecedented in human history." However, the current trajectory of city growth is hardly sustainable. Cities account for the majority of their countries' carbon footprint and 70% of the world's carbon dioxide emissions. Asian cities already face the challenges of land constraints and high population densities, thus their growth path will have to be very different from that in Western countries such as the U.S. and Europe. How Asian cities grow—specifically, how the big megacities of tomorrow build their roads and buildings, and how they provide energy—will greatly affect the lives of billions.

Smart cities promise to be a next frontier of urban development, employing new technologies including sensors, mobile technology, and big data analytics. The Internet of Things (IoT) is where devices and appliances in buildings, cars, streets, and infrastructure can be connected over the Internet allowing them to "talk to" each other and to users. These innovations have the potential to improve cities in terms of sustainability, livability, and responsiveness to citizen needs.

While smart technologies will not solve every urban problem, there is no question that well-designed and well-run cities that are pleasant and convenient to live in can attract business investment and human talent. Opportunities exist for businesses and government to create solutions that cater to high-rise

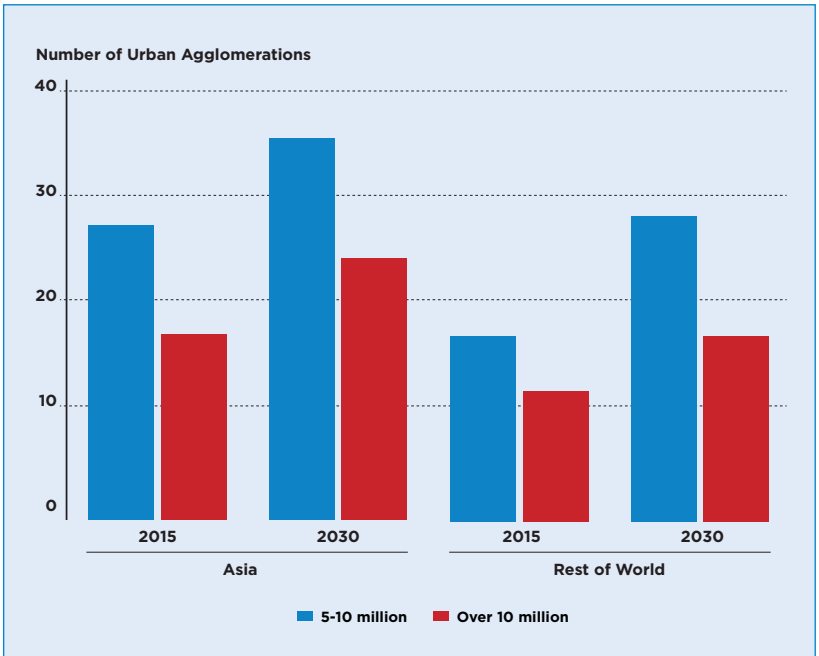

FIGURE 1
NUMBER OF URBAN AGGLOMERATIONS IN ASIA AND REST OF WORLD BY POPULATION SIZE, 2015 AND 2030[2]

homes, crowded neighborhoods, congested roads, and more broadly, services that respond to the needs and improve the living quality of urban residents.

Cities are also the center of decision-making for countries, where key policy decisions in areas ranging from national security to citizen services are made. Cities often suffer the greatest losses during natural disasters, as they are their countries' centers of economy and government. Governments are increasingly expected to be responsive to citizen needs and demands on how to improve their cities' quality of living.

This briefing explores several key areas—buildings, mobility, energy, and citizen services, and demonstrates how Asian cities are evolving and innovating in using smart technologies to achieve the goals of sustainability, livability, and responsiveness.

SMART BUILDINGS

Buildings account for up to 90% of electricity consumption in some Asian cities, and making them more energy-efficient will become an even more pressing need given rapid urbanization in Asia. Although there are many technologically advanced ways to make a building "smart," many issues are addressed not just with high-tech solutions, but also through sound design and policies.

The trend toward energy-efficient buildings is not new, but for Asia, efforts are being scaled up substantially by governments, property developers, and owners, who incorporate energy efficiency measures into design and engineering, as well as building management and operations. Singapore has a national target of greening at least 80% of its buildings by 2030, as measured by performance using the Green Mark Scheme. Hong Kong's Green Building Council has proposed to the government a targeted reduction of 30% by 2030, from 2005 levels, of the absolute electricity consumption of buildings in Hong Kong.[3] As part of Chinese President Xi Jinping's push to cap carbon emissions by 2030, he affirmed that 50% of new buildings in urban areas will meet green building standards by 2020. The Green Building Action Plan, issued in 2013, mandated that more than 400 million square feet in existing commercial and residential buildings be renovated, and one billion square meters of new green buildings to be built by 2015.[4]

Technological innovation is also taking place in the construction sector, traditionally not seen as a high-tech business. Construction materials are integral to building energy efficiency, as they contribute to thermal conductivity and insulation of buildings. Cement used for construction is highly energy-intensive. LafargeHolcim, which manufactures building materials, partnered with the Paul Scherrer Institute and ETH Zurich to develop a renewable way to manufacture cement without using fossil fuels. High-temperature solar heat is used to produce a high-quality synthetic gas, which substitutes for fossil fuels in cement kilns. Its cement offerings also boast enhanced environmental performance with low carbon concentration.[5]

In terms of building operations, the trend of "connected homes" promises to make urban living more convenient and energy-saving, connecting any number of devices to lighting systems, thermostats, and security systems, all synchronized to operate according to residents' preference via mobile phone or motion or presence sensors. Companies including Apple, Google Nest, General Electric, and Whirlpool have tapped into this growing market of personalized living services.[6]

On a broader scale, Asian countries are investing in and transforming their urban infrastructures; China will invest $320 billion in smart city development over the next decade. In Japan, where 92% of the population lives in cities, four major pilot smart city initiatives have been launched, in Yokohama, Toyota City, Keihanna Science City (Kyoto Prefecture), and the City of Kitakyushu.[7] Eighty percent of Japanese homes are expected to have smart meters installed by 2020. Systems and appliances incorporating presence sensors

and big data to track and analyze power use patterns at homes are expected to become prevalent.[8] With more widespread experimentation and successful application, these information and communication technologies (ICT) have the potential to drive better living quality and energy performance in urban centers.

SMART TRANSPORTATION

Many Asian cities, particularly those in developing economies, face chronic congestion problems. These problems are worse than in the West due to urban density, inadequate transportation infrastructure, and rapid growth in car ownership. The Asian Development Bank estimates that Asia needs $8 trillion in infrastructure investment from 2010 to 2020.[9] According to McKinsey's analysis of that data, $2.5 trillion of that investment will need to be made in the transport sector.[10]

Traffic congestion leads to fuel wastage, air pollution, and productivity losses. In an annual Traffic Index released by Dutch navigation company Tomtom that measures congestion levels in 218 cities worldwide, navigational data showed that Chinese cities were notably congested, with Chongqing, Chengdu, and Guangzhou making the top 20. Taipei was also ranked 11th in the world. British motor oil company Castrol also partnered with Tomtom to release a "Stop-Start Index" ranking urban drivers by the patterns of deceleration and acceleration associated with urban traffic jams; Jakarta was ranked as having particularly severe gridlock.[11]

Good public transportation is key to solving the congestion problem, and Asia's cities have in recent decades expanded public transit infrastructure to improve mass mobility, ranging from Jakarta's TransJakarta bus system to Hong Kong's Mass Transit Railway (MTR). In the meantime, governments are striving to find better ways to manage road traffic. Singapore was an early adopter of the Electronic Road Pricing (ERP) program, built around automatic toll monitors that do not require vehicles to slow down during manual toll collection. Instead, it manages road congestion with a pay-as-you-use system, using electronic gantries to charge rates that change depending on the time, route taken, and local traffic conditions. Other Asian cities including many in China are also exploring or piloting similar congestion pricing or traffic restriction schemes, in the hopes of reducing congestion and pollution.

The next frontier of urban transport is smart transportation infrastructure that helps to understand and predict mobility patterns. As part of Singapore's Smart Nation initiative, the government's Infocomm Development Agency (IDA) has been working with other government bodies and private companies to establish a network of over 1,000 sensors to collect data to develop and test algorithms that determine vehicle and pedestrian movement. This information will help manage traffic by enabling traffic light signaling that will react and adjust to real-time traffic and pedestrian patterns.[12] The proposed next generation of ERP will use a satellite system to charge drivers for the actual distance traveled in priced zones, and bundle together other value-added services such as real-time traffic data and electronic parking payment.[13]

Technology is also being used to create "connected cars," which aim at improving automobile safety and efficiency in cities. Consultants at PricewaterhouseCoopers expect connected car technologies to generate more than $40 billion globally in customer spending in 2016. [14] Connected cars present opportunities to multiple industries, including technology companies that create and produce digital content, insurance companies that gather data on driving styles and risks, consumer Internet firms that sell products and services to drivers, and of course the auto companies that house these technologies. At a technology event in Dubai in 2015, Chinese technology company Huawei launched an IoT solution aimed at making public transportation safer for citizens in the Gulf. This IoT solution will offer a range of services, including in-vehicle video surveillance, accurate passenger tracking, emergency service communication, and real-time vehicle health data analysis to help transportation authorities monitor, track, and communicate with their fleet.[15]

Another mobility solution that has been employed in Asia to reduce car traffic and pollution is the bike-sharing system, which is already popularized in some U.S. and European cities. Taipei's popular YouBike program, in a Build-Operate-Transfer partnership with local bicycle-maker Giant Manufacturing, scaled up an easy-to-use and affordable bike-share system which saw 22 million rentals in 2014.[16] Motorized scooters are also a popular method of getting around Taipei. Taipei-based company Gogoro seeks to solve the "range-anxiety" issue with electric vehicles by building a network of stations throughout Taipei where drivers of Gogoro's smart scooter can swap out batteries and keep driving. The scooter can also sync to a smartphone app where users can download usage data. Such local innovation drawing from expertise in related industries such as electronics and manufacturing could transform road traffic and spread to other Asian cities.

The emergence of the sharing economy for transportation, led by ride-sharing mobile applications from Silicon Valley, notably Uber, and their local competitors, is also transforming mobility in cities and contributing to reducing the demand for private cars. According to a study by Columbia University professor David King, having multiple modes of transit easily available is a hallmark of a functioning public transportation system, where riders are more likely to use public transit and then take a cab or ride-share for part of the journey, rather than driving themselves both ways. In China, the 2015 merger of the country's two major ride-share apps, Didi Dache and Kuaidi Dache, to create Didi Kuaidi has the potential to reduce demand for private vehicles in China's notoriously car-clogged major cities. Ride-share mobile applications are an innovative grassroots solution that effectively decreases the demand for private vehicles without direct government intervention. In parallel, Southeast Asia's largest taxi app player is GrabTaxi, which has almost 4 million mobile users across six countries in the region.

SMART ENERGY

In the next 15 years, energy demand in Asia is expected to double.[17] This demand increase will be concentrated in cities with high population densities. Since Asian cities remain largely powered by conventional carbon-based energy sources, generating electricity in a sustainable way that minimizes pollution poses a great challenge. Thankfully, falling prices and better technologies in renewable energy generation and electric grids, coupled with policy changes that encourage the use of these technologies, may signal a more positive future.

According to Bloomberg New Energy Finance, renewable energy investments worldwide grew to $329 billion in 2015, mainly driven by solar and wind energy investments. China saw more than $110 billion in clean energy investments, which is close to the combined investments of its closest rivals, the United States ($56 billion) and Europe ($58 billion).[18] China plans to introduce a national carbon trading program for key industries in 2017, which will be an expansion of smaller provincial pilot initiatives that were started in 2012.[19] In Shenzhen, reforms imposed by the National Development and Reform Commission have enabled buyers and sellers to deal directly with each other and pay transmission costs to the electric company China Southern Power Grid, in an attempt to increase competition among energy suppliers.[20] For solar energy, China and Japan together invested almost $75 billion in 2014, nearly half the global total.[21] South Korea's government is also making large investments in clean energy and concentrating its efforts on building energy-self-sufficient islands that rely on energy storage systems and electric vehicles, based on a model pioneered on Jeju Island, with major investments from the government and private sources.

Smart grid initiatives promise to harness the power of data analytics to create intelligent sensor systems to minimize wasted energy, power outages, and unexpected jumps in demand. Driven by lessons learned in the wake of the Fukushima earthquake in 2011, Japanese cities have led the way in increasing their investment in smart grid technologies. Companies like Mitsubishi are implementing smart grids throughout Japan, where ICT data are used to address inconsistencies in supply and demand,

and help to maintain a stable flow of electricity.[22] Kashiwa-no-ha Smart City in Japan was built by a partnership between Hitachi, the Tokyo Electric Power Company, local universities, and other groups; the center of the smart grid in this city is a locally controlled micro-grid that derives most of its energy from rooftop solar panels. It uses an interface designed by Hitachi to provide analytic details on the grid, while swiftly and efficiently switching loads between buildings based on supply and demand.[23] This system has allowed the city to cut peak power consumption by 26%.[24]

Schneider Electric is one of the companies leveraging the use of IoT and smart grids to build more efficient infrastructure in cities. When electrical systems of buildings are connected to smart grids, the grids detect power usage in different parts of the city and divert power to places where it is needed most. Schneider has been helping factories around Asia, including in China and Indonesia, to automate operations in reaction to rising labor costs. For instance, it improved the efficiency of a cement manufacturer in India which uses wind energy to power some factories. Schneider's software, integrated with the grid, is able to "tell" the factory operators to increase production when it detects higher activity from the windmills.[25]

SMART GOVERNMENT

Apart from deploying smart technologies around cities to improve buildings, transportation, and utilities, an essential ingredient of smart cities is to use data and technology to enable urban residents to build trust in their governments, and for governments to become more responsive to citizen needs, particularly in the realms of public safety, public health, and disaster detection and response services.

United Nations projections estimate that by 2050, the percentage of elderly citizens (60 years or older) in Asia is expected to exceed 25% (from 12% in 2015), or more than 1.3 billion people, giving governments a key opportunity to improve the delivery of public health and medical services.[26] Singapore has been exploring the use of IoT and smart technology to transform the healthcare sector, and prepare for its aging urban residents. Singapore's IDA, along with other healthcare partners, will build up a Smart Health-Assist program and leverage ICT technologies to deliver care for patients in the comfort of their own homes and communities.[27] Smart Health-Assist will mark a shift from reactive healthcare to preventive healthcare by using sensors to actively monitor health in patients' living environment and promptly detect any illnesses.

Devastating natural disasters have taught cities to recognize the importance of building resilience and early warning. Smartphones contain sensors that are similar to those found in more expensive and sophisticated seismic detection facilities. Although these individual devices might not be as sensitive as their scientific-grade relatives, they are globally ubiquitous, and can be programmed to send data of a quake to a central location, which can be merged to provide an overall picture of the event to come. Researchers at the U.S. Geological Survey tested the feasibility of a crowd-sourced early warning system using actual data from the 2011 Fukushima earthquake. The study found that even if fewer than 5,000 smartphones in an area sensed surface displacements from an earthquake and were connected to the network, the earthquake could be detected and analyzed fast enough to warn people before damaging shaking occurred, enabling emergency services to be deployed in a more timely way.[28]

As smart city governments seek to ramp up efficiency, optimization, and security, they must build trust with citizens, especially those who are skeptical about issues such as data privacy and government surveillance. Urban planners of the future need to collaborate not just with the technological Leviathans, but also with psychologists and sociologists who understand people, and learn how to build cities that will thrive beyond market buzzwords.[29] Concerns about data privacy and security need to be addressed through strengthening data protection laws and measures. The availability of open data from the government, such as the U.S. government's Open Data Initiative that makes government informa-

tion available as machine-readable open data files, will likely spur public interest and support as well as accelerate innovation.[30]

CONCLUSION

Building cities for more than three billion people in Asia presents governments and businesses with enormous challenges as well as opportunities. Smart technologies incorporating IoT have the potential to become increasingly powerful tools for improving buildings, transportation systems, utilities, and citizen services. Sound policy decisions and the political will to reduce existing inefficiencies and make needed changes are also important to adopt experimental technologies and expand them into functional systems.

Ultimately, smart cities must succeed in pulling disparate technologies and systems together in a way that meets the particular demands of and provides services of value to their citizens living in these urban areas. Doing so will not only improve the quality of life of urban residents, but also enhance national competitiveness.

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