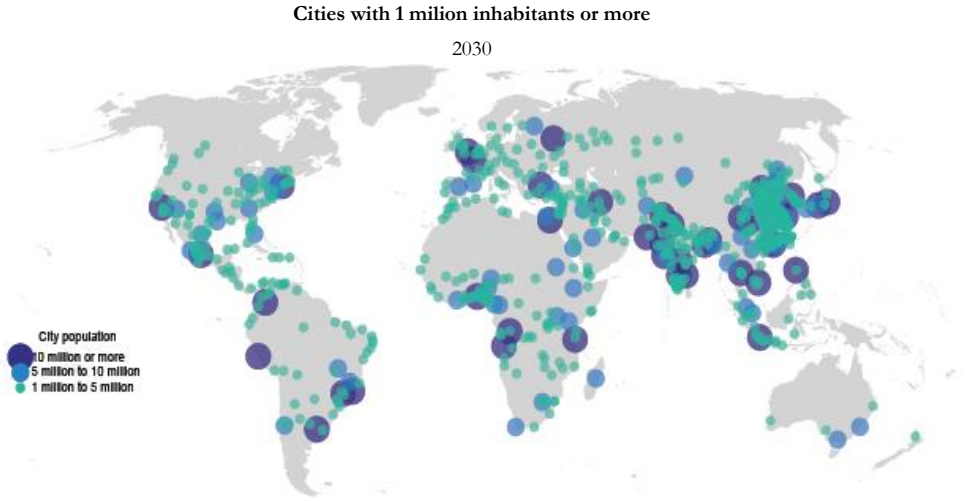
Insight

SMART CITIES – THE CITIES OF THE FUTURE ARE ALREADY HERE

Smart Cities, for so long a thing of myth and fantasy, are no longer a utopian vision of the future, but instead a very real and tangible development, examples of which can be found in most parts of the world today.

While cities have always been magnets of economic growth and opportunity, they are now attracting increasing swathes of the global population, reaching a key milestone recently when, according to the UN, the number of people living in urban areas exceeded those in rural areas for the first time ever.

Some 55.3% of the world's population now inhabit cities, a huge increase from back in 1950 when that figure was below 30%, the UN has said. Within that, there are now 548 cities with a population of 1 million or more. These include 33 so-called megacities, cities with a population over 10 million, and six metacities, with a population over 20 million. By 2030 this is expected to increase to 43 megacities and 11 metacities. By 2050, 68% of the world's population will live in urban areas.



Source: The World's Cities in 2018, United Nations Department of Economic and Social Affairs, Population Division (2018)

Cities have a critical role to play as engines of wealth creation, accounting for an annual economic output of $72tn, or about 85% of global GDP currently. In the US over 90% of GDP is generated in metropolitan areas and the 10 largest generated $6.8tn in economic value in 2017, the equivalent total output of 38 US states.

But the rise of the urban population and its density poses and exacerbates multiple challenges including air pollution, crime, energy use, resource consumption, urban sprawl, traffic congestion, governance, sanitation and waste management. Looking at the numbers, cities occupy 2-3% of the world's land mass, but consume more than 75% of its natural resources and account for 50% of global waste, 67-76% of energy use and 71-76% of greenhouse gas emissions. At the same time, 91% of the world's population lives in places where air pollution levels exceed WHO limits, leading to an estimated 4.2 million premature deaths a year.

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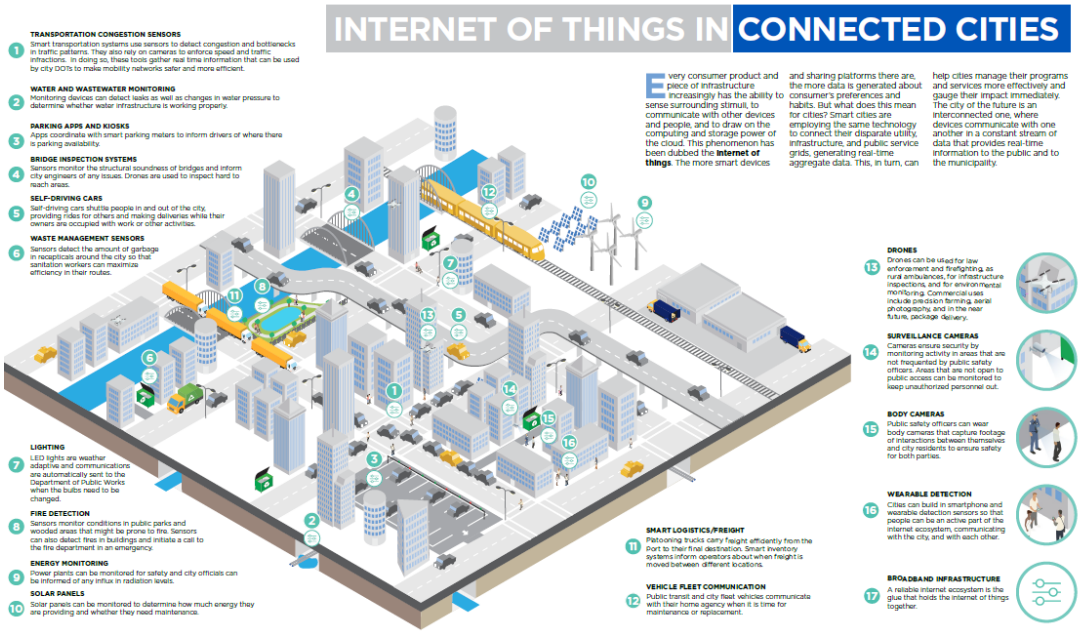
Smart cities as a solution

As the world looks for solutions to these issues, urban developers are looking increasingly towards "smart cities" as a way to help address these challenges. A smart city is effectively a digital ecosystem that collects through devices out "on the edges" information about a city's conditions, then communicates the data through a citywide network to the centre where it is analysed, before sending back out actionable information, alerts and signals to improve a city's efficiency and the quality of life of its inhabitants.

Importantly, we are reaching a tipping point in terms of available smart and connected devices as well as data generation. With five billion smartphone users, literally billions of connected IoT devices within city boundaries and sensors at every corner, it is estimated that over 200m GB of data a day is generated in a typical city of one million inhabitants. Exponential developments in data analytics and artificial intelligence are driving corresponding advances in system analytics and the ability to generate predictive insights.

There are three layers to a smart city. First there is the technology base, which consists of a critical mass of devices which includes smartphones and sensors connected by high-speed communication networks. Sensors take constant readings of variables such as traffic flow, energy consumption, and air quality, among many other aspects of daily life, before putting this information at the fingertips of those who need it. Secondly, it requires specific applications and tools, translating raw data into alerts, insights, and actions. Such tools are available in multiple domains: security, mobility, health, energy, water, waste, economic development and housing, and engagement and community. Finally, the third layer is public usage. Applications succeed only if they are widely adopted and lead to a change in behaviour. Properly used they can catapult individual users into the driver's seat by giving them more transparent information to make better choices.



Source: National League of Cities (2016)

Smart cities are not a vision for the distant future. Governments across the world are developing and implementing Smart City projects. Major initiatives include China ($74bn across 500 designated cities), India ($15bn across 100 cities), UAE (Dubai Plan 2021, $8bn), Singapore (Smart Nation, $2.4bn), Spain (Barcelona, $90m), and Australia ($50m). Estimates of the exact market size vary depending on the parameters utilised, but it is conservatively estimated that over $500bn is currently being spent annually on Smart City initiatives, a figure that is projected to exceed $1.5tn by the mid-2020s.

Smart infrastructure

Smart infrastructure lies at the heart of any smart city initiative. It includes intelligent and automated systems that manage, communicate with, and integrate different types of infrastructure, such as energy grids, transportation networks, water and waste management systems, and telecommunications.

It involves moving from "bricks and steel" to fully integrated intelligent infrastructure, effectively bringing all parts of the infrastructure puzzle together and incorporating them into an interdependent and reliable ecosystem. Referred to as "Infrastructure 3.0", it provides real-time optimisation and incident handling across all domains – utilising advances in sensors, controls, and software to predict outcomes, take actions and manage systems more effectively.

Inadequate infrastructure is a major impediment to urban prosperity in both emerging and developed markets. At present, according to the UN, 14% of the world's cities are considered highly fragile, with 66% registering medium levels of fragility. PwC in its "Capital Project and Infrastructure Spending Outlook" estimated that over $78tn in global infrastructure investment will be needed in the decade to 2025 to accommodate growth, with New York, Beijing, Shanghai and London alone requiring $8tn. This involves not just revamping traditional hard assets but also making infrastructure more resilient to stresses and shocks, as well as putting in place and enabling next generation IoT features.

5G, which is up to 100x faster than 4G, will be a massive enabler. It will offer quicker and more adaptive response times, lower latency, lower energy requirements and enhanced security. Building on that foundation, smart city technologies will enable a more efficient use of embedded infrastructure. This includes water management, waste and sanitation, as well as urban food production solutions. Looking at water as an example, utilities can achieve billions of savings every year from using smart water solutions. These savings can be achieved through the use of smarter pressure management techniques, remote maintenance and diagnostics, smarter water quality monitoring and leveraging network data to enable a more strategic capital expenditure planning process. Other enhancements, such as managing water consumption and pricing more dynamically, can also help save money. In fact, the Smart Water market alone is expected to reach $23bn by 2024.

Smart energy

Cities account for 71-76% of greenhouse gas emissions and 67-76% of global energy use, with the latter expected to rise to 80% by 2040. A growing number of cities are committing themselves to ambitious renewable energy goals. San Francisco has committed to 100% renewables by 2030, followed by San Diego by 2035 and Vancouver by 2050. Copenhagen, Stockholm, Oslo, New York and Sydney have set similar targets. But to achieve those objectives entails moving beyond just engaging renewable resources to also digitalising the electrical grid.

A "smart grid" is effectively an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying demands of end-users. Smart grids co-ordinate the needs and capabilities of all generators, grid operators, end-users and electricity market stakeholders to operate all parts of the system as efficiently as possible, minimising costs and environmental impacts while maximising system reliability, resilience and stability.

These systems incorporate electricity from both large-scale solar and wind farms outside city boundaries as well as smaller distributed sources near the point of consumption. Integrating these with a city's electricity distribution system requires smart interfaces between intermittent renewable sources and appropriate storage mechanisms to ensure a reliable power supply and a stable, balanced system. At the same time, the increased electrification and digitalisation of infrastructure, buildings and transport place increased demands on urban grid networks. Managing such grids requires network intelligence, including sensors that enable the remote monitoring of equipment such as transformers and power lines. It includes smart meters that can communicate with the network, providing readings at frequent intervals and allowing for accurate monitoring, real time pricing and time-of-use tariffs. Importantly, such systems can also help stimulate a demand side response, changing electricity usage in response to incentives, shifting electricity demand away from peak periods.

Smart buildings

We spend 90% of our time in buildings and they account for 40% of energy, 25% of water, and 40% of resource use globally, as well as being responsible for one-third of all greenhouse emissions. The global building stock is expected to grow from 163 billion square meters in 2017 to 184 billion square meters by 2026. However, most buildings are characterised by a complex array of subsystems which exist in silos, such as lighting, ventilation and cooling, as well as security, leading to inefficiencies in energy consumption, building usage and quality of services.

Though the shell of the building (the circa 60% of the cost base that is effectively cement and bricks) is likely to remain relatively unsophisticated, 40% of a building can be made "smarter". In fact, there are multiple parts of a building that stand to benefit from such technologies. These include: smart security, smart HVAC ($25bn market by 2024), smart elevators ($25bn market by 2025), smart lighting ($24bn market by 2024) and smart glass ($8bn market by 2024). In fact, the next phase is to incorporate disruptive technologies such as the IoT and big data to bring a building "alive". This involves a shift from performing pre-programed, tasks to more intelligent, intuitive tasks such as predicting and optimising energy usage according to occupancy.

The features of smart buildings are wide ranging. One can, for example, use smart technology to set up lighting to operate on an intelligent/efficient schedule; identifying who and when someone is entering and leaving a building; sensing emergencies and turning off facilities when occupants could be in danger; recording activity and sending alarms and data to the security team; optimising incoming air flow to regulate air quality, temperature and comfort, and sending alerts when problems are detected.

Smart mobility

As city populations become larger and denser, increases in congestion, air pollution and emissions require a fundamental rethink of the fitness for purpose of current urban transportation networks. Solutions will invariably revolve around shared mobility, enhanced

public transport networks and the increased penetration of electric vehicles as well as autonomous solutions, which our colleague Giles Tulloch explored in his April Insight "Driverless Cars: Where are they heading?". We do not wish to replicate his work here but would echo the possibilities that could be unleashed. Increased traffic efficiency, decreases in air pollution and emissions, better service levels, lower transportation costs, improved road safety and reduced demand for urban real estate are all tangible economic and quality of life outcomes.

Smart security

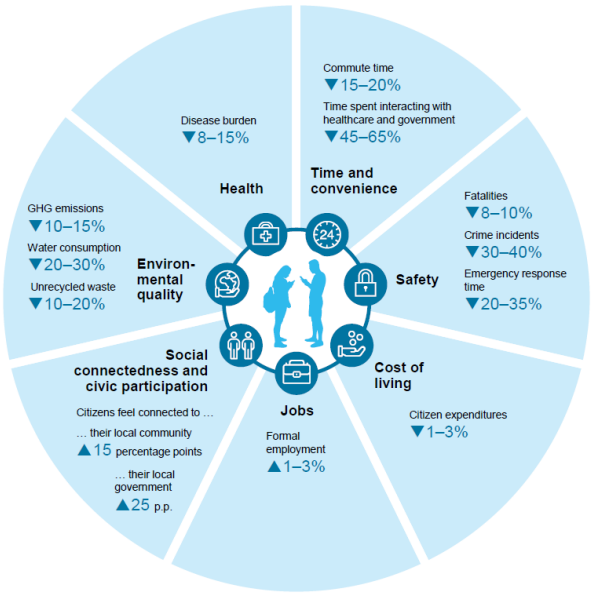
Tackling both crime and terrorism in increasingly dense urban environments places additional strains on city authorities. Smart security solutions include technologies such as video surveillance and managed security services that are designed to protect people, property and information. Growth areas include CCTV, incident detection, crowd monitoring and control, adaptive lighting, emergency alerts and notifications, environmental monitoring, disease surveillance and epidemic monitoring, and smart care and assisted living, to name a few. Smart video surveillance and analytics alone are set to drive a $77bn market by 2023, with an estimated 350 million surveillance cameras already in operation. This includes video surveillance as a service (VSaaS), which is hosted cloud-based surveillance, as well as software including video analytics and management. At the same time, the global biometrics market is expected to reach $59bn by 2025. Automated fingerprint systems currently dominate the market, while face, iris and voice recognition are seeing the fastest growth.

Smart governance

Improving quality of life is not just about a city's hardware. It is also about citizen-facing services and making the interaction between local government and residents more streamlined. As part of that process, city government agencies are increasingly engaging with constituents online. Some are creating official channels on existing social media platforms such as Facebook. Others, including Shanghai and Singapore, have developed their own tools for accessing information and city services. In the United States, cities including Boston, Los Angeles, and Seattle have developed apps for nonemergency requests, where residents can report issues ranging from nuisances to potholes. Barcelona has taken it a step further by creating a digital platform for civic participation. It offers users a way to weigh in on city council decisions, make proposals and receive a follow-up about issues raised.

The road ahead

Cities that use smart technologies effectively can make significant progress to enhance quality-of-life via time saved, health and safety outcomes, environmental impact, and social connectedness and civic participation, improving some key metrics by 10–30%. These issues directly touch tens of millions of lives. In its study "Smart Cities: Digital Solutions for a more



Source: McKinsey Global Institute analysis (2018)

liveable future", McKinsey found that smart technologies can reduce fatalities by 8–10%, accelerate emergency response times by 20–35%, shave the average commute time by 15–20%, reduce the disease burden by 8–15%, lower greenhouse gas emissions by 10–15%, and reduce water consumption by 20–30%.

At the same time, there are of course deep-rooted reservations to be overcome. Increased surveillance and data-driven policing raise concerns about "big brother" watching and the potential to be used as a tool for political dissent suppression. Governments and private-sector players now hold sensitive personal data, making it vital to establish safeguards about its handling and protection. At the same time, smart cities can be vulnerable to cybersecurity attacks. The Internet of Things provides extensive open ground for hackers to target. Compromised security systems, traffic lights and self-driving cars could pose life-and-death risks, and the same would apply if a bad actor was to shut down a city's power grid or water supply. Cities will have to develop deep cybersecurity expertise and stay ahead of the constantly evolving threats that are out there.

It is also important to note that cities are not homogenous entities, but rather a collection of singular ecosystems, such as airports, businesses, local authorities and individual citizens, each with its own challenges and stakeholders. Most stakeholders operate in silos and investments are made independently, sometimes resulting in poorly informed decision-making for cities as a whole. Already strained finances also limit city authorities and implementation periods of over 10 years require a long term and strategic mindset. Finding ways to establish horizontal collaborations between key players will therefore be critical, as will pooling public and private resources to finance smart city initiatives.

Inevitably, different countries and cities are adopting smart city technologies at their own pace. Merrill Lynch in its report "21st Century Cities" looked at a wide array of factors including connectivity, innovation, human capital, infrastructure and environmental footprint to identify some of the cities leading the way. Unsurprisingly Singapore, London, New York, Paris, Tokyo, Stockholm, Amsterdam, Seoul, Vienna and Zurich topped the list.

For us as investors it is about looking for companies that offer solutions with tangible, prompt returns on investment to stakeholders, and that have clear and defensible technological offerings. This includes hard asset providers that deliver traditional infrastructure hardware and systems, most notably capital goods names such as Eaton and Honeywell, network system enablers, like American Tower, as well as software providers and platform operators like Alphabet, which is leveraging its unparalleled capabilities in artificial intelligence to explore autonomous mobility solutions. Smart Cities is a fascinating emerging field that is looking to provide tangible answers to real world issues. They offer huge potential in what is currently a largely untapped market.

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