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Smart Cities South Korea

Market Intelligence Report

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TECHNOLOGY IS GREAT
BRITAIN & NORTHERN IRELAND

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prepared by Intralink Limited

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1. Introduction

Smart cities are a key part of the Korean government's industrial policy. President Moon Jae-in's government has announced two smart city pilot projects in Busan and Sejong City worth a combined GBP 3bn, of which GBP 1.8bn is to be provided by national government funding approved in late 2018. President Moon sees smart cities as an essential component for improving the quality of citizens' lives and as a means to grow Korea's economy through the development and commercialisation of emerging fourth industrial revolution (4IR) technologies. Significant political support has been given to national smart city projects and the Ministry of Land, Infrastructure and Transportation is motivated to finish the flagship projects before the end of President Moon's term in 2022.

The Korean government has created regulatory sandboxes in both Busan and Sejong, suspending regulations to facilitate the deployment of next-generation technologies from domestic and overseas firms. If the pilot projects that are rolled out under these sandboxes are successful, the regulations may be revised nationwide to spur the development of smart city projects by other regional and municipal governments. With such rapid change brought on by the 4IR, the Korean government has recognized that its regulatory approach is inadequate. To date, new and disruptive business models have required prior authorization but the government is moving toward a negative-listing regulatory approach for technologies surrounding the 4IR whereby new solutions and business models are deemed legal unless specifically prohibited by law.

A Smart City Synergy Alliance consisting of 113 companies was created in February 2019 to coordinate with local and national governments on the platforms, components and services for these projects. Vendor selection will take place for both projects in late 2019. Construction will begin shortly thereafter and the first residents are expected to move in before the end of 2021. Foreign suppliers are welcome to take part, so now is the perfect time for UK companies with compelling technologies and solutions to start developing their contacts and market entry strategies.

Key areas of opportunity for UK companies include the main components of smart city projects, such as autonomous vehicles, smart grids, renewable energy, drones and robotics, as well as the technologies enabling these services, such as data analytics, AI, blockchain and IoT. Major stakeholders, including the national pilot projects, major telecommunication service providers and the Presidential Committee on the Fourth Revolution (PCFIR), have confirmed an interest in partnering with UK companies in smart city projects.

UK companies seeking to participate in Korean smart city projects should look to develop the market as early as possible to ensure that they are able to capitalize on opportunities. The timeline for the completion of the flagship smart city projects is short, with a maximum of two years allocated for construction. Details about the services offered by each smart city will be finalized in late 2019 along with the process for vendor selection, meaning that UK companies will need to be in position by the autumn of 2019 if they are to be successful.

2. Korea – An Overview

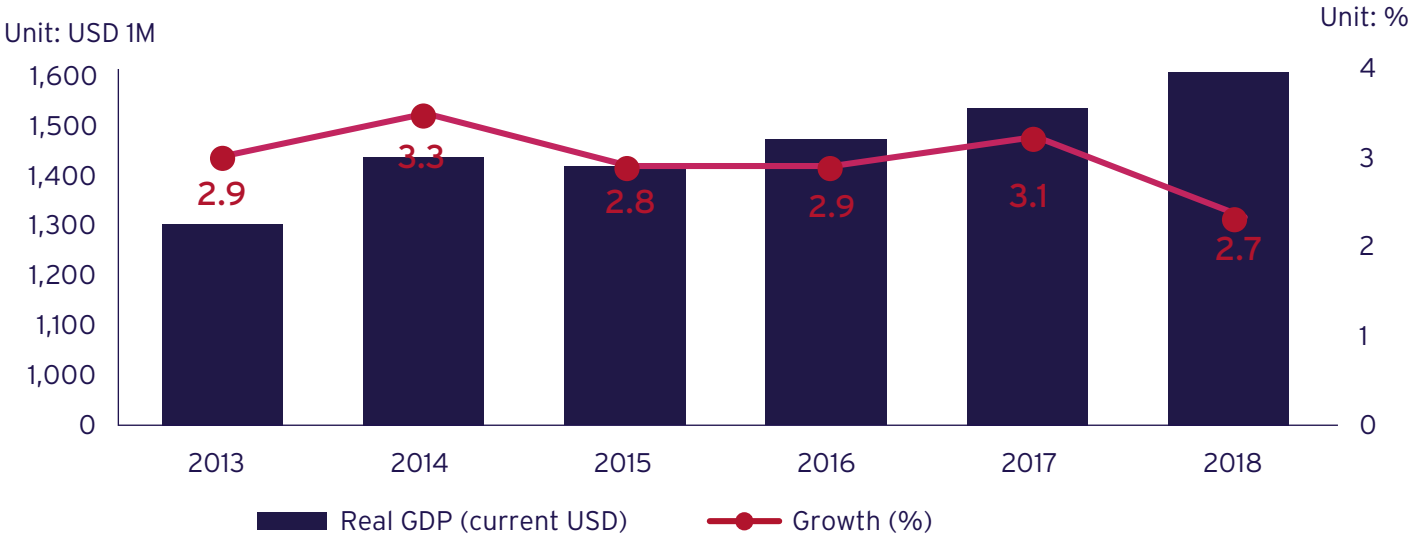
KEY POINTS

- Korea has climbed out of poverty to become a technology powerhouse over the last 60 years
- The country is the world's 11th largest economy with a GDP of just over GBP 1 trillion
- It has maintained an annual GDP growth rate of around 3% in recent years

In the space of just 60 years, Korea has transitioned from an agricultural economy to one driven by high-value industries such as automotive, shipbuilding and advanced manufacturing. Perhaps most remarkable of all is the country's success in the areas of electronics and information communications. As well as dominating the global semiconductor industry, Korea has leap-frogged its peers in terms of ICT infrastructure (smartphone penetration rate, broadband speed, etc.) and this fact, coupled with a demanding and technology-embracing population, means Korea is becoming an economy driven by creativity and innovation.

With a population of 51 million people, Korea boasts the 11th largest economy in the world, a GDP of GBP 1.2 trillion in 2018 and a per capita GDP of GBP 22,980 in the same year. Whilst not experiencing the growth witnessed in China, the country has maintained strong annual growth for a developed economy of close to 3% in recent years, outpacing its regional rival, Japan. Korea's trade dependency ratio is extremely high at over 80% and its economic performance is heavily affected by the economies of China, the US and Japan. Trade and investment flows between Korea and the EU are growing as a result of the FTA that came into effect in 2011. Trade between Korea and the UK specifically has grown rapidly over that period and both countries have expressed a strong desire to conclude a trade deal once the UK leaves the EU.

Figure 1: Korean GDP per Capita (2013 – 2018)



Source: World Bank

3. Smart Cities in Korea

Smart cities are a strategic component of the Korean government's national economic policy for the fourth industrial revolution. The Korean government is seeking to grow Korea's economic competitiveness through the development and commercialisation of emerging 4IR technologies such as big data and data analytics, artificial intelligence (AI), the Internet of things (IoT) and blockchain. Smart city projects offer a way for the Korean government to develop its strengths in these areas through the development and commercial deployment of these technologies, much as it did with the core ICT infrastructure in the late 1990s. The government forecasts a total of GBP 68bn in economic effects from smart city projects by 2030 out of a total of GBP 422bn from the fourth industrial revolution as a whole.

Korean smart cities have their roots in the U-City (Ubiquitous City) of the 2000s. The U-City was Korea's first attempt at the integration of different services in a city through ICT, with the benefits of greater convenience, better quality of life and savings through the integration of different systems. Early examples of services included real-time information on bus and train arrival for passengers, integrated traffic management, including the enforcement of traffic violations, as well as the ability to access government services online. A five-year U-City Master Plan was issued in 2009, along with GBP 332m in funding, and led to the nationwide development and adoption of U-city services.

Smart cities replaced the Korean U-City at the end of the five-year master plan, as the government shifted its focus towards a new model for connected cities that could take advantage of Korea's existing strengths in ICT, as well as promote the development of core technologies that would be crucial to the competitiveness of Korea's economy in the coming decades.

3.1 Government Initiatives

The 2018 Act on the Promotion of Smart City Development and Industry, commonly known as the Smart City Act, creates an open-ended definition of a smart city as consisting of interconnected services and facilities that improve competitiveness and quality of life. This definition gives significant power to individual cities and projects to determine key components and themes, effectively making smart city initiatives a fluid platform for the delivery of diverse connected services.

Industry Insider's Thoughts

"The overall position of the government is to provide the infrastructure and let citizens decide what they want to do with the technology. The spectrum of use scenarios is very wide."

Prof. Kabsung Kim, Chief Advisor, Korean Smart Cities Special Committee, Presidential Committee on the Fourth Industrial Revolution

The Ministry of Land, Infrastructure and Transportation (MOLIT) is the government body responsible for coordinating smart city policy along with the Ministry of Science and ICT (MSIT), the Ministry of the Interior and Safety (MOIS), the Ministry of Environment and the Ministry of Trade, Industry and Energy (MOTIE). A key role is also played by the Smart Cities Special Committee within the Presidential Commission on the Fourth Industrial Revolution (PCFIR), which was established by President Moon in August 2017 to develop and coordinate policy related to the 4IR. Some aspects of project implementation, including site selection for pilot projects and the administration of the Smart City Synergy Alliance, will be handled by the Korea Agency for Infrastructure Technology Advancement (KAIA), a public research institute affiliated with MOLIT.

3.2 National Projects

There are three categories of national smart city projects in Korea: pilot projects, R&D validation projects, and urban regeneration projects. National pilot projects are large-scale projects, effectively serving as reallife laboratories for the development and applicability of a model for smart cities.

Industry Insider's Thoughts

"Today's cities are basically running on twentieth-century technologies and ideas, especially automobile-centred street systems. In the smart city, we want to push for a human-oriented and multi-mobility-centred city that uses twenty-first century technology to increase the sustainability of the city and the happiness of its citizens."

Dr. Jaeseung Jeong, Master Planner, Sejong 5-1 Smart City

Pilot Projects

Two cities, Busan and Sejong City, were selected in early 2018 from a total of 39 candidate cities by the PCFIR. Greenfield sites in both cities, approximately 2-3 square kilometres, were selected due to the ease of development in terms of cost and time. Sejong City (officially known as Sejong Special Autonomous City) is Korea's central administrative city and is located 150 km south of Seoul, while Busan is located at the south- eastern corner of the country, 500 km from Seoul.

Sejong's smart city project, located in the northeastern 5-1 residential district, covers 2.7 km2 and will have a population of 23,000 residents in 9,000 households upon completion. The Busan smart city project, located in its western Gangseo district, will be known as the Eco-Delta City (EDC). The core of the Eco-Delta City development is an area of 2.2 km2, including a portion of the Nakdong River and its tributaries. Some components of the project will be spread out in the surrounding area, giving the project an overall size of 11.8 km2. Two public corporations will lead the development, LH Corporation in Sejong and K-Water in Busan. LH Corporation, officially the Korea Land and Housing Corporation, focuses on public housing and land development. K-Water has expanded from the management of water supply and resources to the development of industrial complexes and clean energy projects.

R&D Validation Projects

The cities of Daegu and Siheung, a satellite city of Seoul, were designated as R&D validation cities in July 2018, acting as testbeds or "living labs" for a Korean smart city model. The development of a Korean data hub model includes the collection, storage and sharing of data across an integrated city-wide platform, as well as its use in component services. The two projects have a combined budget of GBP 75m and will run for five years through the end of 2022. Research in Daegu will target intelligent mobility, crime prevention and resilience in response to natural and man-made disasters. Projects in Siheung will concentrate on the environment, welfare and energy.

Industry Insider's Thoughts

"We are in the process of developing our data architecture and will enter pilot testing next year in order to be able to fully offer new services by 2021."

Senior Manager, SK Telecom IoT Business Division

Urban Regeneration Projects

A third category of national smart city projects are urban regeneration projects that are being positioned as an attempt to resolve the problems of older urban areas, such as lack of space for parking and potential safety issues in narrow alleyways, through the use of data connectivity, rather than large-scale redevelopment. The projects are small-scale and thematic in nature.

In February 2019, MOLIT announced the cities of Daejeon, Gimhae, and Bucheon as the recipients of a total GBP 7.5m in funding. Daejeon's theme will be a "Re-New Science Town" that aims to showcase general scientific R&D as many corporate and government research centres are located in the city. Bucheon will focus on using big data analytics to monitor and reduce air pollution throughout the city, while Gimhae will invest in AR and VR attractions for its historic sites.

Table 1: National Smart City Projects in Korea

Location	Approval	Completion
Daejeon	February 2019	2019/2020
Gimhae	February 2019	2019/2020
Bucheon	February 2019	2019/2020
Daegu	July 2018	2021
Siheung	July 2018	2021
Sejong City	February 2018	Late 2021
Busan	February 2018	Late 2021

Source: MOLIT, PCFIR

3.3 Timeline and Budget

Blueprints for the Sejong City and Busan projects were unveiled in late 2018. Construction and development of services for projects will begin in late 2019, with residents scheduled to begin moving into the cities by late 2021. A significant portion of the first residents to move into both cities will be employees of LH Corporation and K-Water, as well as their families. Construction will continue into 2022 for some services such as healthcare and education, but core services such as mobility are expected to be in place within 2021 for the first residents.

Late 2021 is a crucial period for the national pilot projects as President Moon will be approaching the end of his five-year term, which expires in May 2022. The president has made the development of smart cities a key pillar of his economic policy as part of the fourth industrial revolution. Direct presidential support for smart cities ensures that government ministries involved will make significant efforts towards successful completion of the pilot projects by 2021.

The overall cost of the national pilot projects, including construction of the cities themselves, is expected to be approximately GBP 3bn. More than half of this money will come from government ministries, most prominently MOLIT and MSIT, as well as the lead developers of the projects, LH Corporation in Sejong and K-Water in Busan. The government and developers together are expected to contribute GBP 1.8bn in support for the projects from 2019 to 2021, with the developers expected to recoup their investment by selling the land upon completion of the projects. Private companies are expected to invest the balance of the development costs, either as part of an SPC or as individual entities.

Government funding for the pilot projects is restricted for use in developing the strategic services and technologies that are part of the pilot projects, such as autonomous vehicles and health services. Money from the developers will be used to build basic infrastructure such as roads, sewage systems and construction of residences. MOLIT and the PCFIR are considering different business models for attracting the estimated GBP 1.2bn in private sector investment needed by the national pilot projects. The government has announced GBP 18m of funding in 2019 for companies seeking to develop critical technologies for smart city projects, with more funding expected to follow in 2020 and 2021. The funding includes GBP 750,000 aimed at attracting innovative technology from overseas firms.

Close to half of the GBP 18m funding is earmarked for digital twins of the cities (GBP 3.4m), data analytics platforms and control centres (GBP 2.6m), and a citywide IoT network (GBP 1.2m). Another GBP 3.8m in funding is directed towards the development of services related to mobility, healthcare, education, energy, environment, and safety.

Another strategy utilized by the government to attract investment from the private sector is a regulatory sandbox lifting regulations in areas such as autonomous vehicles, digital healthcare, and drones, making it easier to develop and commercialize necessary technology.

3.4 Regulations

The Korean government has recognized that regulatory reform is necessary to allow for the commercialization of strategic 4IR technologies. Existing regulations require prior authorization of new and disruptive business models, a process that can be lengthy and expensive. Burdensome regulations have led to specific examples of innovative Korean companies losing out to international competitors that were able to get to market quicker, unhindered by the need to secure licences for activities where there were no specific regulations in place. The Korean government is moving toward a negative-listing regulatory approach for technologies surrounding the 4IR whereby new solutions and business models are deemed legal unless specifically prohibited by law.

The Korean National Assembly passed the Special Act on Promotion and Vitalization of Convergence of Information and Communications Technology in September 2018. The Act lifts regulations for a limited period of time in strategic growth industries related to ICT. In the case of smart cities, the regulatory sandbox applies to all designated smart city projects. These sandboxes allow pilot projects to occur within a limited geographical area free of regulations that might inhibit the project elsewhere in the country.

The bill was adopted in response to concerns from many industry experts, as well as President Moon, that regulations concerning the collection and use of data for IoT applications, particularly when involving public-private partnerships, would be an insurmountable barrier for smart cities in Korea. The need for regulatory reform was also cited as a tool for encouraging private sector investment in smart city projects by removing regulatory uncertainty surrounding commercial viability of smart city technology at large scale.

Regulatory exemptions for smart city projects are awarded on a project basis by the PCFIR and MOLIT. The regulatory sandbox covers six categories: personal data usage, autonomous vehicles, drones, private networks, software development and land use. The specific regulatory exemptions are summarized below:

Table 2: Smart Cities Regulatory Sandbox

Category	Details
Personal information	Removes data privacy protections under the Personal Information Privacy Act if data is stripped of identifying markers before processing
Autonomous vehicles	Lifts Road Traffic Act ban on use of video recording equipment in vehicles if utilized by an autonomous vehicle for R&D purposes
Drones	Requirements to report recording videos and images of aircraft to Ministry of National Defence are simplified if done for R&D and safety purposes
LAN	Expands ability of public telecommunications service providers to connect to a private network, presently restricted to highly specific uses under the Telecommunications Business Act
Software development	Allows conglomerates to bid on public tenders for software, presently restricted by the Software Industry Promotion Act
Land use	Allows developers to enter private contracts for the sale of land to companies

Source: Ministry of Land, Information and Transport (MOLIT)

There is a possibility that some features of the regulatory sandbox may become permanent law. In fact, an amendment to the Smart City Law proposed in October 2018 would make permanent regulatory changes related to car-sharing, renewable energy sources, and urban zoning within smart cities. The most significant change would involve car-sharing services, which would be released from a requirement under the Passenger Transport Service Act to have designated pick-up and release points for vehicles, as well as a dedicated storage lot. The revision to the law would offer users greater flexibility in using car-sharing services.

Changes in renewable energy sources, apparently made with the Busan Eco-Delta City in mind, will allow for water from river sources to be used in hydrothermal generation. Existing laws only allow for water from the sea to be used in generation. Other items in the proposed amendment include a reduction in the ratio of land that must be devoted to low-rise residential buildings and making it easier for smaller companies to enter the IoT industry.

3.5 Vendor Selection

The vendor selection process for Sejong and Busan is expected to utilize special-purpose companies (SPCs) or public-private partnerships (PPPs). One possible format is having multiple consortia, each led by an industry leader, such as Hyundai in mobility, working with many smaller companies to deliver a segment of services in the pilot projects. Prospective vendors are currently planning to build their own consortium and bid on tenders that are expected to be released starting in late summer or early fall 2019. Confirmation on the method for vendor selection, such as SPCs or PPPs, is expected in mid-2019.

Industry Insider's Thoughts

"We want to make it so that companies with disruptive technologies can find us, particularly those related to health, education and clean energy."

Dr. Inhyok Cha, Senior Executive Advisor, SK Telecom

The specifics of how vendors will be selected and whether multiple SPCs will be selected in each city instead of a single SPC handling all services are expected to be confirmed in mid-2019 by the PCFIR and the pilot city projects. A tentative plan is for the ownership of SPCs to be divided such that the Korean government will control a 51% stake while private companies combine to own a 49% share in the company. Both the PCFIR and national pilot projects have confirmed their interest in having international companies participate in the bidding process. Unlike past IoT projects in U-Cities, there is no territorial exclusivity planned for individual telecommunication operators, though it is possible that they divide up a single project geographically for greater efficiency.

A Smart City Synergy Alliance consisting of 113 companies was announced in February 2019. More than 350 companies applied for inclusion in the alliance, which is co-chaired by LG CNS, a large systems integrator under the LG group, and waste management start-up Ecube Labs. The alliance is comprised of 26 large companies such as SK Telecom, KT and Hyundai, as well as 37 SMEs and 50 start-ups. Sectors covered by the alliance members include pilot project component services such as mobility, education, healthcare and energy, as well as core technologies such as data analysis and security, blockchain and AI.

The Alliance is expected to act in a communicative and advisory role with government agencies, helping to draft and coordinate smart city policy. The list of companies included in the alliance is expected to grow throughout 2019. Overseas companies are welcome to join the alliance by contacting the KAIA's Smart City Innovation Alliance Support Group (www.kaia.re.kr).

3.6 Key players

The smart city ecosystem consists of government agencies and ministries at the national and local level, large conglomerates and a number of smaller start-ups. Key players in the private sector include the leading local telcos SK Telecom and KT, alliance co-chairs LG CNS and Ecube Labs, as well as providers of smart city services such as Stradvision. National-level government bodies such as MOLIT, MOTIE and PCFIR coordinate with municipal governments in Sejong City and Busan.

Figure 2: Smart City Ecosystem

Source: Intralink research

4. Opportunities for UK Companies

korean cityscape to supply

Industry Insider's Thoughts

"Korean smart city projects are a good opportunity for UK companies. Once a decision is made, the process will move really quickly."

Dr. Myounggu Kang, Director, Smart City Research Center, University of Seoul

This section identifies four areas within the Korean smart city projects that represent opportunities for British companies: mobility, energy, education and healthcare, and infrastructure. These industry verticals closely track the key themes of both the Busan and Sejong smart city projects. These opportunities have been qualified by our interviews with key stakeholders from the public and private sector. In addition to the verticals discussed below, we have also identified opportunities for UK companies in core smart city technologies with multiple applications, such as AI, data analytics and management, IoT, and blockchain.

Table 3: Key Services in National Smart City Pilot Projects

Mobility	Energy	Education/Healthcare	Infrastructure
Autonomous vehicles	Hydrothermal energy	Drone first responders	Cloud-based logistics
Last-mile solutions	Solar generation	Edutech platforms	Smart factories
AI traffic control	Smart grid management	Blockchain EMR	Automated water meters

Source: Busan Metropolitan City, Sejong Special Self-Governing City

4.1 Mobility

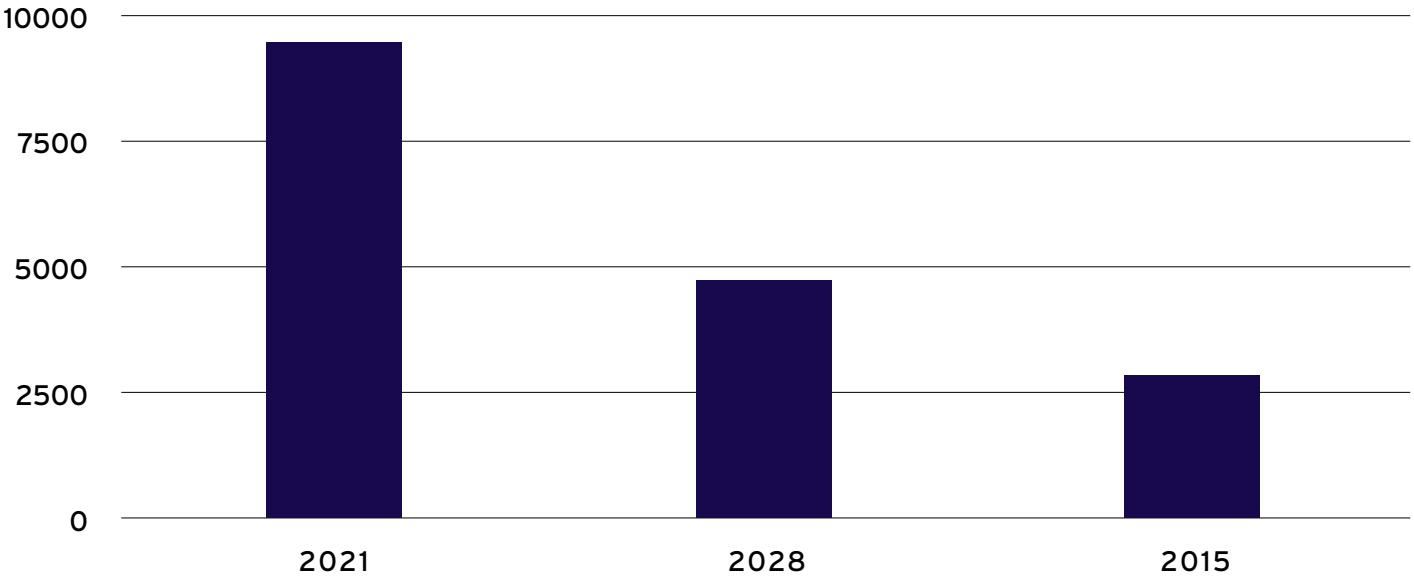
Industry Insider's Thoughts

"Mobility is the key to the Sejong City project. We are trying to construct cities that have very futuristic technology by attracting lots of investment."

Dr. Jae Yong Lee, Presidential Committee on the Fourth Industrial Revolution

Mobility is a key theme across Korean smart city projects, in particular the national pilot projects in Sejong City, where it has been identified as the priority. Mobility-related services in Sejong are expected to be developed and deployed first, being ready by the time the first residents arrive in 2021. Sejong's master plan calls for providing door-to-door transportation solutions for residents that focus on next-generation technology such as autonomous vehicles, powered by both hydrogen and electricity, as well as last-mile solutions such as electric scooters. Car and ride-sharing will also be a part of Sejong's goal of a two-thirds reduction in the number of cars used per capita by 2040.

Figure 3: Projected Number of Cars in Sejong Smart City Project, 2021-2040



Source: Intralink research

Sejong and Busan will be making investments in the infrastructure necessary to support their transportation plans. Sejong will dedicate the centre lane on roads in the 5-1 district to autonomous vehicles and make EV charging stations widespread, often interacting with the city's self-supporting smart grid system. Sejong and Busan will also seek to eliminate traffic congestion through the use of AI powered by 5G that is integrated into a traffic management system. In Busan, the AI will work with existing traffic cameras to analyse traffic flow and optimize traffic lights with the goal of reducing congestion by 30%. Busan predicts that its system will save residents up to 60 hours a year in reduced commute time.

Mobility in Busan calls for robots to assist with parking and returning cars to drivers in the form of an automated valet service. Robots will also assist in enforcing traffic laws and parking violations. Busan will explore last-mile transportation solutions through an automated tram line powered by clean energy and different types of ride-sharing devices that seek to minimize private car ownership.

In order to reduce congestion and offer greater convenience for residents, Sejong and Busan will make extensive use of drones, as well as different types of autonomous vehicles, to handle deliveries that are presently handled by trucks and motorbikes in Korean cities.

Autonomous vehicles used in Sejong and Busan by 2021 will likely utilize level 3 self-driving systems, which Korea aims to commercialise by 2020 at the K-City test site in Hwaseong. The site, jointly operated by MOLIT and the Korea Transportation Safety Authority (TS), features a 2 km track featuring intersections, school zones, pedestrian and bike paths, as well as tunnels and train crossings. In late 2018, both SK Telecom and KT completed successful tests of vehicles utilizing their 5G networks to communicate with other vehicles, as well as an autonomous vehicle platform in the case of KT.

A nationwide effort is underway to increase the number of charging stations for eco-friendly cars. An SPC consisting of major Korean automakers Kia and Hyundai, as well as SK Gas, Hyosung Heavy Industries, and international companies such as Linde and Air Liquide was established in November 2018 to build hydrogen charging stations. The SPC has received significant incentives from MOTIE, necessary to encourage the investment, in exchange for committing GBP 92m to build 100 hydrogen charging stations across Korea by 2022.

KT has identified EV charging stations as one of the key segments of its energy business and received one of five licences from the Ministry of Environment for installing stations nationwide. KT outpaced its rivals POSCO ICT, GNTEL, Korea Electric Vehicle Charge Service and EVERON, having installed close to 4,000 stations as of 2018.

The strongest opportunities for UK companies related to mobility are:

- Autonomous vehicles: Technologies such as autonomous driving platforms, AI, and machine vision will be in strong demand
- 5G: High-speed high-bandwidth, low-latency 5G networks will be needed to support the use of autonomous vehicles and their infrastructure
- Hydrogen for energy: Hydrogen vehicle adoption is growing quickly, and companies in the hydrogen-toenergy field will be in demand more than ever, particularly those supplying hydrogen vehicle charging stations

4.1.1 Case Study

Stradvision	
Website	www.stradvision.ai
Application	AI machine vision systems for autonomous vehicles
Key Technology	Deep-learning software that identifies cars, humans, road signs and objects
Overview	Stradvision is a Korean startup spun out of POSTECH in 2014 that supplies deep learning-powered vision-processing software for use in ADAS (advanced driverassistance systems). Stradvision's software is capable of detecting blind spots, pedestrians and potential collisions, with work ongoing to add capability for automated parking, acceleration, deceleration and lane changes. Headquartered in Pohang, North Gyeongsang province, Stradvision also has an office in the United States. In August 2018, Stradvision announced GBP 5.3m in investment from Hyundai Mobis, a major Korean tier-one auto supplier, as part of Hyundai Mobis' drive towards developing the necessary lidar and radar sensor technology required for autonomous vehicles by 2020.

4.2 Energy

Energy efficiency and clean energy generation figure prominently across smart city projects. Sejong has set a goal of moving towards energy independence by utilizing its own smart grid that relies on renewable energy sources, in particular solar energy. In addition, Sejong aims to increase the efficiency of its energy supply through building management systems, electricity trading systems between consumers, and twoway energy exchanges between electric cars and the city's power grid.

Busan, meanwhile, will similarly utilize energy management systems and emphasize the role of hydrothermal power generation for the Eco-Delta City. A 122,000-square-metre Geothermal Energy Cluster, including a hydrothermal generation plant, will utilize water from the Nakdong River and Pyeonggang Stream to increase the energy independence of the Eco-Delta City.

Various smart energy projects are underway across different districts in Seoul as part of a citywide goal of making the city 30% energy independent by 2022, as well as reducing 180,000 tons of greenhouse gas emissions annually. The centrepiece of Seoul's smart energy developments, led by LG CNS, will be the Magok district, already home to many corporate R&D centres utilizing building management systems. Features will include energy-saving technologies such as smart lighting, cooling and heating systems that use energy from the ground, solar panels and ESS.

Korea is still far from the adoption of a national smart grid due to the significant cost of adopting advanced metering infrastructure (AMI). The national electric utility company KEPCO has installed 8.6 million nextgeneration meters, but 80% of these do not have the two-way communication capability required for a smart grid. Regulatory changes have allowed the growth of a nascent brokerage market, currently at 900 MW and expected to grow rapidly, and key players in the energy sector are exploring different ways to enter the growing smart energy segment, particularly as part of smart city initiatives.

Although attempts at a large-scale smart grid have failed to date, they are emerging at the local level, particularly in the national pilot projects. KT has emerged as a prominent player in the smart energy business through its MEG (Micro Energy Grid) platform, which provides four key services: generation, energy management, demand response, and EV charging stations. Its generation capabilities rely on solar panels and energy storage systems that store energy for use when output levels are low.

Industry Insider's Thoughts

"What can ICT add to the energy industry? We think it can provide stability as we adopt renewable energies, enhance operations through data analytics, enable a prosumer market and simplify maintenance."

Jakyung Hahn, Vice President, Smart Energy Task Force, KT

KT's generation management solutions also offer remote management and diagnostics, allowing power stations using KT's platform to increase the amount of time their solar panels generate power by more than 10%. The MEG platform has a demand response feature that utilizes arbitrage, allowing enterprise customers to exchange consumption at peak periods for lower-priced energy at times of low demand. KT's management services offer design, consulting and retrofitting systems to reduce usage at peak periods to more than 10,000 factories, high-rise apartments and office towers across the country.

The biggest opportunities for UK companies related to energy are:

- Data analytics and energy management platforms: Korea is strong in the hardware of localised energy storage and distribution, but much less so in the underlying intelligence of distributed power
- Energy savings technologies: An area of true strength for the UK, Korea has not placed the same emphasis on energy efficiency as the UK, but this has started to change over the past few years

4.2.1 Case Study

LG CNS	
Website	www.lgcns.com
Application	Energy-efficient building management solutions
Key Technology	AI and big data-based energy management platform, microgrids
Overview	LG CNS is a subsidiary of the LG Corporation that specializes in providing systems integration and ICT services across a range of industries, including energy, transportation and finance. LG CNS has been active in early smart city projects such as Seoul's Magok district and was announced as a co-chair of the Smart City Synergy Alliance in February 2019. LG CNS has been deploying its smart energy building management platform nationwide, most notably in the Magok district. With a combination of advanced meters produced by LG CNS, and ESS using cells produced by sister company LG Chem, LG CNS is able to feed information to its big data platform and optimize energy consumption in real-time.

4.3 Education & Healthcare

The Korean education system has yet to fully exploit Korea's advanced ICT infrastructure due to policy and regulatory hurdles. In Sejong and Busan, however, planners have been given significant latitude to explore different technologies and designs to reform education in a way that could have nationwide implications through the establishment of special schools.

Existing plans for these special schools call for the implementation of technologies such as 3D printers and robot arms in the classroom in order to create experiential, creative learning environments. Sejong is aiming to diversify teaching methods and utilize edutech platforms that will allow for frequent assessment of students and greater equalization of classroom conditions through the use of data. This data-driven equalization opens the door to alternative methods of evaluation in a country that is dominated by the use of standardized testing. Sejong also aims to explore the use of neuro-architecture to design buildings in a way that takes into account the impact the design of a space will have on its users.

Healthcare components in smart cities will depend heavily on the freedoms offered by regulatory sandboxes as existing regulations are particularly onerous with regards to smart healthcare. Sejong and Busan are planning to use connectivity, wearable devices and robotics in the home, public spaces and medical facilities to improve the responsiveness and delivery of healthcare.

Busan has outlined a plan for collecting and utilizing patient data, including genetic information, that is stored using blockchain and analysed by big data to provide customized treatment. The sharing of patient data between hospitals is also expected to improve the efficacy of treatment. Much of the treatment would take place in the West Busan Smart Health Cluster, where a comprehensive medical centre using digital health technologies will also serve as a research hub. The cluster will also feature caretaker robots interacting with patients and elderly residents in retirement homes.

Sejong will use AI in the home to detect medical emergencies such as falls, injuries or illness and call emergency responders. Drones on call will be able to respond to emergencies within three minutes, collecting images, video and other data that is relayed to first responders and medical professionals in hospitals. First responders will also be equipped with wearable devices that collect data that is relayed to hospitals, enabling more seamless treatment.

Seoul has also introduced trial projects in smart healthcare area across multiple districts. The Eunpyeong district provides elderly and disabled residents with location-detecting devices that send a text message to a family member or designated contact if they leave the district. A project announced by Yangcheon district in February 2019 will detect potential medical emergencies in the homes of senior citizens through the use of 'smart plugs' that connect to TVs, household appliances and lamps. The plugs measure electricity usage and in case of a lack of, or change in, usage after 50 hours, automatically trigger a visit to the user's home.

Education and healthcare are expected to see longer timelines for full-scale deployment within smart city projects. Educational services in Sejong are expected to be deployed later than other services as they are contingent on a sufficient number of students being present to support the opening of schools. No fixed timeline is set for when schools are expected to open, but a large-scale deployment of educational services in Sejong is expected to happen in 2022 or later. The deployment of healthcare services is also expected to be slow in the early stages as residents move in to the cities, but the Busan big data custom healthcare platform is expected to be in service within 2021.

The biggest opportunities for UK companies related to education and healthcare are:

- Drones: both Sejong and Busan will rely extensively on drones, but the development of Korean UAV hardware and software has been hampered by local regulations
- Robotics: Multiple use-cases exist for robots, in applications such as education and healthcare, creating significant demand for software and technologies such as synchronization and autonomous control capabilities
- Edutech software: Sejong is looking for innovative technology that can be used in the classroom to manage assessments and deliver instructions, with potentially nationwide applications

4.3.1 Case Study

Conus	
Website	www.conus.kr
Application	'Smart plug' solution for detection of medical emergencies
Key Technology	Healthcare IoT, sensors
Overview	Conus is an IoT startup established in 2011. It manufactures the IoTap, a smart plug that utilizes a sensor to detect the usage of electrical appliances and heating systems. Applications include energy and enterprise solutions, as well as detecting medical emergencies in the homes of seniors based on power consumption patterns. A prolonged period without changes in power consumption leads to an automatic welfare check by a social worker. Conus' IoTap has been incorporated in the smart home offering of major telcos.

4.4 Infrastructure

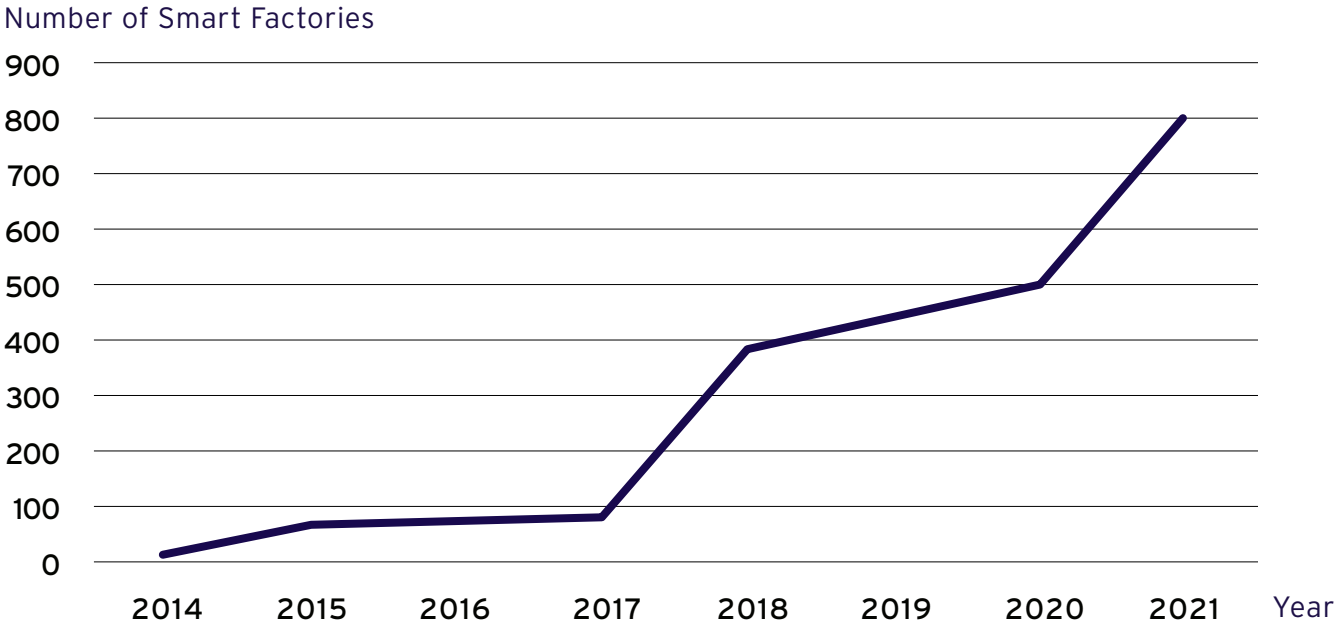
A diverse range of projects have sought to further improve Korea's already strong infrastructure through the addition of connectivity, particularly in areas related to logistics, factories, utilities and waste management. Some municipalities have also tried to link the automation of public services to broader social welfare and public health initiatives. Busan is already in the midst of transforming its port, the fifthlargest in the world, into a smart port through the use of IoT, the first such port in Korea.

The Eco-Delta City intends to further expand on this strength by developing a cloud-based port and logistics platform that utilizes blockchain to share data between manufacturers, shipping companies, freight forwarders and customs to maximize the efficiency of the port in moving goods. Services included in the existing plan are location-based tracking of cargo and a secure platform for processing transactions, as well as sharing relevant documents. Sejong is also considering the use of blockchain to facilitate transactions, including the possible use of a local cryptocurrency called Sejong Coins.

Busan will also invest in a smart water management system, most of which is expected to be in service before the end of 2021. The components of Busan's smart water strategy include smart water meters, automated detection and drainage of pollutants, a water reuse system and a response system for natural disasters. All components will be in place by 2021, while an automated filtration plant, located in the Healthcare Cluster, will be operational starting in 2022.

Busan follows a number of municipalities across Korea that have started the process of automating water meters. These municipalities include Taebaek, Pyeonchang and Yeongwol in Gangwon province, Gimje and Geochang in North Jeolla province, and Jecheon in North Chungcheong province. Gimje and Geochang worked with Australian firm Freestyle Technology between 2014 and 2018 to automate the collection and reporting of data from water meters, install a water management platform providing visibility into all water assets, and add the capacity to detect leaks and trigger welfare checks in households without water usage.

Figure 4: Smart Factories in Busan, 2014-2022



Source: Busan Metropolitan City, Yonhap News Agency

Busan is also aggressively seeking to develop the local infrastructure for smart factories and big data analysis. As of late 2018, there were 383 manufacturing facilities in Busan that were considered smart factories by having incorporated ICT into their processes. Busan is seeking to improve the productivity and competitiveness of its factories by doubling this number to 800 by 2022. On a nationwide level, MOTIE will establish ten smart factory testbeds nationwide by 2022, spending an estimated GBP 150m to develop smart manufacturing technologies in cooperation with local universities and research institutes. The first two sites, Changwon and Ansan, will feature factories connected with data centres, eventually establishing special manufacturing data centres that will boost productivity by as much as 30%.

Busan will also establish a Marine Big Data Centre in cooperation with the Korea Institute of Ocean Science and Technology (KIOST), the Korea Maritime Institute (KMI) and local universities. The space is expected to be open to SMEs and start-ups in ocean-related industries seeking improve their competitiveness and adding new revenue streams.

Efficiency in the waste collection system has been a target for existing projects in Seoul and Songdo. Seoul has installed public trash cans in the central Bukchon neighbourhood that send a signal when full, optimizing the collection frequency and the routes made by garbage trucks. A new project announced in the western Yangcheon district will expand on the Bukchon project by installing sensors in streetlights to monitor illegal dumping and parking, as well as noise violations and pollution levels. Seoul has also made efforts to automate the sorting of recycling waste at apartment complexes. Songdo has gone a step further by utilizing waste collected in each building to generate energy. Waste is collected in the basement of each building by a vacuum system, which captures the heat from the waste and distributes it around the Songdo district.

Opportunities for UK companies related to infrastructure are:

- Sensors: Specialized sensors for devices in a range of settings, such as industrial facilities, waste receptacles, and energy/utility management, will be used to provide real-time connectivity
- Big data: Busan will be investing heavily in big data, establishing a Marine Big Data Centre to develop its competitiveness
- Blockchain: Busan and Sejong plan to utilize blockchain to support data sharing and transactions between businesses, as well as consumer use of cryptocurrencies

4.4.1 Case Study

Ecube Labs	
Website	www.ecubelabs.com
Application	Smart waste management and solar-powered waste compacting
Key Technology	IoT container monitoring, solar panels, data analytics platform and fleet management solution
Overview	Ecube Labs is a Korean start-up that provides smart waste management solutions to more than 100 municipalities worldwide, including in Korea, the UK, US and France. It seeks to address inefficiencies in waste collection, such as infrequent or unnecessary collection trips, by installing ultrasonic sensors in trash bins indicating when the bin is full. Sensors transmit data in real time to a waste analytics platform, which is able to calculate the most effective route for collection vehicles, reducing costs. Ecube also offers a solar-powered trash compactor that reduces collection frequency by up to 80%.

Freestyle Technology	
Website	www.freestyletechnology.com.au
Application	IoT solutions for public utilities and enterprises
Key Technology	Cloud-based IoT management platform and switch
Overview	Established in 2006, Freestyle Technology is an Australian company specializing in enterprise and government IoT solutions, particularly for the energy sector. Free Style Technology utilizes its proprietary M2M IoT switch and Freestyle Micro Engine (FME) to add connectivity to sensors and meters, providing realtime insight into temperature, gas pressure, energy consumption and pipeline flow. The FME is network agnostic, able to work with 3G, Zigbee, Ethernet and WiMax. Freestyle Technology has achieved significant success in the APAC region, working with the Korean cities of Gimje and Geochang to automate their water meters, including data collection and reporting. Freestyle is also able to detect water leaks and recommend methods for repair based on external data such as temperature.

5. Market Entry Strategies

KEY POINTS

- Partnering with local distributors or resellers is strongly advised for foreign companies
- Using a sales team based outside of Korea is difficult due to language and cultural barriers and high expectations of after-sales support
- Foreign companies can apply to participate in government-led projects but there are barriers:
  - Culture, language, business environment, etc.
  - Preference for local businesses adding at least some value to products or services

Korea offers strong opportunities for UK companies across the range of services planned for smart city projects, most notably the national pilot projects in Sejong City and Busan. The significant amount of funding has been approved for the national pilot projects, coupled with the short timeline for completion and hunger for commercial-grade technologies ready for deployment in smart cities, makes Korea an attractive market for UK companies. However, UK companies looking to introduce their technology to Korea should take into account both business-related and cultural factors. UK businesses can approach the Korean market through direct sales from the UK, by appointing a partner or by setting up an office in Korea.

Direct Sales from the UK

The simplest market entry option is for UK companies to sell or license a particular smart city technology directly to Korean end-users. The main downside of a direct sales approach is the lack of local language and time-zone support, as Korean customers tend to be particularly demanding of their suppliers. This can be mitigated by using a local agent or business development consultancy, such as Intralink, capable of bridging time-zone, language and cultural gaps without the long-term commitment of local incorporation and hiring. Market-specific factors to consider include:

- Do we have a strong differentiator – something that sets us apart from our competitors in the market?
- Do we have a strong track record in other major markets? Korean companies are not easily convinced to use a new, disruptive technology as a first-mover without case studies
- Are we willing to localise the product for the market and/or for local regulations, if necessary?
- Are we ready to provide a Proof of Concept (PoC) at little or no cost to the customer? Korean companies will look to drive the price down and will not commit before proving the value through testing
- How do we provide after-sales support? Korean customers expect high-quality, local-language support
- Do we understand the local regulations, particularly in relation to data? Do we need to adjust our business model to adapt?

Appointing a Reseller or Distributor

A more common way to approach the market is to seek a partnership with an established local company which complements your product, has experience in the target sector and can help navigate the legal environment. A local channel partner can provide services such as certification, registration, pre-sales, sales, consulting, installation, technical training, service maintenance and technical support in the Korean market. Even large multinationals take this route in the early stages of market entry. Market specific factors to consider when seeking a partner include:

- Does the partner already serve the type of customer that we do?
- Does the partner have a good understanding of the market in general and my particular application?
- Does the partner already offer solutions similar or complementary to our offering?
- Is the partner focused on short-term wins or will they be able to drive our business in the long run?
- Does the partner have specific experience with public sector projects?
- Are we comfortable communicating with the local partner and are they transparent with us?

Establishing a Local Presence

There are broadly three ways of establishing a local presence: (1) a liaison office, (2) a branch office or (3) a local corporation through foreign direct investment (FDI). Setting up a liaison office is a simple process; but a liaison office can only perform non-profit generating activities in Korea such as market surveys, research and development and quality assurance. Setting up a branch office can be a complicated process that requires documentation to be translated, but it allows for sales activities and the exchange of revenues with the head office. The most common process for an overseas company to open a branch office in Korea is through FDI, where an initial investment exceeding approximately GBP 68,000 is made by the head office, which in return owns stock in the branch. The local corporation leads independent activities and is authorised to perform direct transactions. Market-specific factors to consider when establishing a local presence in Korea include:

- Is our business generating enough revenue in Korea to consider a local presence? Businesses usually consider establishing a local presence after several years of sales (either direct or through a partner)
- Is Korea a strategic market for us, either in terms of securing use-cases or securing further funding?
- Do we need to engage in profit generating activities?
- Will we transfer staff from our head office or hire local staff? In Korea, visas can be difficult to secure for foreign employees and social insurance contributions and severance pay must be paid to all staff that complete one year of employment. An employer's share of these costs equates to 18% of salary
- What location shall we pick for our local presence? Scouting, negotiating, and conclusion of contracts are time-intensive processes that often are hard to conclude without local support.

Exchange rate used in this report:
1 GBP = 1500 KRW

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