National Infrastructure Commission

Study on international best practice in using technology to improve productivity

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NATIONAL INFRASTRUCTURE COMMISSION

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1. Virtual Models in Urban Planning

1.1 Virtual Singapore; Singapore

Flood risk management, Transport, Energy, Solid Waste	**Year Started**	2014	**Focus Technology**	Big Data, Digital Twins, IoT	**Other Technology**	Data Analytics	**Asset Management Lifecycle Stage**	Whole asset life
	Year Ended	2018						

Description of project
► The project is led by the NRF in collaboration with the Prime Minister's Office, SLA, Dassault Systèmes and GovTech
► Virtual Singapore will be a platform that has a 3D dynamic virtual model – a digital twin – of the urban areas of Singapore. It will incorporate both static and real-time data on factors such as, climate, demographics, terrain attributes, energy consumption or building elevation. It will also contain semantic information like the composition and materials of buildings
► Alongside Virtual Singapore, GovTech is deploying a nationwide sensor network called the Smart National Sensor Platform that will be key to collect data that feeds onto the platform
► The platform will be a key tool to simulate and test new solutions to urban problems prior to deployment or construction

Value of project
► US$73.0m

Indirect project costs:
► Funding support of 20% of total qualifying approved direct cost for educating the stakeholders on the benefits and usage of technology

Outcomes / Benefits
► **Virtual Experimentation, Test-Bedding** – the platform enables organisations to test and experiment new projects prior to their deployment
► **Simulation** – testing the built environment under extenuating circumstances such as disaster management
► **Planning and Decision-Making** – the collaborative nature of the platform with a holistic and integrated view of Singapore provides information to make 'better' decisions around asset management
► **Savings achieved -** The collaboration between different stakeholders that is encouraged by Virtual Singapore is likely to deliver significant costs savings due to better decisions on infrastructure management

Role of Government
► Led by the NRF in collaboration with the PMO, SLA and others. The SLA will own and operate the project post completion
► The NRF opened Call for research proposals to provide grant of around US$0.74M per proposal
► Project is receiving Government support under the Smart Nation Initiative and Open Data Policy
  § The Smart Nation initiative follows the standards laid by SSC and the international standards defined by ISO and ITU

Impact of Project / Challenges
► **Impact:**
  § Opportunity to collaborate with communities to co-create and improve the city environment
  § Research and Development – platform will be available to start-ups and academia as well as private and public entities providing the opportunity for these to collaborate, innovate and develop new solutions
► **Challenges:**
  § Privacy and security concerns over sensitive data handled by third-party vendor
  § Government agencies might find it challenging to manage the change by switching to a less 'siloed' environment

1.1 Virtual Singapore

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Detail of Calculations

NA

1.2 SPINEX; Japan

Digital Infrastructure	Year Started	2016	Focus Technology	Digital Twins, IoT	Other Technology	NA	Asset Management Lifecycle Stage	Plan, Design, Build; Maintain, Operate
	Year Ended	NA						

Description of project
► SPINEX was launched by Toshiba in late 2016
► Consists of a technology that leverages IoT, edge computing and data analytics to enable improvements in control of equipment and operational performance.
► SPINEX uses digital twin technology to visualize and examine constantly changing worksite conditions
► Toshiba's initial market focus is directed towards manufacturing plants but plans are to expand SPINEX to be used in other locations/sectors
► SPINEX enables detailed visualization and real-time assessment of the constantly changing site conditions and quality information on asset performance to improve decision-making. It enables one to connect different pieces of equipment, collect data and perform advanced analysis on that information. It uses an open architecture and is capable of multi-cloud/device connectivity

Value of project
► NA

Outcomes / Benefits

► Connects a wide range of devices from which it collects data for rapid decisions and actions on asset operation
► Digital twin allows for anticipation of problems as well as providing a means to implement improvements to generate efficiencies
► Uses AI with facial and speech recognition to integration human intentions and activities in asset operations
► **Revenues** - The company is expecting its revenue to reach US$2B by selling its IoT products, owing to the launch of SPINEX in 2016
► **Savings achieved** - Energy IoT solution (that uses SPINEX) is expected to help control the electric power supply and demand balance thus help save energy

Role of Government

► Private initiative – No government involvement

Impact of Project / Challenges

► **Improved decision making:**
  § Detailed visualization and real-time assessment of production conditions of factories improves speed and quality of decision-making
► **Future Plans:**
  § Combining with Toshiba's other products in areas such as social infrastructure, energy and storage business

1.2 SPINEX

Sources

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Detail of Calculations

Project Revenues:
Assumptions-
The revenue mentioned is the projected revenue of the company in 2017 by adding SPINEX to its product offering

1.3 Urban Planning Application; Estonia

Digital Infrastructure	**Year Started**	2014	📈 **Focus Technology**	Sensing	⏱ **Other Technology**	Analytics	🔄 **Asset Management Lifecycle Stage**	Maintain, Operate; Service Provision
	Year Ended	2018						

Description of Project

► Urban Planning Application (UPA) is a smart governance solution for a city and transportation planning that integrates citizen experience with state-of-the-art data handling. This application is being used to support better planning for the Tallinn Smart City programme

► In a city with 1 million people, 0.25 billion location updates can be generated per day. In contrast with static sensors, this provides more data and of better quality. The application will then combine it with other spatial datasets and extensive data analysis tools

► It includes several different analysis tools that allow for the analysis of citizens' mobility patterns in greater detail. For example, it will help analyse the Origin-Destination matrix more accurately and provide insights to cater to the challenges faced in the smart city

Value of project

► NA

📈 **Outcomes / Benefits**

► **Improved city planning:**
  § Help identify the reasons of bottlenecks in the urban space
  § Analysis of the Origin-Destination matrix to generate insights to cater to challenges faced in smart city

► **Citizen engagement:**
  § Fast and easy access to information about on-going planning processes to users
  § Citizens have ability to comment and submit their own proposals

🏛 **Role of Government**

► **Public-private-people partnership:**
  § UPA is the result of a public-private-people partnership for establishing new ways to improve the inclusion of various public sector bodies, private entities, residents, NGOs, and other civil agencies in planning processes

► **Promotion:**
  § City officials promoted use of application to facilitate involvement of different groups in making city planning process more open / transparent

🔍 **Impact of Project /** 🚧 **Challenges**

► **Impact:**
  § Constant inflow of real-time data helps get a better understanding of how and why people move
  § Analysis results combined with other datasets provides valuable input for planners and decision-makers about the needs of citizens

► **Challenge:**
  § Need to provide sufficient assurance to citizens on data privacy and security
  § It will be crucial to enable the appropriate levels of trust so that citizens feel assured they can share their location and travel information

1.3 Urban Planning Application

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Detail of Calculations

NA

1.4 VR utility inspection project; UAE

Energy; Water	Year Started	2016	📈 **Focus Technology**	IoT, Virtual Reality	🕐 **Other Technology**	NA	🔄 **Asset Management Lifecycle Stage**	Maintain, Operate
	Year Ended	NA						

Description of project
► VR utility inspection project was launched by Dubai Electricity and Water Authority (using SAP autonomous robots) under the National Innovation VR Strategy. It is a proof of concept in a high-voltage power tunnel in Dubai
► The project aims to enhance the inspection process by making it faster, safer and more cost effective. Robots carrying scanners and sensors will patrol the electricity lines and help in remote inspection of the electricity and water networks. The data will be uploaded to SAP's cloud for analysis

Value of project
► US$32.7m

📈 **Outcomes / Benefits**	🏛 **Role of Government**	🔍 **Impact of Project / 🚧 Challenges**
► The project provides remote inspection solution thereby eliminating the need for full area visual inspection by a human expert ► It will save time and effort in the maintenance of high-voltage cables compared to conventional methods ► **Intangible Benefits -** Brand Value: DEWA aims to attain leading position as one of the innovative and most efficient utilities in the world	► The project is launched by DEWA, a public service infrastructure company, owned by the Government ► The pilot project launched by DEWA will fall under the purview of the Government's National Innovation Strategy and Smart City initiative	► **Impact:** § Expected to instil a culture of creativity and innovation in the workplace § Technological advancement that will contribute towards achieving the objectives of Dubai Plan 2021

Acronyms: DEWA - Dubai Electricity and Water Authority

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1.4 VR utility inspection project

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Detail of Calculations

Project Value:
Calculations-
The project value mentioned is the combined value of 19 pilot projects approved by Dubai Future Foundation

1.5 Microsoft HoloLens in power plants; UAE

Energy; Water	Year Started	2017	Focus Technology	Sensing	Other Technology	Mixed Reality, 3D Modelling	Asset Management Lifecycle Stage	Maintain, Operate
	Year Ended	NA						

Description of project
► The Dubai Electricity and Water Authority has adopted Microsoft HoloLens – the world's first self-contained holographic computer - for maintenance and operation of its power plants
► Microsoft HoloLens is a mixed reality technology that allows the user to engage with digital content while interacting with the hologram
► Technology will allow for more efficient cost control, reduce energy consumption and reduce likelihood of incidents in DEWA's utility network
► It will allow visualization of the Smart Power Plant, provide an interactive 3D models for the plants' equipment, and remote expert assistance (including access to maintenance job cards, equipment, training manuals, and other operating procedures)

Value of project
► NA

Direct project costs
► US$5,000 (cost per commercial suite of Microsoft HoloLens)

Outcomes / Benefits

► Expected to accelerate decision-making process and subsequently help in managing and forecasting demand to improve energy efficiency
► Reduced likelihood of human error in maintenance operations of power plants
► The scenario visualisation, data-gathering and remote maintenance of DEWA's Smart Power Plant increased efficiency of the operate and maintain phase in this asset, culminating with a reduction in power consumption by as much as 30%.
► **Savings -** Reduced power consumption by as much as 30%
► **Intangible Benefits -** Brand Value: DEWA aims to attain leading position as one of the innovative and most efficient utilities in the world

Role of Government

► The project is launched by DEWA, a public service infrastructure company, owned by the Government
► DEWA is investing in state of the art technologies to support innovation, and contribute to achieving the goals of UAE Vision 2021 and Dubai Plan 2021

Impact of Project / Challenges

► **Impact:**
§ "Easy-to-use" technology that does not require extensive training
§ Expected to instil a culture of creativity and innovation in the workplace
§ Technological advancement that will contribute towards achieving the objectives of Dubai Plan 2021

1.5 Microsoft HoloLens in power plants

Sources

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Detail of Calculations

NA

2. Redeveloping Public Housing

2. Smart Yuhua Residential Estate project pilot; Singapore

Energy; Water & wastewater; Solid waste	Year Started	2015	**Focus Technology**	IoT, Sensing	**Other Technology**	Data Analytics	**Asset Management Lifecycle Stage**	Whole Asset Life
	Year Ended	2018						

Description of project

► HDB and IDA are conducting Smart Yuhua Residential Estate project pilot, for 9,000 residents of 3,194 flats in HDB estate of Yuhua. The project includes smart home and smart neighbourhood solutions, integrating technology with day-to-day living of residents

► Solutions for the households and neighbourhoods in this program include:
  ► **'Smart Home solutions'-** Home Energy and Water Management Systems and Elderly Monitoring Systems
  ► **'Smart neighbourhood solutions'-** Smart Pneumatic Waste Conveyance System, Smart Electrical Sub-meters, Remote Water Meters and Smart Solar Energy Monitoring System

Value of project

► NA

Outcomes / Benefits

► **Improved efficiency of utility distribution network** – IoT-enabled sensors allow for a reduction in unaccounted (lost) water rates
► **'Citizen-friendly' technology** – technology was easily accepted by citizens
► **Greater cost control** – citizens are able to keep track of their utility usage levels and achieve cost savings
► **Reduction of imported water** – by reducing leaks and potentially water usage, less water needs to be imported from Malaysia
► **Scalable benefits across WOG** – a number of government agencies are working on this initiative
► **Savings -** An annual cost saving of US$0.2M to US$0.3M for 3.2k households in Yuhua

Role of Government

► HDB, statutory board of the Ministry of National Development is responsible for this project
► The pilot project falls under Smart HDB Town Framework, which aims to assess feasibility and cost–benefit of utilising smart home technologies before being implemented in other HDB estates
► The project supports the Smart Nation program of Singapore

Impact of Project / Challenges

► **Impact:**
  § This project will help local authorities / utility providers identify leakages and manage resources more efficiently
  § Success of HDB-led projects, will likely have a scalable impact because ~80% of population occupies houses developed by HDB
► **Challenges:**
  § Concerns over the high costs of implementing these solutions after trial period is over
  § Challenging to explain the functional aspects and value of the systems to elderly residents

Acronyms: HDB – Housing Development Board; IDA - Info-communications Media Development Authority

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2. Smart Yuhua Residential Estate project pilot

Sources

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Detail of Calculations

Project Savings:

The programme is covering 3.2k households and has led to an average cost saving of 10-15% per month per household

Assumptions-

► All the values are based on the household responses for the trial period

► Average monthly SingaporePower bill (including 50% Electricity, 40%, Water and 10% Gas) for HBD 2 room household in Singapore for January 2017 has been considered

Calculations-

► Average monthly SingaporePower bill= US$59.14 per household

► Cost saving of 10-15% per month= US$5.9 to US$8.9 per month per household

► Annual Cost saving (X12)= US$70.8 to US$106.8 per household

► Annual Cost saving of 3.2k households= US$0.2M to US$0.34M

3. AI for Asset Maintenance

3. AI based MTRC project; Hong Kong

Transport	Year Started	2004	**Focus Technology**	AI , IoT, Sensing	**Other Technology**	NA	**Asset Management Lifecycle Stage**	Maintain, Operate
	Year Ended	NA						

Description of project
► MTR Corporation deploys AI technology to streamline and automate the quarterly planning and weekly scheduling of all engineering works across the subway stations
► The maintenance workforce of 10,000 and 2,600 weekly engineering projects are coordinated by an algorithm-driven AI system
► The system monitors entire subway line to determine critical maintenance tasks and directs the workforce according to the priority. Sensors along the tracks, switches, and signals generate real-time data, to assist in informed decision-making with effective IoT application

Value of project
► NA

Direct project costs
► US$0.7M including ITSD staff cost, AI software and consultancy costs, outsourced programming work, hardware and software license costs

Outcomes / Benefits

► **Efficiency gains:** MTR realized an improvement of more than 50% in overall maintenance efficiency contributing to the 99.9% on-time record of trains
► **ROI gains:** Effective maintenance and engineering works helped enhance asset conditions and extending asset life
► **Long-term planning:** The ETMS helps in long term planning, used up to 1 year ahead of the time of execution of the engineering works
► **Safety**: the algorithm eliminates the possibility of error from human manual processes
► **Maximised resource allocation**: streamlined workflows and more efficient processes provide MTRC with oversight of what tasks will be done and when
► **Savings -** Improvement of 50% in overall maintenance efficiency; Elimination of two days/ week preparation time of repair schedule, saving US$0.8M/yr; # of passengers/ staff hour increased by 33% (2004-2006), thereby improving staff efficiency.
► **Revenues -** Enhanced assets condition and extend assets life, leading to increased profitability

Role of Government

► The project was jointly led by MTRC and City University of Hong Kong, with other technology partners
► Mass Transit Railway is operated by MTRC. In 2004, the MTR Corporation was 76% owned by the Government
► The research conducted by City University was partially supported by a grant from the Research Grants Council of Hong Kong Special Administrative Region, China and from the City University of Hong Kong

Impact of Project / Challenges

► **Impact:**
  § Agility and Scalability: capability of adding new stations, new lines, new rules, etc. to the system.
  § Customer satisfaction: impressive on-time record
► **Challenges:**
  § The 2011 redesigning recovered many challenges faced by 2004 design
  § Regulations applicable for maintenance work of subway lines and airport express such as Permit-to-Work (PTW) and Isolation Record Form (IRF) need to be considered by AI
  § AI Engine needs to expand and adjust according to the growing complexity of the railway network

3. AI based MTRC project

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Detail of Calculations

Project Savings:

Assumptions-

- In order to quantify 50% improvement in overall maintenance efficiency, factors related to maintenance efficiency have been considered-
  - § Railway Operating costs per car Km operated
  - § Staff efficiency (number of passengers per staff hour)
- The analyses is done for 2004-2006 period considering-
  - § Project initiated in 2004
  - § MTRC merger with KCRC in 2006
- The variations in *maintenance efficiency, railway operating costs per car Km operated* and *staff efficiency* are not only on account of the project, but also various other factors such as energy consumption savings, network expansion, technological advancements and others

Calculations-

- Conducted trend analysis for
  - § Railway Operating costs per car Km operated
  - § Staff efficiency (number of passengers per staff hour)
  - § Maintenance Staff Costs
  - § Maintenance Expenditure
- Data collated from MTRC Annual Reports (2000-2016)
- The percentage change values are calculated in absolute terms

4. Urban Transport and Traffic Control

4.1 Enterprise Command and Control Centre (EC3); UAE

Transport	Year Started	2017	**Focus Technology**	Machine learning and AI; Big Data; Sensors	**Other Technology**	3D Mapping; Drones	**Asset Management Lifecycle Stage**	Maintain, Operate; Service Provision
	Year Ended	NA						

Description of project
- ► The government's objective is for 30% (currently stands at 16%) of Dubai's residents to use public transport for their daily travel by 2030
- ► EC3 was launched to build a centre to monitor the city's mass transit system including the Dubai metro, Dubai tram, maritime transport, public buses and taxis
- ► The centre uses 'smart technologies' and AI to monitor the various traffic-related situations across the city – from accidents to crowd control – and links the RTA's operational agencies with a central, integrated system
- ► It collects movement data from citizens' mobile phones as well as surveillance information through 11,231 CCTV cameras for planning and coordination of transportation network
- ► As of 2017, 34 systems are connected to EC3 and 55 million records are processed and evaluated per day
- ► The objective of the project is to monitor the city's transit system and enable a coordinated approach to manage the transportation network

Value of project
- ► US$91.0m

Direct costs
- ► US$90.4M (Construction and furnishing of centre, Development of technological systems and infrastructure, Design and consultancy)

Outcomes / Benefits	**Role of Government**	**Impact of Project / Challenges**
► **Efficiency and operational gains**: centre will ease traffic congestions, reduce transit time and cost, fend off traffic accidents, and curb environmental pollution ► **Faster response to emergencies:** use of AI allows for faster decision-making. AI and machine learning provide the capability of receiving voice commands and instantly entering these on the system. Machine learning will also reduce the likelihood of human error in coordinating an emergency situation. ► **Origin-destination data:** the collection of information from citizens' mobile phones allows for the identification of the origin and destination of citizen journeys ► **Cybersecurity team:** protects RTA's operational, technological systems from threats & security risks	► Roads and Transport Authority (RTA), an independent government transportation authority has funded the development and operations of the EC3 centre ► The centre is being operated by RTA in Dubai	► **Designed for future mobility systems:** § EC3 is also capable of supporting future mobility systems like Hyperloop, driverless cars, unmanned aerial vehicles and drones, which could be deployed by the RTA to monitor traffic and road condition ► **Main challenge:** § Understand how EC3 will be able to adapt to the growth plans of public transportation in Dubai, e.g. the metro is expected to have a 15km extension and 7 new stations

4.1 Enterprise Command and Control Centre (EC3)

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Detail of Calculations

Project Direct costs:

► Construction and furnishing of centre costs: US$43.6M
► Development of technological systems and infrastructure costs: US$38.9M
► Design and consultancy costs: US$7.9M

4.2 BlipTrack queue and flow measurement technology; Sweden

| Transport | Year Started | 2017 | 📈 **Focus Technology** | Sensing | ⏲ **Other Technology** | NA | 🔄 **Asset Management Lifecycle Stage** | Maintain, Operate; Service Provision |
| | Year Ended | NA | | | | | | |

Description of project

► Trafik Stockholm, a traffic management centre, installed BlipTrack sensors at strategic points along the roads of the city. These sensors detect Bluetooth, Wi-Fi devices, in-car audio and communication systems and display live travel times on Trafiken.nu and on several VMS-signs placed around the city for the travellers

► The aim of the project is to optimize road usage by analysing traffic patterns

► It provides traffic information to the authorities helping them to analyse the traffic patterns and optimize road usage during incidents or high traffic congestion periods. Also, the travel times help road users to make informed decisions about their journey

► The platform used to manage collected data is 'user-friendly' and allows one to customize the platform with the type of data that most adequately suits for its purpose

Value of project

► NA

📊 **Outcomes / Benefits**	🏛 **Role of Government**	🔍 **Impact of Project / 🚧 Challenges**
► **Provides information about traffic movement:** ► Sensors provide statistical information, including travel times, average speeds, dwell times and movement pattern to authorities ► **Traffic analysis:** ► Allows authorities to initiate countermeasures and evaluate existing traffic models ► Helps authorities understand the impact of traffic control, weather-related patterns, congestion patterns at road works, accidents, and driving behaviours	► The project was initiated by Trafik Stockholm, a traffic management centre (Trafik Stockholm is a cooperation between the Swedish transport administration (Trafikverket), the city of Stockholm and Nacka kommun)	► BlipTrack has already been deployed in the UK in airports (Manchester, Birmingham, Bristol and Edinburgh) and the Port of Dover

4.2 BlipTrack queue and flow measurement technology

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Detail of Calculations

NA

4.3 Intelligent transport systems; Hong Kong

Transport	Year Started	2001	Focus Technology	Sensing	Other Technology	AVI detector, spot speed detector	Asset Management Lifecycle Stage	Maintain, Operate; Service Provision
	Year Ended	2010						

Description of project
► The project initiated by Transport Department of HKSAR includes several advanced technologies including Speed Map Panel Displays, Journey Time Indication System and Driving Route Search Service supporting the authority in managing traffic and providing value-added transport services to citizens
► The system is built on technologies including spot speed detector, AVI detector, RFID based detectors and others
► DRSS, an eRouting provides driving route, real-time traffic condition and parking information for pre-trip planning
► Speed map panel and journey time indicators are established at critical diversion points of strategic routes and are updated every two minutes defining traffic congestion to assist motorists to make an informed route decisions beforehand

Value of project
► US$54.07m

Direct costs
► US$33.92M

Outcomes / Benefits
► The system is helping transport department in managing the traffic and reducing traffic congestion
► The transport authority is providing value-added services to citizens by providing them the journey time information of different cross harbour routes and helping them in making an informed route decision in advance as well as in real time

Role of Government
► The project was initiated by government run Transport Department of HKSAR in partnership and collaboration with the private sector, academic and professional institutions. The systems are being operated and owned by the Transport Department. ITS organizations like ITS-HK promote the ITS industry among members internationally and play an important role in the development of ITS in Hong Kong

Impact of Project / Challenges
► **Impact:**
§ Savings in fuel consumption, reduction in vehicle emissions and noise pollution, and improvement in public health overall
§ The project provides value added services to the citizens

Acronyms: AVI- Automatic Vehicle Identification; DRSS- Driving Route Search Service

4.3 Intelligent transport systems

Sources

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Detail of Calculations

Project Direct costs:

► Intelligent Transport System (ITS) development cost : US$1.02M
► Deployment of Area Traffic Control (ATC): US$10M
► Traffic Control and Surveillance System (TCSS): US$284.5M
► Traffic Management and Information Centre (TMIC) : US$36.4M
► Other expenditure: US$2.2M

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4.4 Electronic Road Pricing (GNSS/CN) system project; Singapore

Transport	Year Started	2016	📈 **Focus Technology**	Big Data, Sensing	⏱ **Other Technology**	Cameras	🔄 **Asset Management Lifecycle Stage**	Maintain, Operate; Service Provision
	Year Ended	2020						

Description of project
► Land Transport Authority (LTA) awarded the tender to develop the satellite-based (GNSS/CN) Electronic Road Pricing system to the consortium of NCS and Mitsubishi Heavy Industries Engine System Asia (MHI)
► The system involves an on board equipment (OBE) attached to the vehicle, which sends positioning and transaction details to the central system controlled by transportation or road authorities via GNSS
► Based on a pay-as-you-use principle, the toll is charged when motorists use priced roads during peak hours. It is used in managing road congestion and removes existing gantry system

Value of project
► US$406.7m

📈 Outcomes / Benefits

► The program will assist to minimise traffic volume during peak hours, optimise usage of the road network, fair pricing, and eliminate human error from the conventional ERP system
► The interactive unit in vehicles will offer traffic advisories from LTA such as information on priced roads in advance and real-time traffic for drivers to better manage their journey
► The motorists would be able to pay for parking, checkpoint tolls and the usage of off-peak cars electronically
► **Savings -** Removal of physical gantries will save US$200M to US$210M of gantry implementation cost and US$80M to US$90M annual operations cost

🏛 Role of Government

► The project is initiated by LTA, a statutory board under the Ministry of Transport of Government of Singapore
► LTA awarded the tender to NCS and Mitsubishi Heavy Industries for the development of the technology
► Along with the project cost, the government will also bear the one-time IU replacement costs for Singapore-registered vehicles
► The project supports Singapore's smart nation plan

🔍 Impact of Project / 🚧 Challenges

► **Impact:**
  § The system provides value-add services and reduces the traffic congestion
  § LTA aims to maintain the target traffic speed of 20-30km/h for arterial roads
► **Challenges:**
  § Privacy and security concerns about unwarranted surveillance by satellite systems
  § Critics complain that the pricing policy is ambiguous and the Government is ignoring the policy implementation factor

4.4 Electronic Road Pricing (GNSS/CN) system project

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Detail of Calculations

Project Savings:
The new system would remove the need for physical gantries and the cost associated. As of 2016, there were 76 ERP gantries in Singapore. Calculations for cost associated with gantry system-

Assumptions-
- The values are based on Ministry Of Transport, Singapore, Budget 2016.
- Total project cost of implementation of ERP Gantries at Ayer Rajah Expressway have been considered as a proxy
- The values have been approximated to a range

Calculations-
- Cost of implementation of 4 new ERP Gantries(From budget 2016) = US$11.1M
- Cost of implementation of 1 new ERP Gantries = US$2.7M
- Total cost of implementation of 76 ERP gantries= US$ 205.2M
- Approximations- US$200M to US$210M
- Annual cost of running 1 gantry= US$1.11M
- Annual cost of running 1 gantry= US$84.36M
- Approximations- US$80M to US$90M

5. Smart City Complexes

5.1 Busan Green U-City; South Korea

Infrastructure	Year Started	2005	**Focus Technology**	Sensing	**Other Technology**	Cloud	**Asset Management Lifecycle Stage**	Maintain, Operate; Service Provision; Strategic Financial Investment Planning
	Year Ended	2012						

Description of project
► The project aimed to create a smart city by using the cloud-based infrastructure with collaboration from local government and private entities
► The city is underpinned by several innovations:
   ► A cost-effective cloud-based architecture that enables the easy provision of new urban services to a large numbers of users
   ► City's multi-service open platform can deliver both commercial services for the city, as well as free services for its citizens that can be expanded over time
   ► The city government has opened municipal data to third party developers to encourage innovation in the public service sector
► The aim of the project is to deploy new services and enhance existing ones by analyzing data captured via connected devices, distributed sensors and Internet technologies

Value of project
► US$320.0m

Outcomes / Benefits

► **Public-private collaboration and innovation** – the provision of city data and having the Busan Mobile Application Centre provide incentives and support for private entities to attempt to solve pertaining urban challenges
► **Improved cost-control** – the collection of city data and management of services in an integrated manner, provides the means to have greater oversight on cost
► **Efficiency gains** – The Integrated Operations Centre is expected to help the improve the use of resources, city logistics and waste management
► **Savings -** Reduce overall / regular health care cost, especially for low income residents and elderly population
► **Revenues -** The applications developed by BMAC have generated revenues of US$2.2M and online sales revenue of US$42,000 for Busan City

Role of Government

► The project is a part of a public private partnership set-up between Busan Metropolitan City, Cisco and KT
   § All of them share both the costs and the risks of the project
► Busan Metropolitan Government, provided financing for this project and it plans to recover it both from operational savings and new revenue streams

Impact of Project / Challenges

► **Impact:**
   § Reduction of carbon emissions by 2,981 metric tons by 2020
   § Create jobs for 3500 app developers and 300 sole developers
► **Challenges:**
   § Continue developing innovative business models to ensure new services are profitable
   § Initial focus on the business sector need to be broadened to ensure that cloud-based services are adopted by the community

Acronyms: BMAC - Busan Mobile Application Centre

5. Busan Green U-City (Cloud Infrastructure, Smart services)

Sources

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Detail of Calculations

NA

5.2 Smart city complex; South Korea

Infrastructure	Year Started	2016	Focus Technology	IoT; Sensing	Other Technology	NA	Asset Management Lifecycle Stage	Maintain, Operate; Service Provision; Strategic Financial Investment Planning
	Year Ended	NA						

Description of project
► The project is aimed at building a model complex to contribute to the nationwide environment of IoT services
► As a part of the initiative, the city government is expected to cooperate with private businesses to deal with urban problems such as security, environment, energy and transport
► The aim of the project is to build more IoT model complexes in Korea by cooperating with regional governments and contributing to establish a nationwide ecosystem for IoT services

Value of project
► NA

Outcomes / Benefits

► **Reducing operational costs:** IoT sensors installed on trash bins to reduce the operational costs by eliminating unnecessary pickups
► **Smart meters:** IoT technology in water, gas and electricity meters to improve utilities management
► **Bus stops:** more than 200 bus stops in Goyang will be equipped with environmental sensors that detect fine dust, exhaust emissions and noise in streets
► **Savings -** The waste collection system installed under the project reduces the cost of waste collection by up to 80%

Role of Government

► The city partnered with LG Uplus; Regional government to cooperate with private businesses to deal with urban problems such as security, environment, energy and transport
► Ministry is expected to open the public data it will collect from the project and share it with other regional governments and businesses
► LG Uplus will source sensors and devices designed for public services and apply them to urban problems

Impact of Project / Challenges

► The project allows for a more efficient management of assets and personnel
► **Improving comfort index:**
  § Provides environmental information to the management department and citizens in real-time and is expected to help in improving the comfort index and visiting frequency of the citizens

5.2 Smart city complex

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Detail of Calculations

NA

5.3 Songdo International Business District; South Korea

Infrastructure, Transport, Security, Utilities	Year Started	2003	**Focus Technology**	IoT; Sensing	**Other Technology**	Analytics	**Asset Management Lifecycle Stage**	Maintain, Operate; Service Provision; Strategic Financial Investment Planning
	Year Ended	2020						

Description of project
► This project, developed by Gale International, was aimed at building an international business district over an area of 1000+ acres. The city planners have partnered with many technology companies, local service providers, and government organizations in order to implement next generation smart city solutions
► Sensors and IoT technology have been implemented across the city to gather data and analyse citizens requirements
► With this project the Government aims to make it a smart and sustainable city and a testing ground for leading-edge technological infrastructure

Value of project
► US$35B

Direct Costs
► US$10B (design and build of the 100 main buildings in the district)

Outcomes / Benefits
► The sensors installed in the city help people monitor, compare and manage energy consumption and traffic flow
► IoT cube is being used by businesses and start-ups to pilot and further improve their developing solutions to the public on the street
► **Efficient waste disposal system:**
   § Underground waste disposal system sucks the trash out of people's kitchens and delivers to a processing centre
► **Savings -** The network in Songdo IBD is connects all the building subsystems together to save energy and are expected to help bring down the energy consumption by 30%

Role of Government
► A public private partnership between Gale International (majority partner-61%) and Korea based POSCO E&C and the city of Incheon to develop this business district in Songdo
► The project is being executed under the governance of the Incheon Free Economic Zone Authority

Impact of Project / Challenges
► **Impact:**
   § By 2011, 25000 jobs were created in South Korea by the project and infused vitality into the local Incheon Metropolitan City economy
► **Challenges:**
   § SIBD has turned into a residential area than a business one. There are no economic incentives for businesses to set up a facility
   § Less than 20% of the commercial space in the district has been occupied

5.3 Songdo International Business District

Sources

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Detail of Calculations

NA

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