AGREEMENT NO. CE 68/2015(CE) DEVELOPING KOWLOON EAST INTO A SMAARAR CITY DISTANCE 68/2015(CE)

FINAL EXECUTIVE SUMMARY



發展局 起動九龍東辦事處 Development Bureau Energizing Kowloon East Office

ARUP



Energizing Kowloon East Office, Development Bureau

Agreement No. CE68/2015(CE) on Developing Kowloon East into a Smart City District - Feasibility Study

Executive Summary

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This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 248123

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1 Study Background

- 1.1 The area of Kowloon East (KE), consisting of Kai Tak Development (KTD) Area, Kowloon Bay Business Area (KBBA) and Kwun Tong Business Area (KTBA), has borne witness to the rapid growth of industrial development during its heyday as the Hong Kong's base for manufacturing industry. Following the relocation of the Airport to Chek Lap Kok and manufacturing businesses to Mainland China, the stock of industrial buildings slowly became under-utilised. The modernisation of KE through revitalising industrial buildings aims to support the transformation of KE into another core business district (CBD) for Hong Kong. As promulgated in the 2017 Policy Agenda, the Energizing Kowloon East initiative is extended to San Po Kong Business Area (SPKBA), with particular focus on enhancing connectivity, improving the environment, and promoting vibrancy and diversified development.
- 1.2 The strength of KE lies in its diversity and connectivity. Major developments in the area brings vibrancy, leisure and entertainment while the various business areas and commercial buildings enable KE to re-emerge as an economic centre. In view of this and the public interest in utilising technology to develop Hong Kong into a smart city, the Energizing Kowloon East Office (EKEO) of the Development Bureau commissioned the "Developing Kowloon East into a Smart City District - Feasibility Study" (the Study) to investigate the possibilities and applications of different smart innovation and technology; formulate a framework strategy, advocacy statement, and implementation strategy to bring KE into the digital era and transform it into a testbed for upcoming smart city initiatives.
- 1.3 Recognising KE's future possibilities of development and potential to contribute towards the economy and livelihood of Hong Kong as a whole, the overarching vision for KE as a Smart City District is:

To facilitate co-creation of Kowloon East into a vibrant, smart and sustainable CBD2 of Hong Kong

1.4 We took on a people-centric approach towards the delivery our Smart solutions to foster active and attractive communities with a sense of place through innovation and quality design. Our recommendations on the use of innovative Information and Communication Technology (ICT) solutions would enhance road user and pedestrian experiences at large, offering improved mobility, as well as resource efficiency, in particular asset management, to build city resilience. We also explored innovative solutions to improve living quality and urban environment of the smart city district to drive KE's competitiveness in transforming the area into a vibrant and thriving CBD2 of Hong Kong.

2 Smart City Framework for Kowloon East

2.1 The Smart City Framework for KE closely aligns with the Conceptual Master Plan (CMP) 5.0 of CBD2:



- 2.2 Centring on the location of CBD2 and the people, the framework addresses the socio-economic environment, making an influence on both the built and natural environment, all facilitated through the use of ICT. The strategic areas of the framework are as follows:
 - Innovation-Oriented Platform located at the core of the framework, it drives the overall direction of smart city development in KE. As a pilot study area in Hong Kong, an innovation-oriented platform would be *Knowledge-Driven* and constitutes of the elements of *Co-creation*, *Cross-Sector Collaboration*, and *Community Engagement*. Industries, academia, research institutes, government, public, and other stakeholders are encouraged to contribute towards realising the vision of a Smart KE.
 - Governance & Socio-Economic Vibrancy institutional arrangements, coordination, monitoring and management are needed to support smart city development. *Implementation Models* supports smart city operations and encourages collaboration in various aspects of smart city

development, including resource procurement, community engagement, and *Social Inclusion*. Through this, services offered by the urban environment are enhanced, improving *City Resilience* and *Asset Management*.

- **Mobility & Walkability** to echo with the planning objectives of KE, a holistic, low-carbon green mobility approach was adopted. The mobility system would address prevailing problems in *Road Traffic* and the effectiveness of existing *Pedestrian Connectivity*. Promotion of *Green Transport Network* through provision of timely information allowed informed decisions to be made on transportation choices.
- **Resources Management & Urban Environment** the fundamental elements of an urban system comprised of the environment itself and the people. A people-oriented approach helps to create a *Healthy and Sustainable Neighbourhood*, where people are empowered through the use of technologies to enable their daily activities; a better *Built Environment* can be created through *Resource-Efficient Infrastructure* and *Blue-Green Infrastructure*.
- Information & Communication Technology embracing all the strategic aspects, it is the enabler of the framework and plays an indispensable part in the creation and development of a smart city. The backbone consists of *Wi-Fi Infrastructure* for connectivity, *Internet-of-Things (IoT)* sensors and devices to collect and distribute data, and a *Centralised Digital Infrastructure* to allow data exchange. *Open Data* supports the system as well as allowing innovation by ensuring access to data is unprohibited and can be contributed collectively by various parties.

3 Advocacy Statement

- 3.1 To co-create a Smart KE, a concerted effort by all sectors to participate and take forward various smart city initiatives is essential. By leveraging off the knowledge, experience and synergy gained from collaboration, benefits of smart city initiatives can be attained including improvement to quality of life, efficiency to city operation and management, and strengthening competitiveness.
 - a) Government
 - Provide an ideal environment for universities and research institutes to develop high-tech technology and unleash creativity;
 - Promote KE as a test bed of smart city initiatives;
 - Provide a collaboration platform to facilitate interaction among industries; and
 - Provide more data to promote creativity.

b) Logistics & Transport Sector

- Share delivery schedule with the industry through a common data platform which helps to alleviate traffic congestion and improve delivery efficiency; and
- Set up smart logistics lockers at specific locations to provide convenient service options for both the recipients and senders.
- c) Property Management Sector & Building Owners
 - Adopt eco-friendly and resource-efficient green building facilities;
 - Install smart energy and water meters to conserve resources;
 - Open green roofs and green spaces to building tenants and the public;
 - Utilise suitable spaces for urban farming; and
 - Share real-time parking vacancy information.
- d) Public Utility Service Providers
 - Provide smart water, energy and gas meter to provide timely consumption information to customers;
 - Share consumption data of various building types to facilitate research and development; and
 - Increase clean energy ratio and use of distributed energy management system.
- e) <u>Universities & Research Institutes</u>
 - Collaboration with industries and government to promote wider application of technology developed for smart city; and
 - Proactively consider KE as the test bed of smart city initiatives.
- f) Information & Communication Technology Sector
 - Collaborate with universities, research institutes and the Government to promote wider applications of technology developed for Smart City;
 - Provide suitable and forward-looking ideas on communication network, cloud system, open data platform and network information security to prepare for the wide applications of IoTs; and
 - Work in-line with the Government to enhance the coverage and speed of outdoor wireless network.

g) General Public

- Download and use mobile apps developed for Smart City, provide usage data to drive continuous development and mobilise information economy;
- Echo with smart living through using data to support decision choices (e.g. utilising data to choose green transport services to reduce emissions); and
- Share comments on smart city solutions.

4 Smart City Initiatives

- 4.1 Based on the vision of the Study and the major comments received during public engagement activities, various initiatives were proposed through adoption of the proposed Smart City Framework. We proposed the adoption of initiatives that can be easily implemented and are effective in exemplifying the benefits of smart city initiatives towards the improvement of existing conditions in KE, drive its competitiveness, and improve resource efficiency through a people-centric approach.
- 4.2 Short-term initiatives are those anticipated to be implemented or completed by 2020 while medium-to-long term initiatives considers extension of smart city initiatives applications conducted in the short-term to a wider area (e.g. to other areas of KE or beyond) or extending its use beyond the trial period. Results, data, and lessons learnt from the short-term implementation of smart city initiatives are shared with relevant parties to further stimulate innovation.
- 4.3 The smart city initiatives proposed under the Study are tabulated as follows. Proof of Concept (PoC) trials are further detailed from Section 4.24 onwards.

Mobility & Walkability

4.4 *Wayfinding & Navigation System* – to encourage more walking and less use of motorised transport by providing useful information on walking routes, using new technologies to make walking more attractive, and seamless navigation between indoor and outdoor areas.

Short-term (Up to 2020)	Medium-to-long-term (Beyond 2020)		
1. Indoor-Outdoor Navigation System			
 Use MyKE as a demonstration platform to showcase the convenience brought about by positioning Enrich and update the digital walking map contents to include features, such as back alleys, internal passageways through buildings, footbridges, subways, lifts, ramps, sheltered route, etc. to meet the needs of individual users Advocate to building owners with internal public passageways to provide indoor positioning and way-finding on MyKE 	 Consider formulating a data-inputting standard* for building managers (i.e. data providers) to input indoor-positioning-data and incorporating into its "3D Indoor Map" (*by making reference to ASTRI's existing standard, which is used in existing EKEO's system) Formulate 3D pedestrian map for KE Progressively extend the way-finding function (including barrier-free walking routes search) to cover major shopping areas in Transport Department's "HKeMobility" mobile app 		
2. Points of Interest (PoIs) in neighbourhoods			
 Provide some 60 PoIs and different thematic walking routes in KE and SPKBA on MyKE Recommend personalised walking routes based on the users' persona by AI Use augmented reality and virtual reality (AR/VR) to highlight the interesting background and facts about the PoIs Expand the PoI library by incorporating new landmarks, places of interest, etc. on MyKE Share the PoI information as open data in Government's Public Sector Information (PSI) Portal www.data.gov.hk. 	 Receive and consider incorporating the geospatial information of PoIs into its 3D pedestrian map Explore the feasibility of integrating the "Thematic Tour" and "Personalised Tour" functions into MyKE with other similar mobile apps managed by the Government 		
3. Paths with more useful information			
(a) Status of Lifts and Stair-lifts in Map for	Barrier-free Environment		
 Advocate B/Ds responsible for lifts and stair- lifts at government buildings and footbridges to release the status information of lifts and stair-lifts Extend the indication of status of lifts/stair- lifts as a function of barrier-free route and sheltered path navigation in MyKE 	• Consider providing real-time operation status of mechanical barrier-free facilities such as lifts and stair-lifts through Transport Department's "HKeMobility" mobile app		

(b) Pollution Monitoring and Sensing Network		
• Show the predicted air quality data in KE by PRAISE through MyKE	• Keep in view the initiative and consider incorporating the air quality data and other climatic data from the PSI portal into Transport Department's "HKeMobility" app	
(c) Voice-guidance for Visually Impaired Persons		
 Blind Navigation System Based on Voice-over Feature of Smartphones: Develop the function of routing suggestions and real-time navigation for KE and SPKBA 	 Blind Navigation System Based on Voice-over Feature of Smartphones: Continue to enhance the functions of routing suggestions and real-time navigation in VoiceMapHK App by using a more comprehensive Pedestrian Network 	
 <u>Blind Navigation System Based on RFID:</u> Consider using KE as a demonstration platform to add RFID-tags to tactile units at pedestrian crossings 	 Blind Navigation System Based on RFID: Keep in view the development of the technology and identify more pedestrian crossings in KE and SPKBA for adding RFID-tags at and providing navigation guidance for more routes 	

4.5 *Smart Parking* – to optimise parking space usage and improve efficiency of operations of car parks by providing real-time information on parking spaces and EV charging spots, establishing EV charging spots online booking system, and installing smart parking systems such as an automated parking system (APS).

Short-term (Up to 2020)	Medium-to-long-term (Beyond 2020)	
1. Provision of Real-time Information on Parking Spaces and EV Charging Spots		
 Provide data standardisation for real-time parking vacancy information and a user-friendly management portal for uploading real-time data Encourage owners and operators of car parks to share their real time parking vacancy data in KE and SPKBA through advocacy and providing technical assistance Share the parking vacancy information as open data in Government's PSI Portal in API format Provide trial sites for testing various types of parking sensors, such as for EMSD's trial on electro-magnetic parking sensors using LPWAN as a means of data transmission and Transport Department's trial of new generation of parking meters equipped with vehicle sensors to detect occupation of parking spaces Explore the feasibility of integrating both systems taking into account the pros and cons of EKEO's "Easy Parking System" and Transport Department's parking system 	 Provide parking vacancy information using the new generation parking meters in KE and SPKBA Explore the feasibility of enhancing TD's backend system and HKeMobility by making reference to "Easy Parking System" and the feasibility of integrating the two systems with consideration to their strength and weakness Consider imposing similar land lease requirements of supply of real-time parking vacancy information to other suitable sites in Hong Kong 	
2. EV Charging Spots Online Booking System		
• Advocate car park owners/ operators in KE and SPKBA to build, operate and maintain their own online booking platforms, and to release the EV charging spots information		
3. Smart Parking Systems - Automated Parking System (APS)		
	• Consider deploying APS in KE and SPKBA	

- 4.6 *Real-time Illegal Parking Monitoring System* to better manage roadside activities and enhance utilisation of roads and off-street parking through the use of innovative technologies such as Video Analytics (VA), machine deep learning, Artificial Intelligence (AI), etc. Two PoC trials were implemented under this initiative: "Kerbside Loading and Unloading Bay Monitoring System" (detailed in Section 4.34 4.36) and "Illegal Parking Monitoring System" (detailed in Section 4.37- 4.39).
- 4.7 *Real-Time Roadworks Information System* to enhance route planning capabilities through the provision of real-time roadworks information collected from works department using mobile devices equipped with AR

positioning and AR technology. The PoC trial "Real-time Roadworks Information" was implemented under this initiative as detailed in Section 4.46 - 4.49.

4.8 *Intelligent Junctions* – to minimise waiting time and enhance road safety for pedestrians and vehicles through the use of sensors to collect real-time traffic information.

Medium-to-long-term (Beyond 2020)

• Explore installation of intelligent traffic signal system with sensors for pedestrians and vehicles at suitable road junctions in KE and SPKBA

4.9 *Green Mode of Transport* – to provide an alternative for smooth travel as well as creating a walkable, green and low-carbon CBD through the use of low-carbon transport modes such as electric buses, autonomous shuttles and shared use of pavement by pedestrians and cyclists.

Short-term (Up to 2020)	Medium-to-long-term (Beyond 2020)	
1. Electric Buses and Autonomous Buses		
 Facilitate franchised bus companies to explore the feasibility of developing double-deck electric franchised buses suitable for local use Continue to monitor and assess the operational efficiency and performance of electric buses 	• Continue to monitor the latest developments in electric buses with autonomous technologies and review/revise the existing legislations and regulations to facilitate small scale trials in KE Continue to work with the industry to facilitate the deployment of autonomous shuttles at suitable locations in KE	
2. GreenWay for Cycling		
• Conduct trial on 1 km pathway at Kwun Tong Promenade for shared use by cyclists and park users. A video analytic system was used to detect incidents and provide alerts to an operator for immediate action	• Extend the shared-use concept to the cycle track network in KE taking into account the experience gained in the trial	

4.10 *Public Transportation Information* – to minimise road congestion and encourage travellers to use public transport over self-driving through providing relevant public transport services information and allow well-informed instantaneous travel decisions for journey planning.

Short-term (Up to 2020)	Medium-to-long-term (Beyond 2020)
• Install information display panels providing estimated arrival time of buses progressively at bus stops.	• Continue to install real-time information display panels and free public Wi-Fi at suitable bus stops in KE
• Provide bus occupancy information for long- haul routes	• Provide bus occupancy information for the remaining long-haul routes
 Provide integrated multi-modal public transport information on HKeMobility Provide public transport information in KE such as locations of bus stops and green minibus termini and route lists on MyKE 	• Explore the feasibility of providing Smart public transport interchanges in KE with real- time information display panels, free public Wi-Fi services, electric vehicle charging facilities and air-conditioned waiting area

Resources Management & Urban Environment

4.11 *District Cooling System* – low-carbon and energy efficient infrastructure to reduce urban heat island effect and contribute to the development a lowcarbon city in Hong Kong.

Short-term	Medium-to-long-term
(Up to 2020)	(Beyond 2020)
• Extend the district cooling system to serve non-domestic developments in KTD by phases	• Extend the district cooling strategy to other new development areas

- 4.12 Energy Efficiency Data System advanced metering system and real-time data transmission to collect energy consumption data for raising awareness to energy conservation and resource usage for cultivating good energy consumption habits. The PoC trial "Energy Efficiency Data System" was implemented under this initiative as detailed in Section 4.31 - 4.33.
- 4.13 Waste and Recyclables Handling System - effective management and conversion of waste to useful resource through deployment of technology for information collection on waste disposal / recycling and provision of plants for resource recovery. The PoC trial "Smart Recycling Bin System" was implemented under this initiative as detailed in Section 4.43 - 4.45.

Medium-to-long-term (Beyond 2020)	
Organic Resources Recovery Centre	
 Provide an organic resources recovery centre in Kowloon Bay Action Area for recovery of 	
reusable materials and energy from source separated organic waste generated within KE	

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4.14 *Revitalisation of Nullahs* – promote greening, biodiversity, beautification and water-friendly activities while achieving effective drainage capability by upgrading existing nullahs into an attractive green corridor to foster vibrant public spaces and improve connectivity while reducing flood risks.

Short-term	Medium-to-long-term
(Up to 2020)	(Beyond 2020)
• Upgrade Kai Tak Nullah with an aim to turn the nullah into an attractive green corridor - Kai Tak River	• Revitalise the nullah at King Yip Street into Tsui Ping River with environmental, ecological and landscape upgrading works to foster vibrant public spaces and improve connectivity while reducing flood risk in the surroundings

Governance & Socio-economic Vibrancy

- 4.15 *Smart Crowd Management System* use of technology to monitor pedestrian and traffic flow, bottlenecks, and public transport queuing points for people and traffic management and enhance adaptiveness and safety for event goers. The PoC trial "Smart Crowd Management System" was conducted on the day of "Hong Kong Streetathon@Kowloon 2017" under this initiative as detailed in Section 4.25- 4.27.
- 4.16 *Land Sales Conditions* advocate low-carbon and environmentally-friendly design in buildings through stipulations built into land sales conditions of new developments in KE. Specific requirements are included in land sales conditions for new developments within KE such as adoption of green building design of BEAM Plus Provisional Gold rating or above, higher greening ratio, provision of smart water meter system and EV charging facilities. Land sale sites are required to share real-time parking vacancy information for development.
- 4.17 *Smart Road Lights* improve operation of road lights by providing frontline staff with real-time data on road light health and condition as well as remote access to road light operations.

Short-term (Up to 2020)	Medium-to-long-term (Beyond 2020)
 Upgrade over 220 road lights with wireless network in San Po Kong and KTD Area using LoRaWAN Explore other Low-Power Wide-Area 	• Explore the feasibility of wider application in other districts
(LPWA) technologies	

4.18 *Smart Drainage System* – real-time monitoring of changes in drainage system using a wireless sensor network for transmitting collected data, such as hazardous gas levels and water levels, to reduce risk of catastrophic

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incidences, track the origin of pollution, and act as early warning system to flooding and / or system failure.

Short-term	Medium-to-long-term
(Up to 2020)	(Beyond 2020)
• Install wireless underground devices in manholes of both stormwater drainage and sewerage systems in Kowloon Bay, forming a comprehensive system to monitor the water level and gas concentration of designated zones	• Apply similar monitoring system to other stormwater drainage and sewerage systems to enhance the overall management efficiency

4.19 *Water Intelligent Network* – integration of sensing equipment in water distribution network and intelligent network management computer system for continuous monitoring of condition of pipe network and analyse collected data for smart water management.

Medium-to-long-term (Beyond 2020)

• Implement pressure management and district metering system for the fresh water distribution system in KE

4.20 *Smart Pedestrian Crossing* – use of innovative and technological solutions to embrace social inclusion by enhancing safety of pedestrian crossings for elderly and the disabled through extension of crossing time at road junctions.

Short-term	Medium-to-long-term
(Up to 2020)	(Beyond 2020)
• Conduct trials at Ngau Tau Kok Road and Wang Chiu Road and review the effectiveness of such system (extending pedestrian flashing green time by tapping user's Elder Octopus Card or Personalised Octopus Card)	 Subject to the trial results, consider applying similar concept to other suitable pedestrian crossings Explore alternative means of regulating flashing green time according to individual pedestrian needs

Information & Communications Technology

4.21 *Multi-purpose Lamp Posts*- street lamps installed with various IoT sensors forming a district-wide network to allow real-time data collection and transmission to enhance city management. The PoC trial "Multi-purpose Lamp Post" was implemented under this initiative as detailed in Section 4.40 -4.42.

4.22 *Wi-Fi Connectivity and Telecommunication Services* – provision of high-speed, high-capacity and low latency telecommunication, e.g. 5G, and wireless networking, e.g. Wi-Fi, to enable smart city services and IoT use.

Short-term	Medium-to-long-term
(Up to 2020)	(Beyond 2020)
• Facilitate the provision of free Wi-Fi service at more public open spaces and government premises to increase the coverage in KE and SPKBA	 Facilitate the provision of free Wi-Fi service at government facilities and future public open spaces in the area as a standard practice Advocate private developers to provide Wi-Fi access at public areas within their developments

4.23 *Data Standardisation* – enabling data sharing and use by various parties to stimulate innovation and smart city development

Short-term	Medium-to-long-term
(Up to 2020)	(Beyond 2020)
• Standardise the contents, format and frequency of sharing real-time parking vacancy data	• As more smart city initiatives will be launched, both real-time and static data collected and generated by these initiatives, such as real-time information on road works, multi-purpose lamp posts, 3D pedestrian map and EV charging points, can be disseminated through online platforms or integrated into other mobile applications for public use

PoC Trials

4.24 PoC trials were conducted in KE within the Study period to demonstrate the benefits of Smart City development and to provide better understanding of the feasibility of wider application. The experience and knowledge gained from these PoC trials will be shared with the relevant parties for further development.

PoC1: Smart Crowd Management System

4.25 The system was tested on the day of "Hong Kong Streetathon@Kowloon 2017". On the day of the trial, CCTV surveillance cameras with advanced video analytics tools were installed at key bottlenecks along the runway and public transport queuing points to detect crowd flow and identify abnormal conditions. The estimated waiting time of shuttle bus and ferry, as well as the queuing condition of other transport modes were disseminated through MyKE and on-site display boards set up at the venue. The system uses surveillance cameras, sensors and video analytics technology to automatically detect crowd flow and number of vehicles, and identify abnormal conditions, in order to improve the efficiency of crowd

REP-020-05 | Final | Mar 2021 G:\PROJECTSICURRENT JOBS\248000\248123 CE68_15 KLNE SMART CITY\6-00 DELIVERABLE\18 - EXECUTIVE SUMMARY\ISSUEDWORKING\ES_FINAL_ENG (1-9)_ARUP.DOCX management. The system was further tested at Hoi Yuen Road to monitor pedestrian and road traffic flows.

Major Features

- Surveillance cameras, sensors and video analytics technology to automatically detect crowd flow and number of vehicles, and identify abnormal conditions
- Information dissemination (e.g. estimated waiting time of shuttle bus and ferry, as well as the queuing condition of other transport modes) via on-site display and / or MyKE mobile app

a) <u>Smart Crowd Management System Deployment in</u> <u>Streetathon@Kowloon 2017</u>



b) Redeployment at Hoi Yuen Road



- 4.26 The experience learnt from this PoC trial, such as system setup, installation and configuration, and the analysed results, could be shared with other relevant stakeholders for reference in future redeployment.
- 4.27 In the medium-to-long term, it is recommended to explore deployment of a similar system at the future Kai Tak Sports Park, other appropriate locations anticipated with high pedestrian and traffic flow, and mega events such as concerts, carnivals and festive events, is recommended to assist in crowd management. Event organisers are advocated to use similar system for their events while vendors could be engaged to study additional functions and

increase accuracy of the system. Additionally, improvement to the system such as increasing accuracy of video analytics is recommended.

PoC2: Persona and Preference-based Wayfinding for Pedestrians

4.28 The "Easy Walking" function in MyKE provided a wayfinding tool to cater for the different user needs and preferences such as sheltered paths and barrier free paths, while the "Thematic Tour" and "Personalised Tour" function make walking in KE more interesting. Thematic Tours are preprogrammed tours with specific themes planned around major historical and cultural spots in KE. Personalised Tour recommends walking routes based on the users' persona preferences and interests. For Facebook users, the system uses AI to analyse users' Facebook posts for a more accurate personal recommendation. As of May 2019, there are 65 nos. of active PoIs and thematic walking routes in KE and SPKBA on MyKE mobile app.

Major Features

- Enhance local walking experience
- Promote local landmarks exhibiting natural / cultural values, historical significance, built aesthetics, leisure and amusement
- Enabling personalised and thematic walking routes, shaded paths and barrier-free path selection
- Interactive PoIs (e.g. AR, VR, gaming) to highlight interesting background, facts and local stories
- Collect user feedback







- 4.29 AR/VR technologies were used to highlight the interesting background and facts about some PoIs. The PoI library will be expanded by incorporating new landmarks, places of interest, etc. on MyKE. PoI information would be shared as open data in Government's PSI portal (<u>www.data.gov.hk</u>).
- 4.30 In the medium-to-long term, the feasibility of integrating the "Thematic Tour" and "Personalised Tour" functions in MyKE with other similar mobile apps managed by the Government would be explored.





PoC3: Energy Efficiency Data System

4.31 The PoC trial "Energy Efficiency Data System" was carried out in Kai Ching Estate and Tak Long Estate to allow participating households to track energy consumption data in real-time on dedicated "Smart Energy @ KE" mobile application. The system collected real-time energy consumption data for raising awareness to energy conservation and resource usage for cultivating good energy consumption habits. The collected data can then be used to analyse usage trends and patterns as well as developing user profiles. A total of 480 smart meters meters were installed at 80 participating households on a variety of household appliances including air-conditioners, lighting circuitries, refrigerators, washing machines etc.

Major Features

- Dedicated mobile app "Smart Energy @KE"
- Systematic approach to data acquisition for residential buildings
- Real-time energy consumption data
- Promote benefits of energy efficient buildings

Major Features

• Build a sense of community and connection amongst households through friendly contests and knowledge sharing



- 4.32 Real-time energy consumption data was provided, at both household level and appliance level, to building occupants through web application and mobile app. Collected real-time and historical energy consumption data at both household and community level can be used to analyse loading trend, pattern and profile analytics. The aggregated results from the trial can be shared with electricity companies with a view to establishing effective measures in energy saving for households.
- 4.33 In the medium-to-long term, relevant departments and authorities are recommended to explore the installation of smart electricity meters in new developments and progressively upgrade conventional meters to smart meters in other developments, especially in public housing estates. Owners of commercial buildings / private residential buildings in KE are advocated to apply similar systems and share their energy consumption data for more energy saving measures. The electricity company (i.e. CLP) is advocated to support, install, operate and maintain the system at the buildings in KE and SPKBA. Data from the installation can provide a better understanding of the energy consumption patterns and usage, therefore, it is recommended to make the real-time data on end-uses as reference to survey data of "Hong Kong Energy End-use Data" and include the data as the data source.

PoC4: Kerbside Loading/ Unloading Bay Monitoring System

4.34 The system utilises surveillance CCTV cameras in some segments of roads and utilise video analytics to monitor the usage activities and availability of kerbside loading/unloading bays. This is a trial of single ordinance at multiple locations where illegal-parking-related traffic offence at loading/ unloading bays is focused. Two pilot sites in sections of How Ming Street and Hoi Bun Road in Kwun Tong are selected for trial installation of the kerbside loading and unloading bay monitoring system. The system can detect vehicle occupancy status, vehicle-parking duration and vehicle registration mark. It can also detect whether there is any abuse or illegal occupancy. Real-time occupancy information is made available through MyKE mobile app to assist drivers with loading and unloading needs.

Major Features

- Monitor use of loading / unloading bays (e.g. vehicle occupancy status, vehicle-parking duration and vehicle registration marks)
- Video analytics on occupancy and improper use
- Real-time occupancy information collection and dissemination
- Provide information to law enforcement to support in carrying out duties (e.g. vehicle information, location information, occupancy duration, etc.)

h) PoC Trial Site - Hoi Bun Road





- 4.35 Real-time occupancy status would be shared through MyKE and data.gov.hk to optimise usage of road spaces. Different configuration setups and scenarios would be tested to facilitate future redeployment. A feasibility study is recommended to devise a roadmap to enable adoption of the technology. Experience gained upon completion of this PoC trial is anticipated to facilitate the refinement of system configuration and future redeployment at other loading / unloading sites.
- 4.36 In the medium-to-long term, lessons learnt from the PoC trial that are shared with relevant parties would enable for pursuit of necessary legislative amendments to enable the adoption of such system in law enforcement. A redeployment of similar systems in other blackspots in KE and SPKBA is also recommended.



i) Kerbside Loading / Unloading Bay Installation

PoC5: Illegal Parking Monitoring System

The illegal parking monitoring system comprises of CCTV cameras, car 4.37 plate recognition and video analytics capabilities to deter illegal parking. Key tasks of this PoC trial include installation of suitable hardware and software for monitoring motor vehicles parking on the roads at three trial areas for detecting the potential violation cases. Three pilot sites, one in San Po Kong and two in Kwun Tong, have been selected for installing the system for PoC trial.

Major Features

- Monitor parking vehicles for potential violation cases and pave way • for prosecution purposes in the future
- Site observation on traffic black spots and potentially relieve • congestion, save travel time and reduce traffic emissions
- Video analytics and situation recognition on major traffic offences (e.g. double parking, unauthorised parking, unauthorised loading/unloading, etc.)

k) <u>PoC Trial Site - Sze Mei Street</u>





- 4.38 The experiences gained from this PoC can be shared with relevant parties and stakeholders for pursuit of necessary legislative amendments to enable adoption of such system in law enforcement and serve as reference in future redeployment. The occupancy information will also be shared similar to PoC4. It is recommended a feasibility study to be conducted to devise a roadmap including studying privacy-related matters to enable adoption of such technologies, if proven, in taking enforcement actions.
- 4.39 In the longer term, the system can be re-deployed at other illegal parking blackspots at the roads or streets in KE and SPKBA, which are prone to illegal parking and with more traffic conditions. It is also recommended to explore the use of information and the necessary legislative amendments to enable adoption by law enforcement.

PoC6: Multi-purpose Lamp Post (MPLP)

4.40 The main objective of this PoC trial is to develop the MPLP System in which 7 lamp posts located in KE (EKEO, Electrical and Mechanical Services Department Headquarters, Kai Tak Cruise Terminal, Zero Carbon Building, Kai Tak Runway Park Pier, Fly the Flyover 01 and 03 at Hoi Bun Road) interconnected with wired and/or wireless telecommunication network forms an IoT backbone and make use of the various IoT sensors fixed in the lamp posts enabling real-time collection of city data such as weather, air quality, temperature, people and/or vehicle flow related information, etc. for city management and the support of various applications of smart city initiatives. Their features vary depending on the locations and needs, including air quality and weather monitoring, pedestrian and vehicle flow analysis, realtime information dissemination, electric vehicle charging facilities, solar power facilities and Wi-Fi hotspots. The collected real-time data are released on MyKE mobile app and data.gov.hk.

Major Features

- Climatic Sensors
- Air Quality Sensing Box
- LED Lighting & Control

Major Features

- LPWA Gateway
- Wi-Fi Hotspot
- Camera
- Info Dashboard
- EV Charger
- Spare slot(s) for IoT device(s)
- Solar Panels





n) Data dissemination data.gov.hk

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4.41 The collected data have been shared in MyKE app and data.gov.hk to the public and the experience gained and data collected from this PoC trial can

REP-020-05 | Final | Mar 2021 G:\PROJECTSICURRENT JOBS:248000!248123 CE68_15 KLNE SMART CITY/6-00 DELIVERABLE\18 - EXECUTIVE SUMMARY\ISSUED\WORKINGIES_FINAL_ENG (1-9)_ARUP.DOCX be shared with relevant departments and collected city data can be shared to relevant departments for conducting trend studies at street level. There was a roll-out of the first 50 multi-functional smart lampposts under government pilot scheme in Kwun Tong and the KTD.

4.42 In the medium-to-long term, further installation is recommended to be carried out at suitable locations, in particular along major road corridors in KE and SPKBA, to support various Smart City initiatives and act as an IoT sensing spine in the area of KE.

PoC7: Smart Recycling Bin System

4.43 Fill-level sensors have been installed in 33 recyclable collection bins (RCB) around the area of KE. By analysing the data of fill levels collected, the system can estimate the fill-up time and suggest an optimised collection route by AI. To avoid overflow, the system can also provide alerts to frontline staff when the RCBs are almost full. The system would be able to enhance resource planning and staff deployment as well as street hygiene.

Major Features

- Real-time fill levels of RCBs
- Route optimisation by AI
- Fill-up time estimation



- 4.44 The collected data can be used for enhancing the current collection arrangement and the experience learnt from this PoC trial, such as system setup, installation, configuration, and analysed results could be shared with other relevant stakeholders for deployment of the system to other collection routes.
- 4.45 In the medium-to-long term, relevant departments are recommended to explore with its contractor and relevant parties in deploying the system to other collection routes with an aim to replace the current route-based recyclables collection practice by using this new system in future waste collection services as appropriate.

PoC8: Real-time Roadworks Information

4.46 This PoC trial adopted AR positioning technology to collect real-time roadworks information by automatically measuring the true dimensions of worksite and computing the relative position of the affected area. The system can capture the actual road closure area and instantly geo-reference the polygon onto the map. Data collected can then be disseminated through MyKE and data.gov.hk.

Major Features

- AR measurement of roadworks boundary by on-site workers
- Roadworks location positioning (e.g. via GPS or manual input)
- Centralised database for roadworks information
- Share collected information (e.g. via API or data.gov.hk)
- Enable trip planning
- Public alert on nearby roadworks



p) Road works information disseminated in "MyKE"

- 4.47 The PoC trial is conducted for roads with speed limit less than 70km/h and footpaths in KE to allow stakeholders to familiarise themselves with the roadworks reporting system and provide users' feedback for streamlining the operational procedure.
- 4.48 This PoC trial offered a convenient and effective means to provide more accurate, precise and reliable real-time roadworks information. Accurate roadworks information are made available on MyKE facilitated drivers and pedestrians to plan their journeys. The collected roadworks information have been opened up on data.gov.hk or shared to Government Departments through a common cloud / server using API for public dissemination to facilitate third-party development of mobile apps.
- 4.49 In the medium-to-long term, subject to the results of the PoC trial, it is advised to consider incorporate this initiative with current reporting system for roadworks at high speed roads (speed limit >70km/h) to enrich the

system. The system can be extended to broaden the spatial coverage of realtime road works information and include traffic diversions due to road works by other parties, such as utility companies. It is also recommended to explore the feasibility of disseminating the collected information via Transport Department's "HKeMoility" app.

Cross-Sector Collaboration

- 4.50 KE provided a test bed and demonstration ground for smart city projects to maximise the synergies created through tri-party (viz. government, private sectors and professionals / academic institutions) collaboration. Continual effort was made to encourage universities and research institutes to develop innovative smart city solutions. Some examples include:
 - HKUST: Personalised Real-Time Air Quality Informatics System for Exposure Hong Kong (PRAISE-HK)
 - ASTRI: Smart Indoor and Outdoor Geographic Information System
 - PolyU, HKU, HKUST, Friends of the Earth(FoE): Smart City Tree Management
 - CLP HK Ltd: Smart Energy Community
 - HKUST: People-Aware Smart City: A People-Centered Integration, Mining and Decision Framework
 - PolyU: Cost-Benefit Analysis Framework for Smart City

5 Recommendations for Kai Tak Development (KTD)

- 5.1 The scheme of KTD consists of a mix of community, housing, business, tourism and infrastructural use, the area provided places for multi-functional use which can form key nodes for the area. These can form a network of landmarks or a single thematic landmark to foster social relations, people interaction, and information exchange.
- 5.2 KTD could be considered as consisting of 3 hubs:
 - Sports & Event Hub It is a sports-oriented modern Kai Tak Sports Park, complemented by a holistic network of facilities consisting of indoor sports centre building, and extensive cycle tracks and jogging trails along the 11km waterfront promenades
 - Leisure Hub The waterfront areas are reserved as open spaces (including parks and promenades) mainly for public leisure and enjoyment. Educational and comfortable heritage trail, cycle track or other convenient pedestrian networks further demonstrate and promote the concept of "Walkable KE"

• Tourism & Commercial Hub— Retail, business, and hotel provisions are planned to mix with the sports and sophisticated activity nodes to ensure vibrancy in different times of the day and different days of the week



Sports & Events Hub

5.3 To improve safety and operation of Sports Park and surrounding areas, as well as enhancing vibrancy and excitement, the following initiatives were proposed.

Smart Initiative	Major Feature
Intelligent Pole / Smart Street Lamppost System	 Basic street lighting functions Network access and connectivity services Video surveillance
Info Hub / Spectator Service Kiosk	 Live event information broadcast Self-service ticketing and shopping Virtual matches Interpretation and translation service Emergency report service
Crowd Resilient and Management System	Traffic and pedestrian flow monitoringVideo surveillance with visual analyticsSafety alert
High Density Wi-Fi Hotspots	High network coverageHigh network capacity
Intelligent Pedestrian Crossing	Pedestrian group identificationCrossing time extensionPedestrian safety
EV Charging Spots	• EV car charging facilities inside car park

Leisure Hub

5.4 With the various open spaces and community areas present in KTD, the following initiatives were proposed to enhance visitor experience and improve spaces to encourage visitation and foster sense of place.

Smart Initiative	Major Feature	Recommended Locations
Walkability with Navigation System	 Positioning and navigation services Route suggestion Personalised and / or Thematic route suggestion Points of Interests / Landmarks Public feedback Cultural / Local education 	 All types of open space Waterfront sites
Intelligent Pole / Smart Street Lamppost System	 Basic street lighting function Environmental and climatic sensors Internet access and online connectivity Video surveillance Entertainment light effect (enhanced / responsive lighting) 	 All types of open space Waterfront sites
Urban Digital Node – Info Hub / Kiosk	 Attraction / Landmark / Local information access Road safety Wayfinding 	 All types of open space Waterfront Sites
Smart Bus Stops	 Real-time information Video analytics (queueing status) Trip planning / pre-planning 	• Open spaces with bus stops / PTIs / transportation
Real-time Water Quality Predication System	 Water quality data collection Water quality prediction Water quality information dissemination 	 Waterfront sites Open spaces with water features
Smart Waste Bin & Video Surveillance	Bin fill-up status monitoringWaste collection route optimisation	• All types of open space
Smart and Self- Cleaning Toilet	 Self-cleaning toilet Presence sensors Automatic door closing system Hygiene-centric facilities (e.g. automatic faucet & soap dispenser) UV disinfection Smart mirror system (health assessment) 	• All types of open spaces with toilets / sanitation facilities

Smart Initiative	Major Feature	Recommended Locations
Smart Tour Guide for Heritage Trail	 Personalised and / or Thematic route suggestion Multimedia / AR content Push (pop-up) notification 	• Heritage Trail
Leisurely Water Taxi	Connection with waterOnline taxi reservation	• Waterfront sites
Smart Playground and Mobile Environmental Sensors	 Connection with other street furniture Energy generation from games facilities Air quality tracking Real-time environmental data collection 	• All types of open spaces

Tourism and Commercial Hub

5.5 To make use of the locale of KTD and create instances where citizens and visitors can enjoy the facilities, we proposed the following initiatives to facilitate node operators, event organisers and facilities operators to better provide quality services which ultimately affects people's experience in KTD.

Smart Initiative	Major Feature	Recommended Locations
Seamless Event and Places Navigation System	 Positioning and navigation services Personalised and Thematic route suggestion Points-of-Interest / landmarks information 	Commercial sites (retail / office / hotel)
Urban Digital Node – All-in- One Info Hub / Kiosk	 Real-time retail / commercial department / food & beverage information Online shopping and advertising E-coupons / promotional events information Mobile device charging Emergency report service Interpretation and translation service 	• Commercial sites (retail / office / hotel)
Eat Smart – Smart Food Service	 Dining option information Smart / mobile food ordering Real-time seat availability Automated / robotic food preparation service Food waste recycling / treatment (e.g. food-to-fertiliser) 	Commercial sites (retail / office / hotel)

Smart Initiative	Major Feature	Recommended Locations
EV Charging Spots & Online Booking Platform	 EV car charging Online payment and booking	• Commercial sites (retail / office / hotel)
Induction Power Transfer System for Electric Vehicles	 Contactless charging for EV cars on road 	• Commercial sites (retail / office / hotel)
Automatic Waste Collection Systems	Underground waste transportationFood waste recycling	• Commercial sites (retail / office / hotel)
Smart Waste Bin & Automated Cleanliness Detection System	Bin fill-up monitoringWaste collection route optimisation	• Commercial sites (retail / office / hotel)
Tri-generation Technology	• Efficient use of energy (e.g. space heating / cooling)	• Commercial sites (retail / office / hotel)
Smart Grids and Meters	 Real-time utility consumption information Usage / behaviour monitoring Integration with Building Management System (BMS) 	• Commercial sites (retail / office / hotel)
City Points of Interest— Interactive Installation & Facilities	 Smart display and visualisation Life-enriching stairs Floating theatre Façade lighting 	• Commercial sites (retail / office / hotel)
Multi-Purpose Sensing Structure	 Energy efficient lighting Environmental and climatic sensor Network access and connectivity Telecommunication Information visualisation EV charging 	 Tourism Node Commercial sites (retail / office / hotel)

6 Digital Infrastructure

6.1 In supporting the development of KE into a Smart City District, the Centralised Digital Infrastructure for KE provides a feasible and actionable model for EKEO in two perspectives: knowledge sharing with relevant government bureaux / departments to enhance public services delivered in

the KE area; and disseminate information in a transparent manner to better connect with the citizens and community.

- 6.2 It is important to ensure that the Centralised Digital Infrastructure for KE has the capability to create an open ecosystem that supports collaborative innovation and enables data sharing for government departments. It should also provide open data for public use and collect digital data to deliver the prioritised Smart City District projects. Taking advantage of this environment demands that the Centralised Digital Infrastructure for KE shall be flexible, scalable, and optimised based on end user activity.
- 6.3 In the short to medium term, the current digital infrastructure of EKEO is sufficient to meet the demand for storage of data generated by on-going PoC trials and other initiatives. It is recommended to adopt existing digital infrastructure to centralise the digital data for sharing with the public at data.gov.hk.
- 6.4 In the long term, if any applications for PoC trials and other initiatives are feasible for wide-scale deployment, they shall be further redeployed by corresponding department(s). The digital data of these applications will be stored and managed in their own systems. Upon the availability of CSDI, the digital data will be shared with the public or government departments at CSDI subject to their suitability.

7 Cybersecurity and Data Privacy

7.1 Security risks arising from operation of initiatives across the 4 layers of ICT infrastructure of a smart city are identified to be the following:

Security Aspect	Security Risk	
Application Layer		
Data Confidentiality	• Over-exposure of data in applications	
Data Integrity	Misinterpretation of data in applicationsIncorrect data processing logic in applications	
Data Availability	 Hardware failure of system infrastructure supporting applications Hacking to applications 	
Authenticity	 Phishing Dissemination of hoax	
Accountability	Provision / use of incorrect data	
Privacy	Illegal use of personal data	
Intellectual Property	Illegal use of open data	
Data Layer		
Data Confidentiality & Privacy	Hacking to centralised databaseVandalism of data centre infrastructure	

Security Aspect	Security Risk	
Data Integrity	Theft of storage media	
Data Availability	Hardware failure of storage media	
	• Insufficient capacity to accommodate huge volume of data	
	Disaster to data centre	
	Denial-of-Service(DoS) to data service	
Authenticity	Re-direction of network traffic to forged hosts	
Accountability	Incorrect processing of data collection	
Privacy	Over-exposure of personal data to applications	
Intellectual Property	Over-exposure of corporate-owned data	
Network Layer		
Data Confidentiality & Privacy	• Eavesdropping over data transmission network	
Data Confidentiality	• Unauthorised access to off-premises network devices	
Data Integrity	• Corruption of data during transmission over network	
	Hardware failure of core network devices	
Data Availability	• Failure of mobile networks	
	Denial of network service	
Authenticity	• Man-in-the-middle attack	
Sensing Layer		
Data Confidentiality	• Leakage of data from temporary storage of sensors	
Data Integrity	• Exploitation of vulnerability in sensors	
Data Availability	Vandalism of sensors	
	• Technical malfunction in extreme weather conditions	
Authenticity	Forged sensors feeding deceived data	
Privacy	• Excessive or unfair collection of personal data	

- 7.2 In general, the following measures have been applied for PoC trials under the Study to ensure system safety and data security:
 - All contractors had to follow the standard confidentiality agreement for non-disclosure of information.
 - No government data or management decisions are to be disclosed without approval from the government.
 - Security practices and procedures are enforced on the system in compliance with IT security Policy of the Government.
 - Mitigation measures are taken on identified privacy issues based on Personal Data (Privacy) Ordinance (PDPO) and relevant regulations.
 - Personal particular information and records as defined by PDPO are treated as proprietary and confidential information.

- All applicable laws concerning data privacy is observed in the process of analysing, specifying, design and construction of the systems for PoC trials.
- 7.3 Specific data privacy measures were taken for each PoC trial, such as data transmission and system design requirements, to specifically address the different data privacy and security concerns related to the individual PoC trial.
- 7.4 Recommended security measures to mitigate security risks include:
 - Define data management framework: to deal with the challenges encountered in a big data environment (i.e. Volume, Velocity, Veracity and Variety).
 - Establish a data interoperability model: to address the challenges faced during use, integration, and compilation of data from different data owners (e.g. health sector, transportation providers, government, academics, etc.).
 - Adopt strong authentication mechanisms: to safeguard data transmission and collection on sensors. Public Key Infrastructure (PKI) environment can be adopted to provide certificates for device authentication while "Killswitch" functionality allowed administrators to disable device remotely under security threat. Sensors with only local access capabilities are not recommended and should be integrated with an enterprise Identity and Access Management (IAM) system or Identity Relationship Management (IRM).

8 Sustainability Assessment

- 8.1 A sustainability assessment had been carried out to analyse the sustainability implications of the various initiatives proposed, including PoC trials and proposed initiatives in the short- and medium-to-long term. The results of the assessment indicated that the initiatives would bring about a number of improvements in the economy, mobility, leisure and cultural vibrancy, social and infrastructure facilities, and environment. These benefits come in the form of positive economic return, encourage innovation and R&D, reduce pollution, and enhance transport services. The initiatives would also affect the society as a whole; bring about benefits to community health, social cohesion through improvements to community provisions such as communal facilities, participation of activities and access to information.
- 8.2 On the other hand, the initiatives may bring about small degradation to the environment by a slight increase in the amount of construction waste produced during installation of hardware. Mitigation measures are to be put

in place to reduce, and potentially remove, the impact placed on the environment by initiatives requiring installation of hardware.

8.3 In summary, the PoC trials and proposed initiatives are sustainable; balancing environmental, economic, and social considerations. After detailed assessment on the impacts of the various initiatives and PoC trials, overall, the development of smart city district in KE can be considered as positive in terms of sustainable development.

9 Conclusions

- 9.1 The Study has reviewed and assessed the strength, weakness, opportunities and threats of KE in face of its transformation into CBD2. Based on the components of the Smart City Framework, various smart city initiatives were proposed to improve the governance and socio-economic vibrancy, resource management and environment, mobility and walkability, and ICT provisions to make KE a better place to live, work, and play. Some short-term initiatives, including PoC trials, have been completed and further measures would be initiated to demonstrate or implement the benefits of smart city to the wider medium-to-long-term community. Proposed initiatives would be progressively taken forward in liaison with relevant departments.
- 9.2 Recommendations were also proposed on the centralise digital infrastructure of KE in short and medium-to-long term, to address the constraints and limitation relating to cyber security, data integrity, privacy concerns and protect personal data. The aim is that the benefit for smart city development can be promoted and raise awareness in the community for creating a sustainable and liveable model with KE as the pilot area.
- 9.3 Through the various suggested initiatives, KE will become a starting point for experiencing the life of a smart city. The success of these initiatives would be dependent on the sharing, collaboration and participation from the government, academia, industry, and public to gain valuable experience for future applications. KE will continue to be a test bed for smart initiatives, helping to lay the foundation for the creation of a vibrant, smart and sustainable Hong Kong.
