

DIGITAL TRANSFORMATION FOR A SMART CITY

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ABSTRACT

The Hong Kong Innovation and Technology Development Blueprint was released in December 2022, charting a clear development path and formulating systematic strategic planning for Hong Kong's innovation and technology (I&T) development over the next five to ten years. In the Blueprint, one of the strategies is to accelerate the development of smart city to enhance citizens' quality of life. To embrace the new I&T era towards smart city development, the Electrical and Mechanical Services Department (EMSD) has been walking through a journey of digital transformation to develop digitalised engineering solutions for smart building as well as smart city management. A Building Information Modelling - Asset Management system has been developed which integrates Building Information Modelling and the digitalised electrical and mechanical (E&M) asset management towards smart operation and maintenance workflow to enhance the management efficiency and optimise city management. With the rapid development of Internet of Things technologies, EMSD has also developed a Government-wide IoT Network which enables the use of battery-powered sensing devices to realise a near real-time remote monitoring of E&M equipment. To further enhance the management of E&M equipment at more than 8,000 government venues, EMSD has established a Regional Digital Control Centre, and would apply big data analytics and artificial intelligence on the operation data of E&M equipment to improve energy efficiency and achieve predictive maintenance. In this paper, some specific use cases relating to digital management in post-pandemic era will also be shared, demonstrating Government's effort in transforming Hong Kong into a smart city.

1. INTRODUCTION

The Electrical and Mechanical Services Department (EMSD) of the HKSAR Government is embracing digital transformation with various innovation and technology (I&T) solutions, aiming at improving public service quality and supporting the development of Hong Kong into a smart city. EMSD is developing the Government-Wide Internet-of-Things Network (GWIN), a network of wireless sensors installed throughout Hong Kong to support various smart applications. Moreover, the use of Building Information Modelling for Asset Management (BIM-AM) in various government or public venues and buildings facilitates digitalisation of operation and maintenance workflows and enhances facility management. EMSD has also developed a departmental Regional Digital Control Centre (RDCC), a unified digital platform that supervises and monitors all major critical Electrical and Mechanical (E&M) equipment through a real-time IoT platform to enhance their operational efficiency and environmental performance. Furthermore, EMSD has also implemented specific solutions related to digital management in the post-pandemic era. These solutions have demonstrated the commitment of EMSD to embracing digital transformation and innovation to improve public service quality and support smart city development.

2. GOVERNMENT WIDE INTERNET OF THINGS NETWORK

To assist digitalisation of E&M equipment, and to support smart city development in Hong Kong, EMSD is building a territory-wide network of wireless sensors for Government use to support smart applications for improving public service quality.

Having evaluated different IoT technologies, Long Range (LoRa) technology, a Low Power Wide Area Network (LPWAN), is considered as a cost-effective

means for implementation of near real-time wide area monitoring. In particular, as the sensor connectivity does not rely on public mobile networks, this can eliminate congestion problems that may be encountered during adverse weather or other critical situations.

In 2019, EMSD deployed the LoRa technology to build its pilot IoT network in Shatin district. The system was completed within a short period of 10 months with a coverage of about 80%. Upon its successful application in Shatin, the GWIN was extended to Kowloon East in 2020, and is being extended to other districts over the territory in phases. As at the end of 2022, over 400 fixed or mobile gateways have been installed at various government facilities across the territory.

The GWIN system makes use of in-situ battery powered IoT sensors installed at E&M equipment under monitoring to communicate wirelessly with relevant gateways using the LoRa technology. These gateways in turn communicate with the central servers through high speed wired or wireless networks. The LoRa-based communication network between the IoT sensors and gateways are operated as a dedicated network with long range transmission capability.

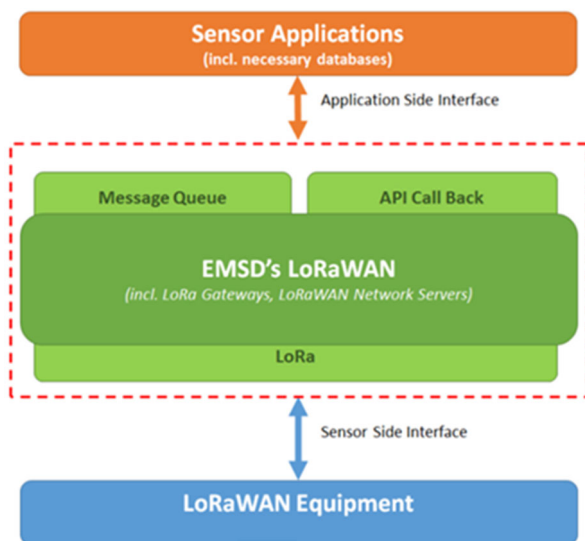


Fig 1 - System hierarchy of GWIN

With the GWIN, EMSD makes use of various types of LoRa sensing devices to conduct near real-time remote monitoring of E&M equipment as well as to support smart city management, such as improving maintenance and repairs of E&M equipment in buildings, managing utilization of public facilities, flood monitoring and underground pipe leakage analysis, and applications directly related to public services, such as Smart Toilet and Smart Parking System.

3. BUILDING INFORMATION MODELLING – ASSET MANAGEMENT

EMSD had been deploying BIM for asset management (BIM-AM) in various government-owned and public body-owned venues and buildings, including government offices, non-government organisation venues, hospitals, etc., to facilitate digitalisation of O&M workflow and to enhance facility management.

EMSD has introduced BIM-AM to achieve digitalisation of E&M O&M services. BIM-AM integrates various critical data for providing maintenance service, such as BIM model, asset data, equipment relationship diagram, operation data, maintenance manuals and records. Such that, BIM-AM provides an all-round and high-tech asset management system in order to enhance the workflow for O&M works.

In order to provide guidelines on the summary of lifecycle information requirements for the contractors to work on EMSD projects, EMSD has developed “Standards and Guidelines on BIM-AM”. It provides a standardised coding for various E&M systems. It also specifies the information requirement for E&M equipment to be inputted in the BIM model and specifies the modelling requirement, project settings, E&M settings, and presentation style.

EMSD also developed “BIM-AM Guidelines for the Handover of E&M Installation to EMSD” for the contractors to prepare BIM & BIM-AM handover deliverables, as well as a “BIM-AM Acceptance & Upkeeping Guidelines for EMSD” for internal EMSD staff to accept and upkeep the models and asset data of BIM venues.

To achieve better efficiency and a smooth workflow of the submission of deliverables from the contractors, EMSD has developed the Asset Information Management Platform (AIMP) for the contractor’s project team to submit BIM model, asset data and related documents during handover stage. The EMSD staff then can use the Common Data Environment (CDE) to consolidate and verify the submissions. The design of the CDE is based on relevant requirements from International Organisation for Standardisation (ISO), Construction Industry Council, and the Development Bureau. It provides a series of functions that can facilitate the handover and vetting procedure for BIM-AM. It also provides a single source of truth of data for the BIM-AM platform.

Furthermore, in order to promote BIM-AM in the industry and increase market competition, EMSD has applied for a patent on BIM-AM systems since 2016, which covers the integration of the system with various electronic systems to ensure the design could

be widely adopted and free from the prohibition from any other organisations.

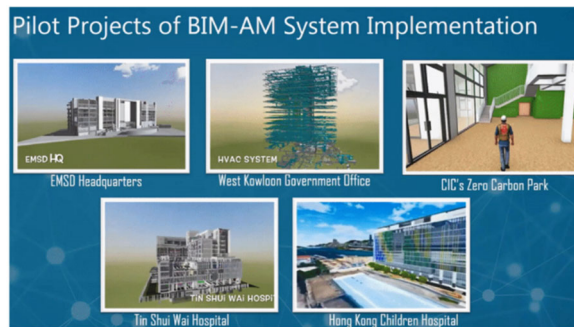


Fig. 2 – Pilot Projects of BIM-AM System Implementation

4. DEPARTMENTAL REGIONAL DIGITAL CONTROL CENTRE

EMSD developed a departmental Regional Digital Control Centre (RDCC) which serves as a unified digital platform at corporate level that integrates multiple local control centres, enabling the supervision and monitoring of major critical E&M equipment through a real-time IoT platform, with a view to enhancing critical assets' operational efficiency and environmental performance. In addition, the RDCC provides real-time supervision and consolidation of building and asset data, and image/video signals from various data sources for equipment monitoring, fault analysis and building/asset-performance visualization as well as for positioning of the essential portable E&M equipment for use in emergencies in the territory. In this connection, the RDCC also serves as a platform for data analytics and artificial intelligence operation for better-informed decision on critical assets' operation review through diagnosis checking, system optimization, predictive maintenance and energy saving evaluation.

On the other hand, the RDCC also serves as an emergency control centre in times of emergencies occasioned by tropical cyclones, natural disasters or other potentially hazardous situations for manpower and emergency-resource allocation among different maintenance units of EMSD and external government departments.

In the future, the RDCC would consolidate and manage through a unified data schema for collecting building and asset data in different data formats and file types such as BIM-AM, Geographic Information System, corporate computer system, job-related workflow system on Customer Centric e-Platform, Asset Management System, Global Positioning System for asset tracker and central Data Lake etc. High-level integration between the departmental RDCC and local RDCCs shall be achieved.

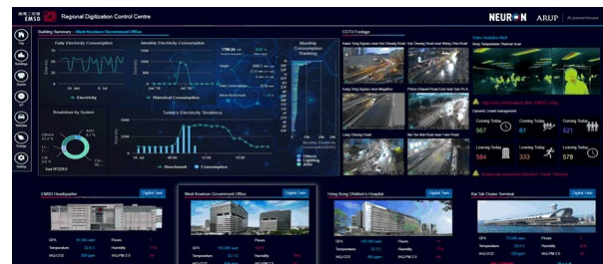


Fig. 3 – Departmental Regional Digital Control Centre (DRDCC)

5. DIGITAL MANAGEMENT IN POST-PANDEMIC ERA

5.1 On-premise Video Conference Solution

During the pandemic, EMSD has deployed an On-premise Video Conference Solution on an on-premise hybrid cloud service. The solution is to provide the functionality of online video conference with information and network security to protect sensitive meeting information from leaking.

The solution integrated with the Smart Reservation System (SRS) for the EMSD Headquarters Building, to form a one-stop convenience for employees to reserve online meetings and webinars, as well as other facilities in the building, such as carpark and physical meeting rooms. It is considered as a more efficient way to leverage limited resources among thousands of EMSD colleagues.

EMSD also applied this video conference solution for the recruitment of Engineering Graduates, streamlining the interview process and making it more efficient and effective. With the help of this system, we were able to complete 400 interviews in 5 working days, greatly enhancing efficiency compared to traditional face-to-face interviews.

Moreover, EMSD has also utilised the solution to provide IT remote helpdesk support services during the pandemic. To maintain social distancing and prevent service interruptions due to a mass infection of E&M maintenance team members, we scattered our maintenance staffs across temporary offices. Remote IT support was implemented via the On-premise Video Conference Solution. This allowed us to provide seamless and uninterrupted IT support services during these challenging times, and hence ensure continuity of our maintenance services.

5.2 Anti-epidemic Robots

Amid the epidemic, EMSD and the Hong Kong Police Force jointly developed a quadruped robot for delivering supplies to persons under quarantine at Ma Sik Road Community Isolation Facility (CIF) in Fanling, to reduce social contacts and the risks of

infection. The quadruped robot moves with four limbs, and could move effortlessly on various terrains. Once the operators enter route commands, the robot will automatically walk, detect and avoid obstacles, and deliver daily supplies from CIF's warehouses to the doorstep of the rooms in the isolated area. The isolated personnel can easily pick up the supplies by themselves.

5.3 Lunar New Year Fair 2023

EMSD and the Food and Environmental Hygiene Department (FEHD) have introduced innovation and technology to monitor the admission to and exit from the Lunar New Year (LNY) fairs in response to the Government's anti-epidemic measures. There were overhead footfall sensors installed at each of the 15 LNY fairs. The sensors deploy video analytics technology to count the number of people admission to and exit from the fairs. The number of people was counted locally to ensure privacy, and only the footfall count was uploaded for further processing. The footfall information was displayed in a "Green, Amber and Red Lights" format on site and also on the FEHD website to enable the public to know about the footfall at all the fairs.



Fig. 4 – Crowds waiting for entering one of the Lunar New Year Fairs

There were also ticketing systems installed at three LNY fairs with high patron flow. When the footfall has increased to a very high level, the ticketing system will be activated, and the public may get an admission ticket on site or obtain an e-ticket through the mobile app which can be downloaded for free.

6. CONCLUSION

EMSD is one of the facilitators of promoting and implementing the use of innovative technologies in the Hong Kong Government. Therefore, EMSD is playing an active role in digital transformation to support smart building and city management through the development of various applications, such as BIM-

AM and GWIN. The RDCC has also been established to enable remote monitoring and predictive maintenance of E&M equipment, improving operational efficiency and reducing costs. Though Hong Kong is emerging from the pandemic, these digitalisation solutions have laid a foundation for EMSD to continuously explore more innovative engineering solutions to improve her E&M services and also leverage the I&T solutions to support other government departments to enhance their public services to transform Hong Kong to an international smart city.

REFERENCES

1. EMSD. (2021, May 25). *Development of Government-Wide Internet-of-Things Network (GWIN) to Enhance City Management*.
2. EMSD. (2022, May 17). *Government Wide IoT Network (GWIN) (1406) - EMSD*. Retrieved from https://www.emsd.gov.hk/en/engineering_service/project_management_consultancy/highlights_of_work/gwin/index.html
3. EMSD. (7, Jan 2023). *Building Information Modelling - Asset Management (BIM-AM)*. Retrieved from Building Information Modelling - Asset Management (BIM-AM): https://www.emsd.gov.hk/en/engineering_service/project_management_consultancy/highlights_of_work/bim_am/