CIC Global Construction Digitalisation Exhibition and Forum 2024

Forum on Smart Built Asset

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“BIM x AI”

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Good afternoon, Ir Albert CHENG (Executive Director of CIC), distinguished guests, ladies and gentlemen.

Innovative technologies are driving the effectiveness of our engineering works as a whole, enhancing works quality, reducing time and saving cost.

Opening

Advancement of BIM starts from historical 2D blue-print drawing to 3D BIM modelling, we all realise the power and effectiveness of project management with 3D BIM models. It’s a revolutionised way of project management for building’s lifecycle. All the post-construction operation and maintenance can have a vivid overview on the site condition which also facilitates future operation and maintenance planning. I believe that all audience here today are very familiar with BIM.

AI – Artificial Intelligence seems to be a magic for decades. It enables and empowers for new business models. The new AI related library and framework in **Python like PyTorch**, and the well-embraced open-source platforms like HuggingFace and GitHub created new practical usage on our current vast datasets such as BIM.

My topic today, BIM **MULTIPLIES** AI, is seemingly a simple equation that represents what my Department, EMSD, is working hard as at today, where we explore the synergy of BIM crossovers AI.

EMSD has already enabled BIM-Asset Management (AM) at about a hundred of government buildings in Hong Kong.

BIM Life Cycle

BIM-AM is an enabler and a powerful tool for data visualisation and management. It is like an organic structure with its own life cycle covering design, construction, operation and maintenance stages.

Currently, EMSD is maintaining more than one million pieces of E&M equipment in over 8,000 government venues. You can imagine, data quality in BIM models is crucial for us to carry out effective operation and maintenance works. We have published the BIM-AM Standards and Guidelines and also handover guidelines for quality assurance of BIM models and to smoothen asset data transfer at the project handover stage.

By the way, we also strongly support the development of openBIM. We have developed Model Preparation Guides & Model Checking Tools to ensure the quality of openBIM files and we are honored to be a winner under the "Handover" category of openBIM Awards 2024.

GWIN

With the emerging IoT technologies, we implemented an IoT network, namely Government Wide IoT Network (GWIN). This network allowed us to deploy smart IoT sensors for digitalising assets within specific venues for smart city development since 2019.

By using this IoT network based on LoRa technology, our IoT sensors in government buildings and venues can transmit real-time data to our on-premise network servers for continuous monitoring.

EMSD has succeeded in furnishing the collection of data from IoT sensors which has largely enhanced the remote monitoring for our E&M equipment. This takes us one step closer to achieve **smarter** building operation and maintenance.

You may ask, with all these data in BIM and BIM-AM, what have we achieved in terms of engineering works on buildings' design and operation? Let's have a look in the simulation.

MiMEP

By leveraging the spatial data handling of equipment in BIM with Asset Management, we can easily detect collision and handle piping laying in the planning stage for MiMEP projects. It is especially helpful, when BIM allows engineers to visualise moving routes and possible challenges before starting works. This definitely saves a lot of time and cost.

This technology was applied in our chiller replacement project at the Tai Lung Veterinary Laboratory which has significantly speeded up the construction process.

Another remarkable use case I would like to share is the recent application in Princess Margaret Hospital, where we used BIM for the delivery route simulation for the MiMEP replacement works.

AI Application on Operational Data in BIM

We should be more familiar with the effectiveness of BIM in displaying spatial data and, achieving the applications which I have just shown to you. However, for non-spatial applications including operation data analysis, energy efficiency optimisation, and predictive maintenance, BIM models would be too enormous, from data size perspective, for AI development.

To efficiently extract the relationship information in BIM models for further AI development, an internationally defined topology standard is being researched and developed in my department. Namely, the Semantic Modelling.

Machine Readability via Semantic Modelling

Semantic Modelling, in short, is a standardised method to describe the relationship between equipment and their corresponding metadata. Let me explain using a simple example:

The Semantic Model standard we follow is the BRICK model. We applied the BRICK Model, similar with English language, in each basic sentence, we have Subject, Verb and Object. For example:

“the CO2 Sensor” - “is attached to” - “the Air Handling Unit”

“the CO2 Sensor”- “has reading” - “900 ppm”

“the Fan Unit” - “is attached to” - “the Air Handling Unit”

“the Fan Unit” - “has fan speed” - “50%”

Gathering these textual descriptions, we can establish a lightweight but large graphical database of relationships, while each “verb” also known as “predicate” in the BRICK model are well defined and explained internationally.

This machine readable information will enable reusing of AI algorithms at various venues swiftly with minimal code modifications.

ChillStream

One of the exciting achievements in EMSD is the trials we had conducted on HVAC optimisation.

The EMSD developed a homemade AI chiller optimisation platform called ChillStream. With the real-time collection of operating parameters, ChillStream is able to predict the cooling load demand in high accuracy, and determine the most energy efficient operating sequence and chilled water supply temperature set point. The optimal operating sequence of the chiller plant and control set points are then sent back to the building for automatic configuration. Those achievements reach a 5 to 10% energy reduction in general. These have great potential for further developments and rolling out to other buildings.

Let's take a look at its introductory video.

Future - Dream Bigger - BIM-^{AI}

Stepping ahead into the future, it appears that BIM multiplies AI, that is applying AI on BIM data should not be sufficient to meet our needs in BIM projects. One of the major challenges in the BIM world is to update BIM models for the purpose of reflecting the actual condition and AA&I works conducted to the building.

We need a new equation to the project, that is to say BIM to the POWER of AI, which means, handling BIM updates using AI.

With the advancement of generative AI and the Large Language Models (LLM), BIM tools leveraging such technologies start to emerge in the market. Text-to-BIM, as shown in the following video is inspiring. Let's take a look.

From what we have seen in the video, by simply typing our updates into the BIM software, the BIM models will be updated automatically. I foresee that this kind of application would be available and widely applied in the near future.

Dream Bigger - BIMAI (BIM to the Power of AI)

Dreaming bigger, **simply by Asking the AI**, actions such as data updating in BIM, equipment monitoring and data analysis in the Maintenance loop can be achieved. Furthermore, **simply by Asking the AI** to control our systems directly, producing incident report and performing simulations can also be done easily in the Operation loop.

All these, **simply - by - Asking - the - AI**.

Thus, from the concept of BIM to the Power of AI, we can rename it to BIM to the Power of **ASKING** AI. Just by asking the AI to perform the tasks we need, the automated operation can then be achieved seamlessly.

Drive deeper collaboration

However, dreams are still dreams unless it is put into actions. The "Power of Asking" has also enlightened me to ask fellow engineers and bright minds in our audience today, to collaborate with us in achieving these practical automations. We shall create an easier and more effective BIM applications together.

Through the E&M InnoPortal and the E&M AI Lab, we aim to enhance collaboration among government departments, public bodies and the I&T sector and encourage the application of innovative technologies for service improvement and smart city development. The E&M AI Lab, initiated by EMSD, also serves as a platform to gather experts and interested practitioners worldwide for knowledge and experience sharing. We need to explore more AI applications on BIM as well as building E&M facilities. The "Power of AI" will continue to play an important role in BIM in the years ahead.

Closing

I believe, continuously engaging the possibilities in openBIM, Semantic Modelling and AI Standards, the future of smart building will definitely be exciting. There are more and more pioneers in adopting AI for smarter and greener buildings. Let's move toward the age of BIM to the Power of AI together.

Thank you.