CONSTRUCTION INDUSTRY COUNCIL
建造業議會

BIM

CIC BIM for Asset Management and Facility Management Case Sharing

2021

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Preface

The Construction Industry Council (CIC) is committed to seeking continuous improvement in all aspects of the construction industry in Hong Kong. To achieve this aim, the CIC forms Committees, Task Forces and other forums to review specific areas of work with the intention of producing Alerts, Reference Materials, Guidelines and Codes of Conduct to assist participants in the industry to strive for excellence.

The CIC appreciates that some improvements and practices can be implemented immediately whilst others may take more time for implementation. It is for this reason that four separate categories of publication have been adopted, the purposes of which are as follows:

Alerts	The Alerts are reminders in the form of brief leaflets produced quickly to draw the immediate attention of relevant stakeholders to the need to follow some good practices or to implement some preventive measures in relation to the construction industry.
Reference Materials	The Reference Materials are standards or methodologies generally adopted and regarded by the industry as good practices. The CIC recommends the adoption of the Reference Materials by industry stakeholders where appropriate.
Guidelines	The Guidelines provide information and guidance on particular topics relevant to the construction industry. The CIC expects all industry stakeholders to adopt the recommendations set out in the Guidelines where applicable.
Codes of Conduct	The Codes of Conduct set out the principles that all relevant industry participants should follow. Under the Construction Industry Council (Cap 587), the CIC is tasked to formulate codes of conduct and enforce such codes. The CIC may take necessary actions to ensure compliance with the codes.

If you have read this publication, we encourage you to share your feedback with us. Please take a moment to fill out the Feedback Form attached to this publication in order that we can further enhance it for the benefit of all concerned. With our joint efforts, we believe our construction industry will develop further and will continue to prosper for years to come.

1. Introduction of this Publication

This publication provides a case sharing on the use of Building Information Modelling (BIM) for Asset Management and Facility Management for reference by the industry. The CIC aims to promote and support the construction industry in BIM adoption throughout the lifecycle in projects, and to cultivate and nurture a culture of adopting BIM and related technologies, such as IoT, to support the green and intelligent building approach. Observations are found in the CIC BIM Adoption Survey Reports 2019[1] and 2020[2], the top BIM hurdles in the construction industry in Hong Kong, including (i) lack of BIM expertise, (ii) lack of BIM project experience, and (iii) absence of BIM requirements by the client. Meanwhile, the adoption rate in BIM uses for asset management and facility management or related purposes is still low. In this connection, the CIC has been collecting relevant showcases from the industry, as well as identified our own pilot projects, and develop as a case for sharing with the industry for reference.

The target users are primarily Appointing Parties / Employers / Clients / Owners (hereafter referred to as 'Appointing Parties') or their agents in the private sector who plan to implement BIM for Asset Management and Facility Management, and is looking for references. This publication is not a BIM Standards or Guidelines, however, it provides project-specific details as reference.

In the beginning of this publication, is the background information of the project case "CIC Headquarters" selected by the CIC as one of our pilot projects, followed by the objectives and the identified benefits of using BIM for Asset Management and Facilities Management in the project, and the scope of work in the project. The subsequent sections will then detail this project case, with focus on key areas, including BIM execution planning, workflows on BIM process, information exchange, introduction of the workflow of integrating BIM and asset information for AM and facilities upkeep, Internet of Things (IoT) integration with the CIC Estates Office Management System, etc. There are guidance notes provided where appropriate in this publication, and at the end of it is the sharing on challenges, difficulties, resolutions and lessons learnt. The CIC welcomes any feedback and we wish to acquire more project cases from the industry for sharing to practitioners.

2. Terminology and Definitions

Asset Information Model (AIM) - Maintained information model used to manage, maintain and operate the asset; required to support an organisation's asset management system.

As-Built Model / As-Built Information Model (ABIM) - It is the end of construction phase model and consists of the PIM identified as suitable to support the strategic and day-to-day management processes of the built asset.

Asset Management (AM) - Asset management refers to a systematic approach to the governance and realisation of value responsible for, over their whole lifecycles. It may apply both to tangible assets

[1] CIC BIM Adoption Survey 2019, available at CIC BIM Portal: https://www.bim.cic.hk/en/resources/publications
[2] CIC BIM Adoption Survey 2020, available at CIC BIM Portal: https://www.bim.cic.hk/en/resources/publications

(physical objects such as buildings or equipment) and to intangible assets (such as human capital, intellectual property, goodwill or financial assets). It refers to the process of developing, operating, maintaining, upgrading, and disposing of assets in the most cost-effective manner (including all costs, risks and performance attributes). It is also increasingly used in both the business world and public infrastructure sectors to ensure a coordinated approach to the optimisation of costs, risks, service/performance and sustainability. The international standard, ISO 55000, provides an introduction and requirements specification for a management system for asset management.

Facility Management (FM) - The term Facility Management (FM) refers to the interdisciplinary activities performed during the Operation Phase of building, space or infrastructure. FM activities typically include operation, leasing occupancy, maintenance, cleaning, etc.

Project Information Model (PIM) - Information model developed during the design and production and construction phase of a project, consisting of graphical information, non-graphical information and documentation defining the delivered project.

3. Project Background

The Estates Office (EO) supports the CIC's operation in facilities management and capital projects. For facilities management, EO is responsible for maintenance services for common MEP (or building services), building structures, landscaping, furniture and equipment; executing statutory compliance checking and up keeping; and providing license renewal services. For capital projects, EO focuses on contracting and project management of revamp works, A&A works and new development works, optimising space utilisation, and the adoption and integration with BIM.

The CIC is committed to optimising our internal use of resources in operations and minimising impacts to the environment. The CIC Headquarters achieved a BEAM Plus Interior Platinum rating, enabling green operations with environmentally friendly designs and smart control. Each department is responsible for setting annual targets in improving energy efficiency, conserving resources and reducing waste in operations.

The EO integrated BIM and IoT technology into the CIC Estates Office Management System (the 'EOMS'), which is the 'Planon system', to enhance maintenance services as well as asset and safety management at the CIC Headquarters. The integration was completed and launched at the end of 2020 providing a more effective and comprehensive management on the CIC premises. In addition, with an aim to streamline the process of recording and evaluating our environmental performance, a sustainability data online portal was established and integrated in the existing corporate-wide EOMS.

Overall workflow of the project

1. Identifying the objectives and benefits of implementing BIM and IoT for AM and facilities upkeep
2. Defining Scope of Work and deliverables
3. Defining implementation team structure and personnel requirements
4. Establishing project schedule (implementation schedule), including project meetings
5. Defining the framework of BIM Execution Plan (BEP) for consultant / contractor to elaborate
6. Clarify workflow on BIM processes
7. Identifying model delivery standards
8. Clarify workflow on logistics of information exchange / data transfer and mapping

9. Aligning the workflow of integrating BIM and asset information for AM and facilities upkeep
10. Identifying the system for AM and facilities upkeep and its requirements on BIM & IoT integrations
11. Establishing the mechanism / workflow for up keeping of model geometry and information in the O&M Stage

Project Team

Appointing Party	Construction Industry Council ("CIC")
Project Name	Supply and Installation of IoT and BIM at the CIC Headquarters for the CIC
Project Address	38/F, and Unit A, B and C of 39/F, COS Centre, 56 Tsun Yip Street, Kwun Tong, Kowloon
Appointed Party (Main Contractor)	ATAL Technologies Limited (ATAL)
Appointed Party (EOMS vendor)	Planon Hong Kong Limited (Planon)
Project Scope	The existing conditions of the CIC Headquarters shall be retained, with implementation of new IoT devices for the purpose of AM and FM. 1. Production of ABIM and related deliverables; 2. Supply of labour, tools, materials, transportation, equipment and all necessary provision to complete the Supply and Installation Works of IoT system; and 3. Integrate the ABIM and IoT system with the CIC EOMS. 4. Repair and renovation is not involved in this project.
Project Schedule	Commencement in September 2020 and completed by end 2020

4. Objectives and Benefits of Using BIM for AM and FM

The project aims to improve the visualisation of assets & facilities at CIC Headquarters by creating a data-rich BIM environment linking up real-time sensor data through IoT & RFID devices, to enhance the efficiency of facility & asset management, enhance our staff / occupant / user experience and quality of life, enable operations & maintenance performance analysis and future optimisation, support sustainability, carbon neutrality, office / community health and safety, energy saving, etc.

5. Scope of Work

5.1. BIM Uses

5.1.1. The Main Contractor shall submit the ABIM with accurate asset information and drawings, and related deliverables to the satisfaction of the CIC and achieve the objectives. The BIM Uses, refer to the *CIC BIM Standards – General (Version 2 – 2020),* include the followings:

(i) BIM Use 03: Drawing Generation;
(ii) BIM Use 20: As-Built Model (ABIM) and Asset Information Model (AIM);
(iii) BIM Use 21: Maintenance Scheduling;
(iv) BIM Use 23: Space Management and Tracking; and
(v) BIM Use 24: Asset Management.

5.1.2. The Main Contractor shall provide the following ABIM and related services to the satisfaction of the CIC:

(i) ABIM Creation Services
  (a) Build up ABIM of the CIC Headquarters based on the 2D as-built floor layout plan drawings in .DWG format provided by the CIC, the Main Contractor is required to conduct field verification by on-site measurement. 3D Laser scanning is optional in this project.
  (b) In general, the ABIM elements / BIM objects shall be modelled at minimum Level of Graphics / LOD-Graphics (LOD-G) 300 for all discipline, while for prefabricated, MiC and DfMA units / elements, if any, shall be modelled at minimum LOD-G 400.
  (c) The ABIM shall satisfy Level of Information Need and fit for the integration with the EOMS.

(ii) ABIM Content Creation Services
  (a) Create BIM objects and object sheet of the project according to the asset details and the *CIC Production of BIM Object Guide – General Requirements* provided by the CIC.
  (b) Apply materials for BIM objects according to information given by the CIC.

(c) Input asset information provided by the CIC for FM and AM operation purpose.

(iii) Revision Services

(a) One revision is included after the acceptance of submission of ABIM. Any additional revision will be at extra cost.

Guidance Notes:

- *As the Appointing Party, it is necessary to specify the objectives of the project including the BIM requirements, such as Exchange Information Requirements (EIR).*
- *As the Appointing Party, it is important to select and specify the type and version of the BIM authoring software used for the project, alternatively Appointing Party may leave to services provider to propose the BIM authoring software for the project; and the BIM authoring software shall be compatible with open format (including .ifc) to satisfy the project needs and enable future uses.*
- *Field verification by means of 3D digital survey technology such as laser scanning is desired. As the Appointing Party, the method / technology for field verification shall be specified in the EIR as it may generate a service fee, and it may be significant in particular when the project scale is large and/or site condition is complicated.*
- *Implementation of Common Data Environment (CDE) for project collaboration in this case is optional. It is desired to have a CDE. However, due to short and tight project schedule and budget, CDE was not implemented.*
- *It is preferably to create the ABIM upon all necessary informaiton is available to avoid rework or continuously update of the ABIM. As the Appointing Party, the number of update / revision of the ABIM after acceptance of submission may be specified in the BIM requirements.*
- *As the Appointing Party, early engagement of estate office / operation team is strongly recommended.*
- *Implementation of preventive and predictive maintenance with the use of big data from Building Management System (BMS) and IoT sensors are recommended.*
- *Appointing Parties may consider to share their building and facility data with suitable centralised data sharing platforms, which may be available in the future. For details including the purpose, considerations and benefits, please refer to the Section 5.8 of the CIC Report on 3D Spatial and BIM Data Use Case Requirements of the Hong Kong Construction Industry (2021)[3].*

5.2. IoT

5.2.1. The Main Contractor shall supply labour, tools, materials, transportation, equipment and all necessary provisions to complete the Supply and Installation Works of IoT system to the satisfaction of the CIC ("the Works").

5.2.2. The power socket for the IoT devices and IoT system will be provided by the CIC.

5.2.3. The Main Contractor shall provide the following IoT platform and IoT devices to the satisfaction of the CIC:

[3] Report on 3D Spatial and BIM Data Use Case Requirements of the Hong Kong Construction Industry (2021), available at CIC BIM Portal: https://www.bim.cic.hk/en/resources/publications

(i) IoT Server, IoT Gateway and Network Infrastructure
(ii) IoT Platform
  (a) Dashboards and Reports
  (b) Work Orders
  (c) End Client Devices
  (d) Thresholds
  (e) Multi-location, Multi-discipline
  (f) Open APIs
(iii) IoT Devices
  (a) Water Leakage Sensors
  (b) Wetness Sensors
  (c) Fall Detection Sensors
  (d) RFID Asset Tag
  (e) TSL Passive RFID Reader
  (f) Bin Sensors
  (g) Indoor Environment Quality (IEQ) Sensor
  (h) Vibration Sensor

5.2.4. Integration of BIM and IoT to the EOMS

5.3. Deliverables

5.3.1. BIM

ABIM, BIM objects and object sheets of the project, including the as-built information and updated as-built drawings, for the purpose of AM and FM.

In this project, BIM model objects were modelled at minimum LOD-G 300 for both MEP disciplines and non-MEP disciplines in general. While for prefabricated, MiC and DfMA units / elements, if any, were modelled at minimum LOD-G 400 as far as practicable. For AM and facilities upkeep purpose, model elements / BIM objects were field verified representation in terms of size, shape, location, quantity, and orientation. BIM objects were built to meet and satisfy the needs of the required BIM Uses as stipulated in the Scope of Works fit for purposes. Sufficient LOD shall be applied.

Building information, attributes and parameters were embedded or linked to the BIM models / BIM objects to enable AM and facilities upkeep. Discipline-specific details were referred to the respective CIC BIM Standards and agreed by the CIC. For as-built models, LOD-I 500 shall be adopted.

5.3.2. IoT devices installation and setup

Supply and Installation of IoT devices according to the requirements of the CIC.

5.3.3. Integration of the ABIM and IoT devices

Integration of ABIM and IoT devices to the EOMS, including testing and commissioning / user acceptance test.

5.3.4. Project Meetings

Participation in all project meetings as and when required, on weekly-basis in general.

5.3.5. Training on the use of the EOMS

Training on the use of the EOMS, including the operation workflow.

5.4. General

5.4.1. The CIC (BIM and EO team) would provide the existing as-built drawings and related information such as, catalogues or specifications of existing assets, if available, for ATAL to take action.

6. Project Meetings

A kick off meeting was held on 14 September 2020, the CIC, ATAL and Planon were introduced and reviewed the project Assignment Brief. A set of agenda items below were discussed for respective participants to follow and action.

6.1. General

a. All parties agreed on official project commencement date
b. All parties agreed on weekly progress meeting
c. All parties agreed on project milestone date and target completion date

6.2. BIM

a. The CIC would provide the existing as-built drawings and related information for ATAL to take action
b. ATAL would provide the first draft of ABIM after one month from receiving of the existing as-built drawings

6.3. IoT

a. ATAL would propose the sensor installation locations after site visit
b. ATAL would submit the sample materials for approval of the CIC before procurement
c. ATAL would propose the methodology of using different IoT sensors
d. ATAL and Planon would collaborate for the connection / interfacing between ABIM, IoT signal and EOMS

6.4. Site Work

a. ATAL agreed to collect 360° panoramic photos and videos as the method for field verification
b. The CIC would confirm the schedule with ATAL for any site work or visit

6.5. Project schedule

a. A detailed project schedule should be produced and kept updated
b. The project schedule below is the planned schedule (for reference only)

ID	Task Name	Duration	Start	Finish	Predecessors	Resou Name
1	**CIC - BIM/IoT Project**	**80 days?**	**Wed 16/9/20**	**Thu 24/12/20**		
2	Kick off meeting	1 day	Mon 14/9/20	Mon 14/9/20		
3	Material Submission	2 days	Wed 16/9/20	Thu 17/9/20	2	
4	Material Approval	5 days	Fri 18/9/20	Thu 24/9/20	3	CIC
5	**Material Lead time**	**30 days**	**Fri 25/9/20**	**Mon 2/11/20**		
6	LoRaWAN Gateway	5 days	Fri 25/9/20	Mon 5/10/20	4	
7	Sensors	30 days	Fri 25/9/20	Mon 2/11/20	4	
8	**BIM**	**55 days**	**Wed 16/9/20**	**Fri 20/11/20**		
9	Drawing Study	5 days	Wed 16/9/20	Tue 22/9/20		
10	Drawing Verification	5 days	Wed 23/9/20	Tue 29/9/20	9	
11	BIM Model Conversion (38/f	20 days	Wed 30/9/20	Mon 26/10/20	10	
12	3D Model Generation	3 days	Tue 27/10/20	Thu 29/10/20	11	
13	BIM Model Conversion (38/f	20 days	Tue 27/10/20	Sun 15/11/20	11	
14	3D Model Generation	3 days	Mon 16/11/20	Wed 18/11/20	13	
15	CobieLite Export	5 days	Mon 16/11/20	Fri 20/11/20	11,13	
16	**Site Preparation**	**56 days**	**Wed 16/9/20**	**Sat 21/11/20**		
17	Site Visit I	1 day	Wed 16/9/20	Wed 16/9/20		
18	Site Visit II	1 day	Mon 21/9/20	Mon 21/9/20		
19	Installation Plan	5 days	Tue 29/9/20	Wed 7/10/20	18FS+5 days	
20	Installation Plan Approval	5 days	Thu 8/10/20	Wed 14/10/20	19	CIC
21	**Gateway**	**1 day**	**Sat 17/10/20**	**Sat 17/10/20**	**20,6**	
22	Gateway Installation	1 day	Sat 17/10/20	Sat 17/10/20		
23	**Sensors**	**15 days**	**Sat 7/11/20**	**Sat 21/11/20**	**21,7**	
24	Sensor Installation Part I	2 days	Sat 7/11/20	Sun 8/11/20		
25	Sensor Installation Part II	2 days	Sat 14/11/20	Sun 15/11/20		
26	Sensor Installation - Contingency	2 days	Fri 20/11/20	Sat 21/11/20		
27	**IoT Platform**	**40 days**	**Tue 6/10/20**	**Tue 17/11/20**		
28	System Enhacement	20 days	Tue 6/10/20	Wed 28/10/20	4FS+5 days	
29	Gather CIC Comments	10 days	Thu 29/10/20	Sat 7/11/20	28	
30	Bug fix and tuning	10 days	Sun 8/11/20	Tue 17/11/20	29	
31	**Planon Interface**	**15 days**	**Wed 16/9/20**	**Thu 8/10/20**		
32	Protocol Design	15 days	Wed 16/9/20	Thu 8/10/20		
33	Implementation	10 days	Wed 16/9/20	Tue 29/9/20		
34	Integration Test	10 days	Wed 16/9/20	Tue 29/9/20		
35	**T&C**	**15 days**	**Mon 23/11/20**	**Fri 11/12/20**	**8,16,27,31**	
36	Overall	15 days	Mon 23/11/20	Fri 11/12/20		

During the project progress meetings, the CIC, ATAL and Planon worked and collaborated closely to discuss and identify major, critical and dominant items for submissions of the Works, including the followings:

1. BIM
    a. A project-specific BIM Execution Plan (BEP) for planning and implementation of BIM in this project, in compliance with the BIM requirements specified by the CIC
    b. BIM model conversion methodology, i.e. from native format to the EOMS
    c. Data conversion methodology, using of a Globally Unique Identifier (GUID), Asset ID and equipment list to ensure the data accuracy, completeness and integrity
    d. Completed BIM models are submitted in native format together with a free online viewer model for CIC to review and comment
    e. Space ID is assigned to indicate the location of each BIM object within the ABIM
    f. Asset Code is assigned to state the position of each BIM object for maintenance management purpose
2. IoT
    a. Agreement on sensor installation location
    b. Agreement on IoT devices (brand and model), including the followings:
        i. Water Leakage Sensors
        ii. Wetness Sensors
        iii. Fall Detection Sensors
        iv. RFID Asset Tag

v. TSL Passive TFID Read
vi. Bin Sensors
vii. Indoor Environment Quality (IEQ) Sensor
viii. Vibration Sensor

3. Site Work
    a. Site visit schedule with on-site staffs
    b. 360° panoramic photos and videos taken for the ABIM preparation
    c. ABIM and field verification

7. BIM Execution Plan (BEP)

A project-specific BIM Execution Plan is prepared by the Appointed Parties, in compliance with the BIM requirements specified by the CIC. The structure and details of the BEP was referenced from the *CIC BIM Standard - General (Version 2 - December 2020)*. Below is the Table of Contents of the BEP.

BEP Table of Contents

8. Workflow on BIM Processes

8.1. BIM Model Development

Information Management

For the purpose of information management, a data-rich ABIM is produced. As-built drawings of building systems, MEP installation details and engineering specifications are the sources of existing as-built information. All information was verified by ATAL upon receiving from the CIC. Meanwhile the project's information standards and project's production methods and procedures, such as naming convention of information model and BIM objects, model breakdown structure, and settings of asset parameters and attributes, were strictly managed according to the CIC BIM standards and requirements and agreed

with the CIC before any production. The entire process of as-built information modelling was closely monitored and quality checked and assured by ATAL to comply with all requirements of the CIC.

Guidance Note: For the planning and organisation of model breakdown structure, federation strategy as well as modelling methodology requirements depend, please refer to the CIC BIM standards – General and relevant CIC BIM standards for recommendations. In addition, the Appointing Party and the project team shall take into account the project scale and complexity, capability and requirements of the BIM authoring software and the BIM-enabled platform to be used for AM and facilities upkeep, as well as the requirements in the conversion / interfacing / integration from/between native BIM models & asset information to/and BIM-enabled platform for AM and facilities upkeep.

8.2. As-Built Information Modelling

Site Information

To ensure the accuracy of the ABIM against the actual site conditions, 360° cameras were used to capture the site conditions and served as a major reference. 360° photos and videos were produced by ATAL as supporting reference and route-traceable record.

The paths / routes for capturing 360° photos and videos was planned before the site visits. All accessible rooms and open areas were recorded. For narrow areas, more site photos were captured as supplementary records. Deviations between site records captured by ATAL and the existing as-built drawings provided by the CIC were reported to the CIC for review and clarification. Raw data of 360° photos and videos were submitted to the CIC for reference. The CIC reviewed and compared the 360° photos and videos and the ABIM submitted by ATAL.

All visible MEP services were modelled accurately according to the site conditions. MEP services which were covered or blocked by false ceilings were modelled with reference to the existing as-built drawings provided by the CIC. A specific parameter, namely "CIC_Site_Verify" would be assigned to all MEP BIM objects to indicate whether it was verified against site conditions.

BIM Object Management & ABIM Preparation

The project-specific BIM objects library and project template with MEP system settings were prepared in the beginning of the project. ATAL Building Service BIM Engineers collected all building systems related information provided by the CIC. All BIM objects were prepared and developed in compliance with the CIC BIM standards and guidelines. BIM objects were standardised, managed and classified in a centralised BIM object library of the project. The relational database was verified and recognised as LOD-I 500 c/w LOD-G 200-400 included in the required asset, facility or equipment, such as T&C data / supplier records / O&M menus / as-built drawings, etc., from the BIM database.

8.3. Coordination and Clash Avoidance

By use of BIM, dedicated Building Services Engineer will identify possible design conflicts and issues.

Software 'Navisworks Manage' was used for design review and coordination, to check clashes of visible MEP services. For any issues found in the clash analysis process, ATAL BIM Engineer attended

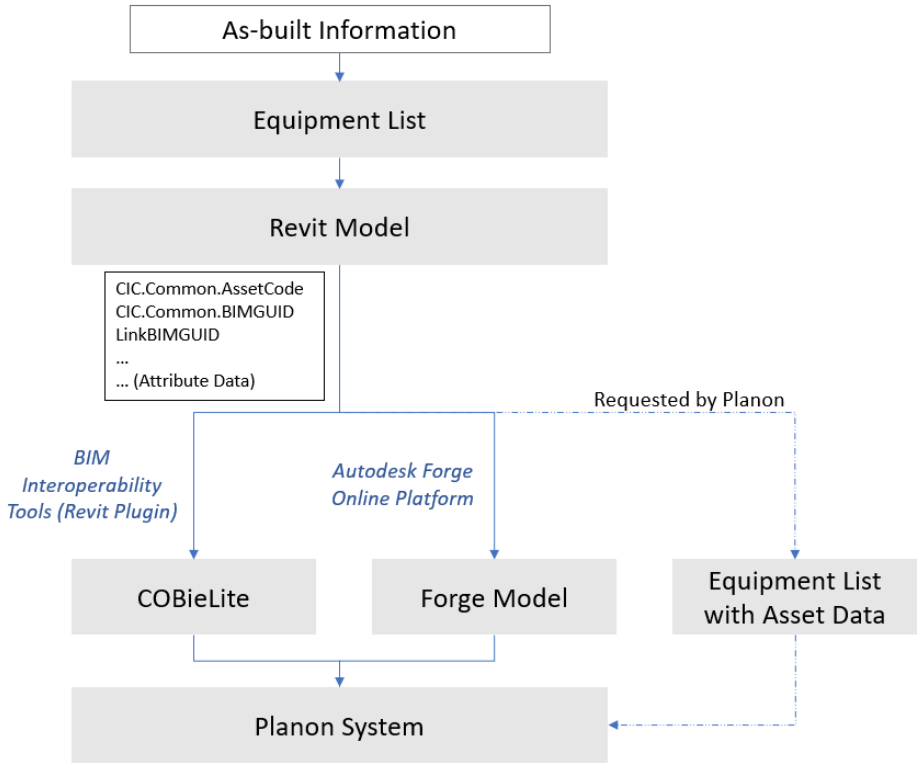
coordination meetings using BIM, to resolve the clashes and potential problems with the CIC before submitting ABIM for approval and handover to the EOMS for integration.

8.4. FM/AM Data-Input & Integration

Specified drawings and schedules were agreed and developed from the approved ABIM. In the BIM authoring software 'Revit', parameter, namely "CIC_Data_Verify" was used for indicating BIM objects that have material catalogue to show its respective information. Attribute and properties of BIM objects for FM/AM were agreed by the CIC. Before importing the BIM model onto the EOMS, ATAL converted the BIM model from native format (Revit) into Forge format. A Forge converter was developed, in which was fully compatible with the BIM requirements and specifications by Planon and the EOMS for this project.

8.5. Data Flow

The flow chart below demonstrates the data flow for building up the initial ABIM and data set for the EOMS in this project.



Asset Data Flow

8.6. Preparing the Revit model

Equipment List

At early stage, an overall equipment list was created and prepared by ATAL by listing out all project related BIM objects (asset for FM/AM) to be included in the ABIM or EOMS. The CIC identified and

confirmed what BIM objects should be included in the EOMS and classified the BIM objects into 10 major categories.

Sample list of required equipment extracted from the BEP of this project as follows:

Items (ARC/STR)	Model Required (Y/N)	FM System Required (Y/N)	Asset Group
Lift Car	Y	N	N/A
Planting (Office/Reception)	Y	N	N/A
Mullion	Y	N	N/A
Ceiling (Grid/Wood Baffle)	Y	N	N/A
Raised Floor	Y	N	N/A
Carpet	Y	N	N/A
Structural Column	Y	N	N/A
Structural Framing	Y	N	N/A
Wall	Y	N	N/A
Window at 38F Restroom Lav.	Y	N	N/A
Door (Building: Hose Reel/Pipe Duct/Exit/Lift)	Y	N	N/A

Items (MEP)	Model Required (Y/N)	FM System Required (Y/N)	Asset Group
Louvre	Y	Y	AC
Return Grill	Y	Y	AC
Supply Diffuser	Y	Y	AC
Round Duct connector	Y	Y	AC
Plenum	Y	Y	AC
Damper	Y	Y	AC
Air-conditioner	Y	Y	AC
EAF	Y	Y	AC
Sensor (Light/Temperature/Door/Flush etc.)	Y	Y	ELV/PD
Shade Control	Y	Y	ELV
Temperature Controller	Y	Y	ELV
IOT	Y	Y	ELV
Alarm Button	Y	Y	ELV

The equipment list contained basic BIM object information, such as object name (Revit Family Name), LOD, location, as well as attribute fields which were suggested by Planon and approved by the CIC. Asset information would be inserted to these fields according to their categories.

Revit Model

LOD-I: Shared parameters were developed and created for Revit modelling according to the attribute fields in the equipment list.

LOD-G: Revit models were constructed according to as-built information, including as-built drawings, site record and asset catalogues. These information were consolidated and amended in the equipment list for model development and auditing.

Sample LOD Responsibility Matrix extracted from the BEP of this project as follows:

- (*) Individual items which are not covered by ceiling has been site-verified
- LOD 500 data are input according to CIC provided information

Model Element	Required	As-Built Modelling			
	(Y/N)	AUT	LOD/LOD-G	LOD-I	Site Verified
Asset Group: AC					
Air Grill	Y	ATAL	300	500	*
Louvre	Y	ATAL	300	500	*
Supply Diffuser	Y	ATAL	300	500	*
Plenum	Y	ATAL	300	500	*
Fire Damper	Y	ATAL	300	500	*
Non-Return Damper	Y	ATAL	300	500	*
Air Conditioner	Y	ATAL	300	500	*
Exhaust Fan	Y	ATAL	300	500	*
Duct	Y	ATAL	300	500	*
Duct Fitting	Y	ATAL	300	500	*

Model Element	Required	As-Built Modelling			
	(Y/N)	AUT	LOD/LOD-G	LOD-I	Site Verified
Concealed and cast-in-place conduit	N				
Asset Group: Lift					
Lift Panel	Y	ATAL	200	200	*
Lift Car	Y	ATAL	200	200	*
Lift Button	Y	ATAL	200	200	*
Asset Group: ELV					
Sensor	Y	ATAL	300	500	*
IoT Sensor	Y	ATAL	300	500	*
Temperature Controller	Y	ATAL	300	500	*
Shade Control	Y	ATAL	300	500	*
Door Control	Y	ATAL	300	500	*
Alarm Button	Y	ATAL	300	500	*
Alarm Indicator	Y	ATAL	300	500	*
Card Reader	Y	ATAL	300	500	*
CCTV	Y	ATAL	300	500	*
Door Release Button	Y	ATAL	300	500	*
Key Switch	Y	ATAL	300	500	*
Emergency Button	Y	ATAL	300	500	*
Room Booking Panel	Y	ATAL	300	500	*
Touchless Door Button	Y	ATAL	300	500	*

Output data from Revit Model to EOMS

The initial ABIM contained latest asset information provided by the CIC and input into Revit by ATAL. When the Revit model was ready, geometry and asset information was exported and transferred to the EOMS.

According to the project requirements, both Forge model and a lightweight .XML format for the standard related to managing asset information, namely 'Construction Operations Building Information Exchange (COBieLite) were submitted to Planon for asset information mapping. Planon requested to use an equipment list in .XLSX format for storing and updating asset information, this would allow Planon to update on the EOMS in a more efficient and compatible way during project implementation period. This method was agreed and approved by the CIC for data transfer in lieu of using COBieLite. Both of the COBieLite, equipment list and the Forge model were submitted to Planon. In operation stage, only equipment list and Forge model were adopted for updating data.

Equipment List with Asset Information

The equipment list with asset information was continuously maintained and updated, and the Revit model was converted to the EOMS from time to time for testing. A final version of the ABIM together with the most updated equipment list were finally agreed and approved by the CIC before integrating into the EOMS.

Forge Model

The Forge model was generated from the Revit model as one of the deliverables to the EOMS for geometry presentation. By using of the Autodesk Forge GUI and platform, Forge model (.svf) was produced.

In this project, the 38/F MEP BIM model and 39/F MEP BIM model served as the master files when uploading to the Forge platform. The linked Architectural (ARC) and Structural (STR) BIM models were uploaded together with the master files. In Forge, geometry of the Revit BIM objects could be mapped with asset information by their asset code (refer to CIC.Common.AssetCode in the equipment list) and GUID (refer to LinkBIMGUID in the equipment list).

Sample asset code as follows, please refer to Section 11 for more details.

- First Exhaust Fan at 38/F: HQ-NA-038-AC-EAD-EAF-001
- Second Exhaust Fan at 38/F: HQ-NA-038-AC-EAD-EAF-002

For BIM objects from linked files, their GUIDs (LinkBIMGUID) were added with the Linked Revit Model GUIDs as a prefix to their original GUIDs. This Linked Revit Model GUIDs were generated automatically when a model file is linked to the master file.

Example:

	MEP File (Master)	ARC File	STR File
Linked Revit Model GUID in Master File	N/A	e.g. 2558c4e6-cdff-4fe2-81e2-51bf8e89da5e-00102705	e.g. e75eb4fc-f590-4df8-849b-01f311d707ad-000331b4
Original Object GUID	e.g. ce54ee25-3eec-4c6b-9dd4-8486e5d1dcde-00099ea4	e.g. ce54ee25-3eec-4c6b-9dd4-8486e5d1dcde-00011ab2	e.g. ce54ee25-3eec-4c6b-9dd4-8486e5d1dcde-00033cd3
LinkBIMGUID (Linked Revit Model GUID in Master File / Original Object GUID)	e.g. ce54ee25-3eec-4c6b-9dd4-8486e5d1dcde-00099ea4	e.g. 2558c4e6-cdff-4fe2-81e2-51bf8e89da5e-00102705 / ce54ee25-3eec-4c6b-9dd4-8486e5d1dcde-00011ab2	e.g. e75eb4fc-f590-4df8-849b-01f311d707ad-000331b4 / ce54ee25-3eec-4c6b-9dd4-8486e5d1dcde-00033cd3

8.7. Quality Assurance and Control

A list of items and procedure were developed aiming to facilitate reviewing and quality checking of the BIM models in terms of LOD-G and LOD-I, which had to satisfy the requirements of the CIC.

QA Items	QC Support
Information	
• Layout Information	360° Video and Images Verification; Site photos Verification; As-built drawings verification
• Asset Information	O&M Manual Checking; Catalogue Checking
Modelling Quality	
• Issue Management	Visual Checking; Clash Analysis (Navisworks Manage)
• Level of Development (LOD)	LOD equipment list; LOD system list
Standards	
• Modelling Standard	Modelling Standard Checklist
• Drawings Standard	Drawing Standard Checklist

8.8. Field Verification

Field Verification Method	
Visual Inspection	360° camera, site photos and videos
Drawings Verification	As-built Drawings

In Revit, parameter “CIC_Site_Verify” was used for indicating BIM objects that were checked with field verification, such as images, 360° image / video.

8.9. Model Archive

Deliverables in the format below were completed by ATAL and submitted to the CIC:

- BIM models of 38/F and 39/F in native format (.rvt)
- BIM models of 38/F and 39/F in Forge format (.svf)
- Equipment List of 38/F and 39/F in Excel format (.xlsx)
- Asset data files of 38/F and 39/F in COBieLite format (.xml)

9. Model Delivery Standards

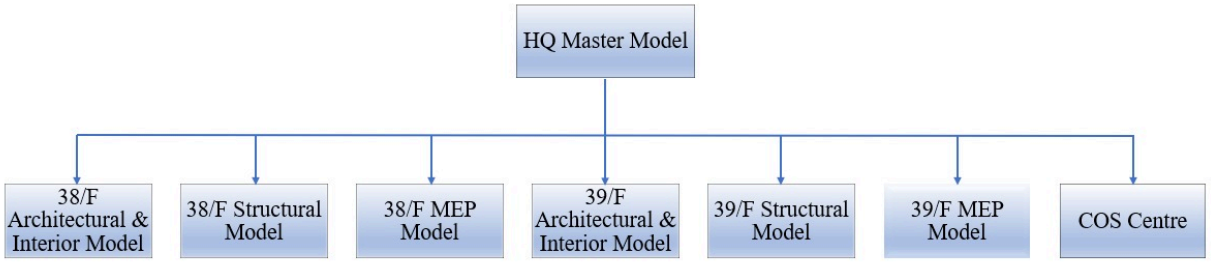
9.1. Coordinate System

The BIM models shall be in HK1980 Grid Coordinates System and refer to Hong Kong Principal Datum. The coordinate information were provided by the CIC.

All BIM models were coordinated with Shared Coordinate System. The Survey Point and Project Base Point of models shall be set as below:

Survey Point	N/S 819157695.0 E/W 841001908.0 Elev 4400.0
Project Base Point	N/S 819154692.5 E/W 841004397.0 Elev 4400.0 Angle to True North 140.34°

9.2. Model Link Diagram



The 'COS Centre' contains the massing model of the project building, including the building boundary line and true coordinates.

9.3. Model File Naming Convention

The model file naming convention referred to the *CIC BIM Standards – General* and was customised to satisfy project-specific needs and was approved by the CIC.

The files were named as below:

Revit File Name:

[Author]-[Zone]-[Level/Location]-[Type]-[Date].rvt

[Author] refers to: CIC

[Zone] refers to: HQ

[Level/Location] refers to: 38F or 39F

[Type] refers to: ARC/STR/MEP

[Date] refers to file date YYYY/MM/DD

e.g. CIC-HQ-38F-ARC-20201231.rvt

9.4. BIM Object Naming Convention

The BIM object naming convention referred to the *CIC Production of BIM Object Guide*. All newly created functional type were listed out in submission to the CIC for approval. Each BIM object naming should not exceed 30 characters for the entire name, including delimiters but excluding the file extension.

The BIM objects are created with the naming convention as follow:

Object Name:

[Category]-[Functional Type]-[Originator]-[Description 1]-[Description 2].rfa

[Descriptor 1]:

a. Duplicate information with the Category and Functional Type should be avoided. For example, if category is “WDW” (means window), “window” should not be used in this field. If functional type is “DBL” (means double), then “double” should not be used in this field.
b. Capital letters should be used for first letter of each word (e.g. WallMounted, GlobalValve).
c. All-capital short forms should be used to indicate materials when applicable (e.g. CONC for concrete, WD for Wood). If Descriptor 1 starts with all-capital short form, an underscore (_) should be used to separate the short form and the following word (e.g. CONC_Kerb, WD_Slash).
d. If Descriptor 1 is blank, three nos. of underscores (___) should be used in place of Descriptor 1 (e.g. SFM-RCB-ACM-___-01.rfa).
e. Descriptor 1 should be kept as concise as practicable with the maximum length of 15 characters in order to reserve space for 2 digit sequential number in Descriptor 2 for potential future expansion.

[Descriptor 2]:

a. Descriptor 2 is a 2-digit sequential number (e.g. 01 to 99) to distinguish different types that cannot be sufficiently identified by preceding fields. (e.g. STE-STA-ACM-NB_Pier-01.rfa)
b. If Descriptor 2 is blank, two underscores (__) should be used in place of Descriptor 2. (e.g. PPF-UPV-ACM-BendSocket-__.rfa)

Type Name:

Further description shall be added for the controlled parameter, for example dimension, size, model type, and mounting method etc., if necessary. Otherwise, type name shall be equal to the Equipment Name or Description in the family name.

9.5. Model Color Scheme

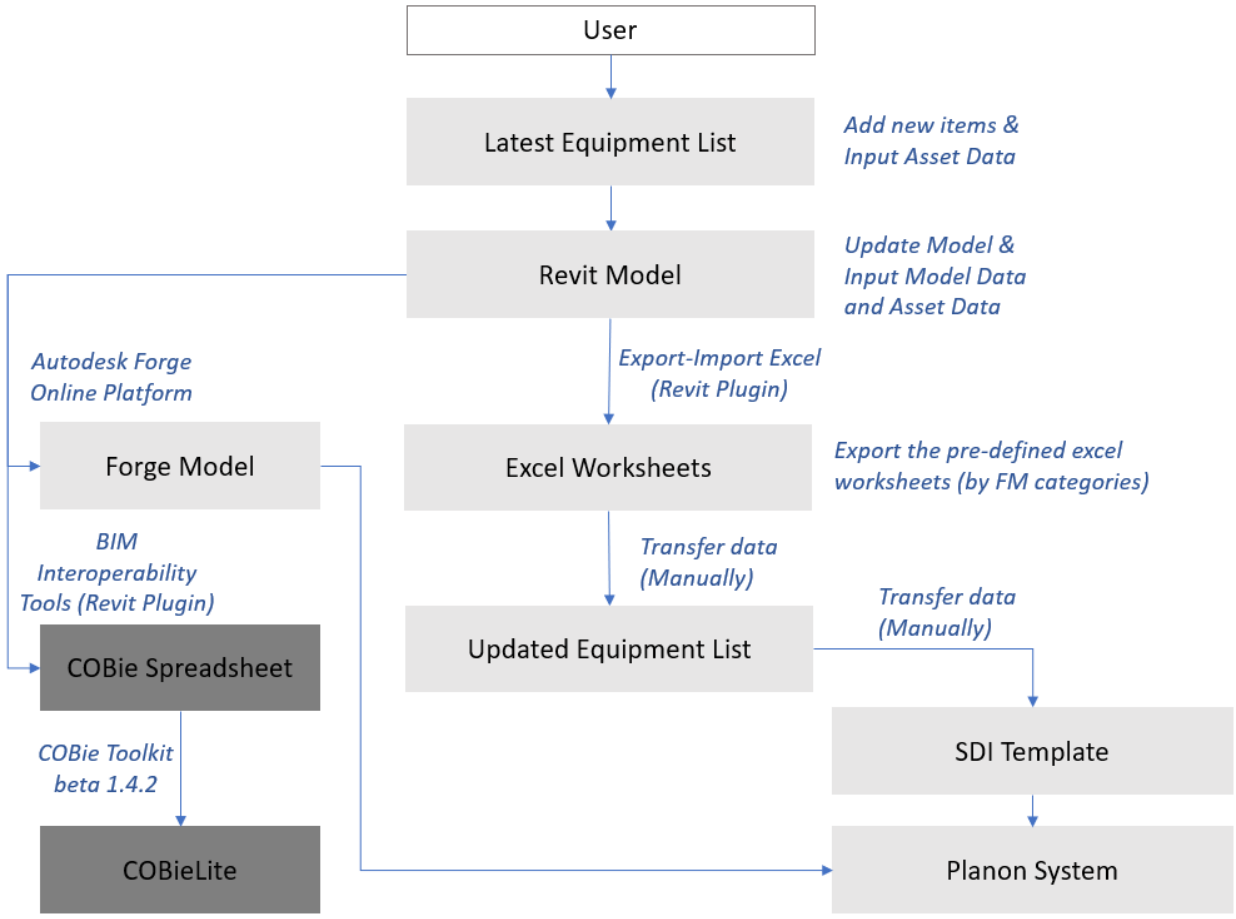
Model color scheme referred to the EMSD BIM-AM Standards and Guidelines v2.0 and was customised to satisfy project-specific needs and approved by the CIC.

No.	System	Description	Presentation (2D)		Presentation (3D)	
			Line Weight	Line Type	R,G,B	Color Palette
1	Lift and Escalator	Cable containment for lift and escalator	0.25	Continuous	128,0,128	
2	LV Switchboards	Cable containment for LV Switchboards	0.35	Divide2	128,128,0	
3	Emergency Generator	Cable containment for Emergency Generator	0.35	Continuous	255,0,64	
4	HVAC	Exhaust Air Duct System	0.35	Continuous	0,255,0	
		Fresh Air Duct System	0.35	Continuous	0,0,255	
		Supply Air Duct System	0.35	Continuous	255,0,0	
		Return Air Duct System	0.35	Continuous	255,0,255	
		Make Up Air Duct System	0.35	Continuous	192,192,192	
		Condensate Drain Pipe System	0.18	Dashed2	255,128,0	
		Condensing Water Supply Pipe System	0.25	Border2	0,128,64	
		Condensing Water Return Pipe System	0.25	Border2	0,128,255	
		Make-up Water Pipe System	0.25	Continuous	192,192,192	
5	Fire Services Installation	Sprinkler	0.25	Continuous	255,0,0	
		Hose Reel/Fire Hydrant	0.25	Continuous	255,0,0	
		Automatic Fire Alarm	0.25	Divide2	255,0,0	
6	Burglar Alarm and Security Installation	Cable containment for Burglar Alarm and Security Installation	0.25	Continuous	128,255,255	

No.	System	Description	Presentation (2D)		Presentation (3D)	
			Line Weight	Line Type	R,G,B	Color Palette
7	PA System		0.25	Continuous	0,128,128	
8	Security System	CCTV	0.25	Continuous	255,153,102	
9	Communication System		0.35	Continuous	128,255,255	
10	Lighting		0.35	Center2	0,255,0	
11	Electrical Distribution		0.35	Divide2	0,255,0	
12	Plumbing System	Cold Water Pipe System	0.25	Long Dash Dash	0,0,255	
		Flushing Water Pipe System	0.25	Center	255,255,0	
13	Drainage System		0.35	Divide2	128,128,0	
14	Water Leakage Detection System	Leak Detection Cable	0.35	Continuous	122,48,160	

10. Workflow on Logistics of Information Exchange / Data Transfer and Mapping

The following implementation flow chart demonstrates the data flow for information exchange / data transfer and mapping.

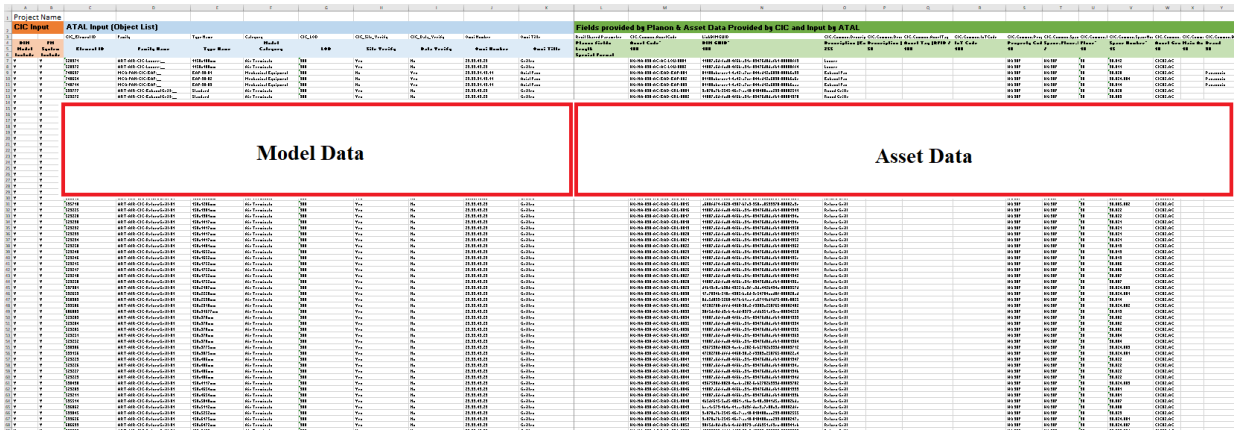


Model Update Data Flow

10.1. Equipment List with Model Data and Asset Information

An equipment list was established and contained all of the asset information in respect with BIM objects. This approach required ATAL to input all the necessary information, submitted to the CIC for reviewing and commenting. It was approved by the CIC and passed to Planon for their further extraction to a Standard Data Input (SDI) template before uploading on to the EOMS.

An example of equipment list as follow:



There is a total of 10 major categories agreed between the CIC, ATAL and Planon for the consolidation of asset information as follows:

Abbreviation	Asset Group
AC	Air-Conditioning / Ventilation / Exhaust System
FS	Fire Services Installation System
PD	Plumbing and Drainage System
EL	Electrical Distribution System
LIFT	Lift / Escalator Service
ELV	ELV / AV / CCTV System / IoT
BLDG	Building Works
LAND	Landscaping / Green Works
FE	Furniture & Equipment
OTH	Others

10.2. Colour in columns refers to the information related to the respect participants.

Columns with heading in Orange: Input by the CIC

- The columns indicate the status when the objects are created in BIM model (LOD-G) and asset information are inserted in the equipment list.
    - BIM Model Include (Y/N) – Determine the object should be created in the BIM Model
    - FM System Include (Y/N) – Determine the object should contain asset information

Columns with heading in Blue: Input by ATAL

- The columns indicate the information and status of the production of objects for ATAL's internal reference.
    - CIC_Element ID – An object ID created from Revit
    - Family – A naming management for object
    - Type Name – Object family type
    - Category – Object family category
    - CIC_LOD – Indicate the model element in graphical and geometric representation, same principle as LOD-G
    - CIC_Site_Verify – is used for indicating objects that are checked with on-site / field verification, such as images, 360° image/video, point cloud data
    - CIC_Data_Verify – is used for indicating objects that have catalogue to show its respect information from CIC

- Omni Number – Table 23 OmniClass® classification is used to organise and retrieve information, the levels are proposed by ATAL
- Omni Title – OmniClass® classification title

Columns with heading in Green: Fields provided by Planon, asset information provided by the CIC and input by ATAL.

- The columns indicate the information of the objects that would be shown in the EOMS.

10.3. LinkBIMGUID

LinkBIMGUID is one of the columns that is essential and acts as the linkage between BIM objects and the EOMS. This parameter is a combined parameter consisting of Linked File Name (same as Linked File GUID) and CIC.Common.BIMGUID (e.g. CIC.Common.BIMGUID in this project 0e307a9b-fcde-494e-a646-54770657a713-000cd648). Data is generated automatically in the schedules. EOMS requires this parameter for mapping the data to the BIM model geometry.

10.4. Material appearance

The CIC required the asset BIM viewer (Forge model viewer) in the EOMS to display materials for selected assets. Material appearance was a potential issue when mapping from Forge model viewer to the EOMS. Some BIM objects were suspected that the material did not successfully attached and displayed in the EOMS, it required investigation and resolution by ATAL technical team in a promptly duration.

Without material attached on BIM objects, example: a CIC notice plate.

An example of a CIC notice plate, with and without material attachment as follow:

Without material attachment	With material attachment
	

11. Workflow of integrating BIM and Asset Information for AM and FM

11.1. Asset Information

Source of asset information shall be provided by following the Excel templates established and the suitability of data format shall be assured before the information is imported into the EOMS. BIM GUID with prefix for assets of non-MEP models in the Excel template is required, to highlight new or modified assets in the EOMS. Planon would provide the 10 Asset Standard Data Input (SDI) templates according to the 10 major assets categories, and a Space SDI template. CIC would be responsible to fill up with the required information and data by copying from the source template to the SDI template.

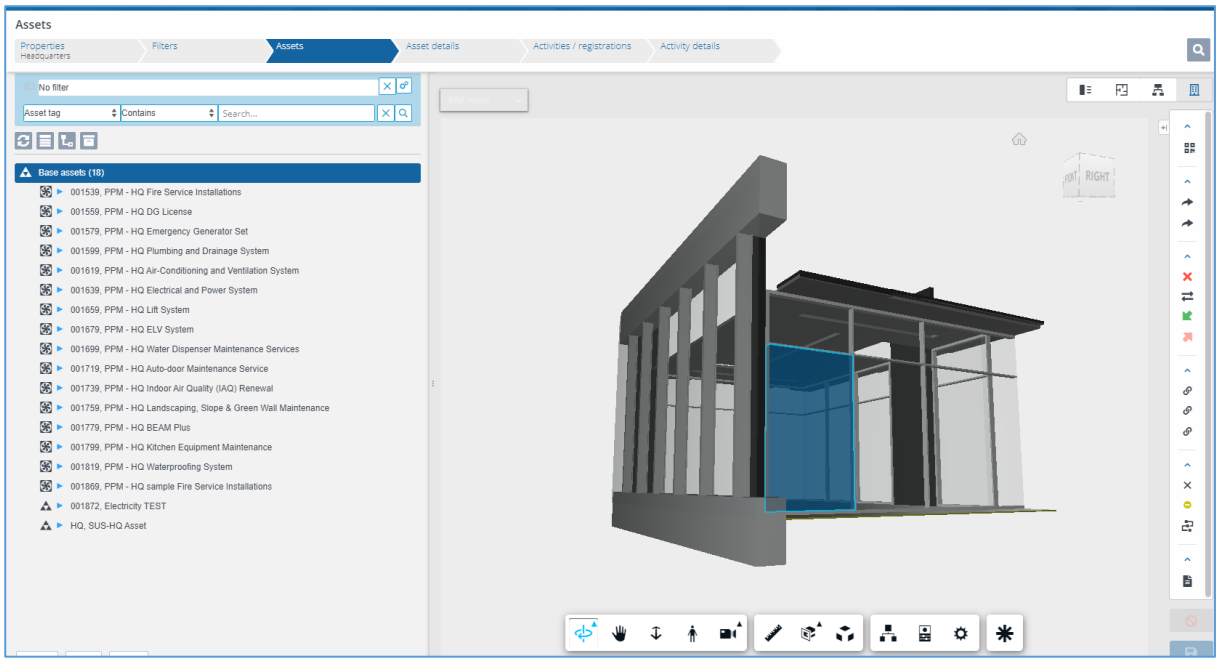
11.2. BIM models

In this particular project, a total of three Revit BIM models, including **MEP** model (**Master model**), **STR** and **ARC** models (Linked models), and combine them in Autodesk Forge format for uploading into the EOMS.

Notes:

- *BIM GUID in the STR and ARC models contains a **prefix** while that in the MEP models does not.*
- *The following data in the Excel templates shall be provided:*
    - *For assets in STR and ARC models → BIM GUID with prefix in the BIM GUID column & BIM GUID without prefix in the last column*
    - *For assets in MEP model → BIM GUID without prefix in the BIM GUID column*

BIM models can be viewed under Asset selection level > Asset's BIM Viewer as shown below:



Below are some of the major fields currently used in the Asset Management in the EOMS. All formats and lengths of the fields were confirmed in the project.

S/n	Description	System Name	Length	S/n	Description	System Name	Length
1	Asset Code	Code	100	43	Power Source	FreeString124	100
2	BIM GUID	BimGuid	100	44	Electrical Power Supply	FreeString3	30
3	Asset Tag	AssetTag	100	45	Current (A)	FreeString4	30
4	IoT Code	FreeString122	100	46	Starting Current (A)	FreeDecimal5	16
5	Desciption	Name	255	47	Cooling Capacity (kW)	FreeString62	50
6	Desciption (Chinese)	FreeString61	50	48	Heating Capacity (kW)	FreeString63	50
7	Translated Name	LangFieldDetail	-	49	Refrigerant	FreeString100	30
8	Property	PropertyRef	10	50	Air Flow (l/s)	FreeString11	30
9	Space	SpaceRef	10	51	Energy label	EnergyLabel	10
10	Asset Group	ItemGroupRef	10	52	Motor Power (kW)	FreeDecimal11	16
11	Main Asset	ParentRef	10	53	Filter	FreeString13	30
12	Brand	Brand	30	54	Service Floor / Location	FreeString111	50
12	Model / Type	Type	30	55	Remarks	Comment	100
13	Model No.	FreeString100	30	56	Head (M)	FreeDecimal2	16
14	Serial No.	FreeString101	30	57	Total Capacity (kW)	FreeString12	30
15	Dimension (W) mm	FreeString102	30	58	Water Flow (I/s)	FreeString14	30
16	Dimension (L) mm	FreeString103	30	59	Motor Power of Pump (kW)	FreeDecimal3	16
17	Dimension (H / D) mm	FreeString104	30	60	Nos. of Phase	FreeDecimal4	16
18	Weight	FreeString27	30	61	Nos. of Way	FreeDecimal6	16
19	Manufacturer	Manufacturer	255	62	Nos. of Pole	FreeDecimal7	16
20	Origin	FreeString64	50	63	Rating	FreeString15	30
21	Manual / Catalog	Regulations	-	64	Outgoing Circuit	FreeString16	30
22	Product Website	FreeString123	100	65	Accessible Lift	FreeString20	30
23	Supplier	FreeString112	50	66	Lift Car No.	FreeString17	30
24	Supplier Contract	FreeString113	50	67	Lift Car Capacity	FreeString18	30
25	Delivery Time	FreeString105	30	68	Lift Car Loading	FreeString19	30
26	Maintenance Service company	FreeString114	50	69	Material	FreeString32	100
27	Date of Handover	FreeDate1	-	70	FRC / FPR (Hour(s))	FreeDecimal8	16
28	Date of Installation / Manufacture	ConstructionDate	-	71	Fire Retardant	FreeString21	30
29	Date first used	FirstUsedDate	-	72	Class (Fire Retardant)	FreeString22	30
30	Warranty Start Date	FreeDate2	-	73	Colour	FreeString23	30
32	Warranty End Date	FreeDate3	-	74	Colour Code	FreeString24	30

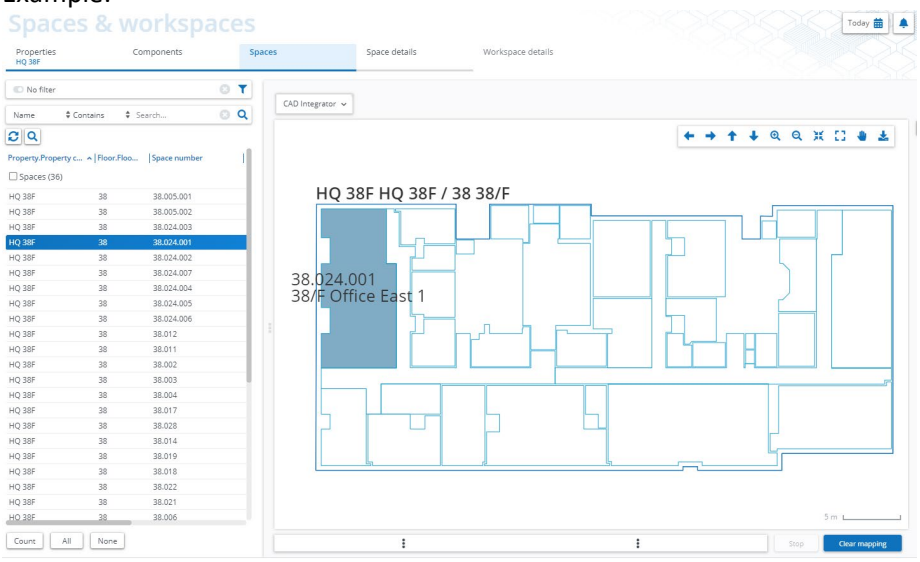
S/n	Description	System Name	Length	S/n	Description	System Name	Length
33	Certificate Renewal	FreeString106	30	75	Internal Finish	FreeString33	100
34	Type of Certificate	FreeString107	30	76	External Finish	FreeString34	100
35	Certificate No.	FreeString108	30	77	Tree ID	FreeString35	100
36	Certificate Renewal Interval	FreeString109	30	78	Tree Assessment Records (Form 1)	FreeString38	100
37	Certificate Validity Period	FreeString110	30	79	Tree Assessment Records (Form 2)	FreeString41	100
38	Is planned maintenance required? (Y/N)	IsPlannedMaintenanceAllowed	1	80	DLO Records	FreeString42	100
39	Maintenance start date	MaintenanceStartdate	-	81	Slope / Retaining Wall No.	FreeString25	30
40	Maintenance end date	MaintenanceEnddate	-	82	Category (1, 2 or 3)	FreeString26	30
41	Maintenance Period	FreeString1	30	83	Frequency of Engineer Inspection	FreeString43	100
42	Term Maintenance Contract Item No.	FreeString2	30	84	Handle by Department	FreeString44	100

11.3. CAD drawings

CAD drawings generated from the BIM model was required for Planon to import into the Space & Workspaces. The CAD drawings include the polylines in the following **CAD layers**:

1. Floor polyline → **50-gross, 51-net**
2. Space polyline → **70-spaces**
3. Space data → **71-spaces_data** (this layer would be put into the Space Block, which contains the Space Name and Space Number attributes)

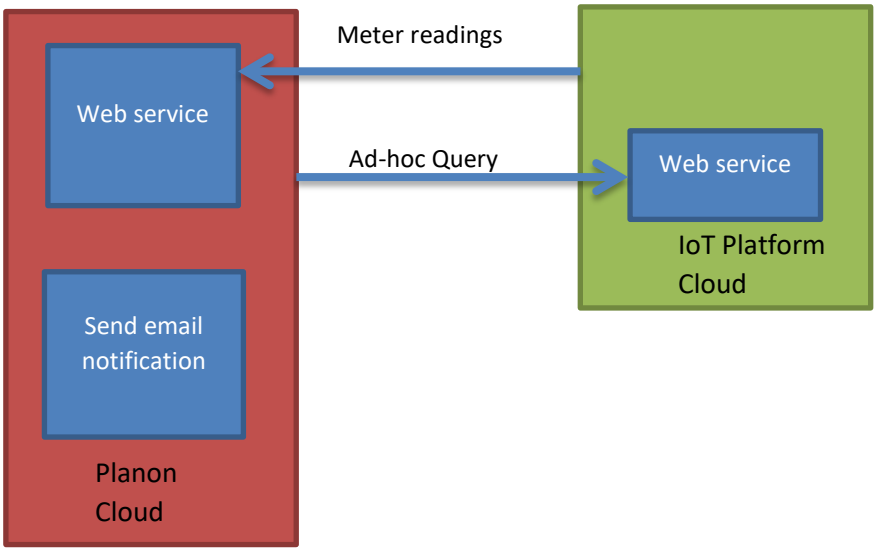
Example:



Guidance Note: CAD/ 2D drawings may not be required, subject to the needs of the operation team.

12. IoT Integration

RESTful (JSON) was the format used for the integration between BIM Model and IoT sensors. The data exchange is bi-directional. The IoT Platform would send sensor readings to Planon, and Planon will then trigger to IoT Platform to send data ad-hocly.



12.1. IoT Platform to Planon

- Change of Value
  When the change of value is detected by the IoT Platform, it will send the updated meter reading to Planon via “Send Meter Readings” service type.

- Keep alive
  When the point failure is detected by the IoT Platform, it will notify Planon and update the Meter status to ‘Active’ status via “Keep Alive” service type.

12.2. Data field definition

- Send Meter Readings
  The IoT Platform calls this service to create readings. This can be for On/Off, Single value and IEQ types.

- Keep Alive
  The IoT Platform calls this service to update meter status.

13. Upkeep of Model Geometry and Information in O&M Stage

Native format of BIM models would be updated in Revit. When data update involves changes in model geometry, for examples, adding objects or attributes, users are suggested to input data by following the operation stage data flow below. In this data flow, Forge model and equipment list with asset information should be exported to EOMS. Since the equipment list with asset information will be the major tool for transferring data, the COBieLite exported will not be imported to EOMS. The following are the detailed steps of producing an updated equipment list from Revit model:

13.1. Request to add new items and data

When a new item is proposed to be added in BIM model, user should start with editing the latest equipment list. User should add a new row for the item on the correct asset category page within the equipment list. All asset information except LinkBIMGUID and CIC.Common.BIMGUID should be filled correctly.

13.2. Modelling and data input

BIM objects should be built up in the BIM model according to the equipment list. The new BIM object should be assigned with an object name and a unique asset ID (CIC.Common.AssetCode), which in lines with project BIM standards.

At the same time, the following data should be input manually into the BIM model:

Model Data

Parameter	Description	Data Format in Revit Model
CIC_Element ID	Refer to “Element ID” in Equipment List; The value of this parameter makes reference to the unique ID generated from Revit model (Element ID). This value is only unique in its own file and is extracted for easy checking internally. This project will use CIC.Common.AssetCode, which is unique across all files, for mapping data in Planon system.	Text
CIC_LOD	Refer to “LOD” in Equipment List; This parameter indicates the LOD requirement of each BIM object.	Text
CIC_Site_Verify	Refer to “Site Verify” in Equipment List; This parameter indicates whether the BIM object was site-verified.	Yes/No
CIC_Data_Verify	Refer to “Data Verify” in Equipment List; This parameter indicates whether catalogues or detailed drawings of BIM objects was provided and the BIM object was built according to these information.	Yes/No

Asset Information

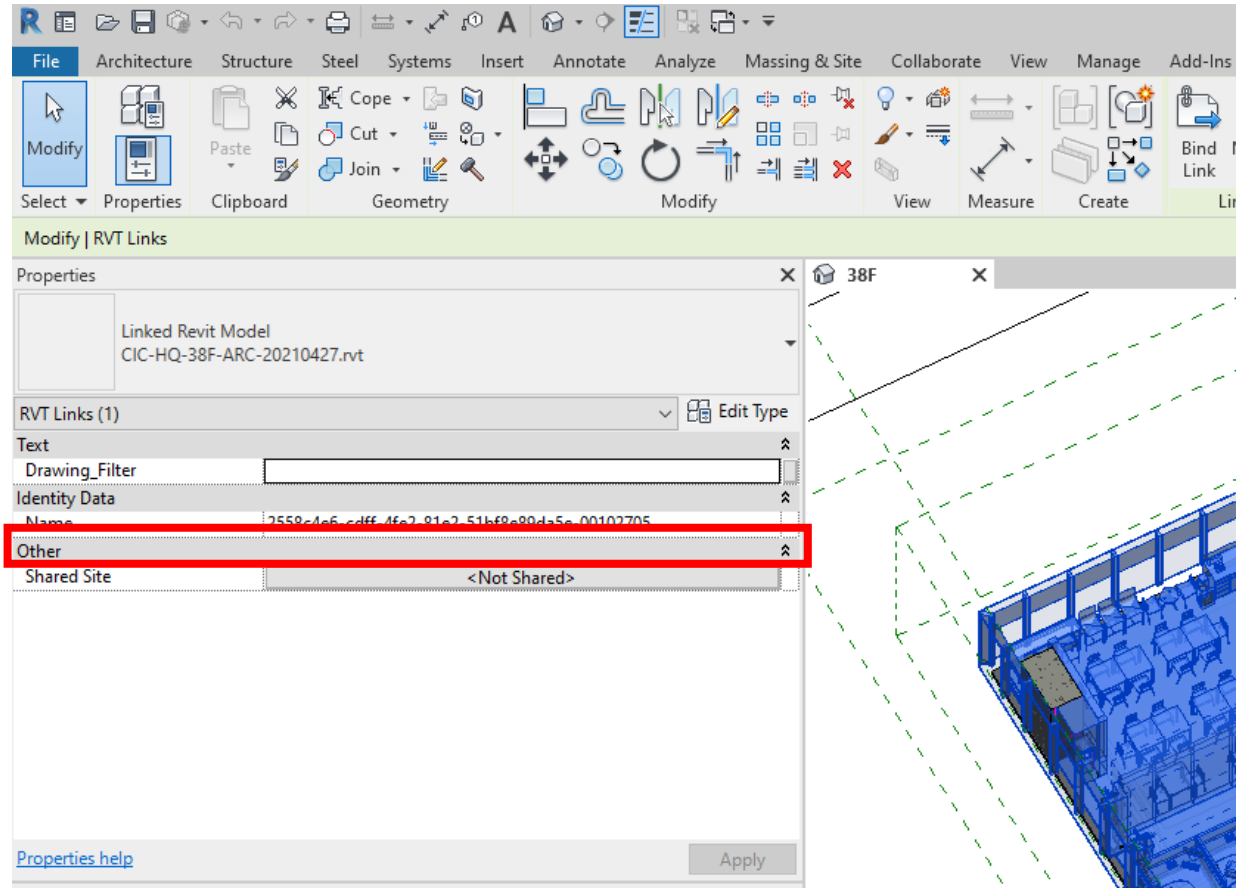
Parameter	Description	Data Format in Revit Model
All asset information provided by user in equipment list (Except LinkBIMGUID and CIC.Common.BIMGUID)	Refer to Planon's fields/asset information in Equipment List; These data are provided by user and should be input into the model.	Text

In the master BIM model file (MEP BIM model), the name of the Linked Revit Model should be input with its File GUID. By this, the LinkBIMGUID of each linked element can be formulated in Revit schedules and be used for data mapping in the EOMS.

Linked Revit Model Properties

Parameter	Description	Data Format in Revit Model
Name	The value of this parameter should be input the Linked Revit Model GUID, which is generated internally in the Revit master file.	Text

Example:



13.3. Export Excel worksheets

After modelling and data input, pre-defined Revit schedules can be exported as Excel worksheets using Revit plugin “Export-Import Excel”.

In each Revit file, there are 10 schedule templates ready for export:

Schedule Name in Revit	Asset Category
CICHQ_FM_AC	AC
CICHQ_FM_FS	FS
CICHQ_FM_PD	PD
CICHQ_FM_EL	EL
CICHQ_FM_LIFT	LIFT
CICHQ_FM_ELV	ELV
CICHQ_FM_BLDG	BLDG
CICHQ_FM_LAND	LAND
CICHQ_FM_FE	FE
CICHQ_FM_OTH	OTH

Apart from the manual data input during modelling, the data below will be generated from Revit automatically and included in the schedules:

Model Data

Parameter	Description	Data Format in Revit Model
Family	Refer to “Family Name” in Equipment List; This parameter indicates the Family Name of the BIM object.	Text
Type	Refer to “Type Name” in Equipment List; This parameter indicates the Type Name of the BIM object.	Text
Category	Refer to “Model Category” in Equipment List; This parameter indicates the Revit Category used for building the BIM object.	Text
OmniClass Number	Refer to “Omni Number” in Equipment List; This parameter indicates the Omni Class number classified for the BIM object.	Text
OmniClass Title	Refer to “Omni Title” in Equipment List; This parameter indicates the Omni Class title classified for the BIM object.	Text

Asset Information

Parameter	Description	Data Format in Revit Model
CIC.Common.BIMGUID	Refer to "CIC.Common.BIMGUID" in Equipment List; The value of this parameter is generated internally in Revit models.	Text
LinkBIMGUID	Refer to "LinkBIMGUID" in Equipment List; This parameter is a combined parameter consisting of Linked File Name (same as Linked File GUID) and CIC.Common.BIMGUID. The data is generated automatically in the schedules. EOMS requires this parameter for mapping the data to the BIM model geometry.	Text

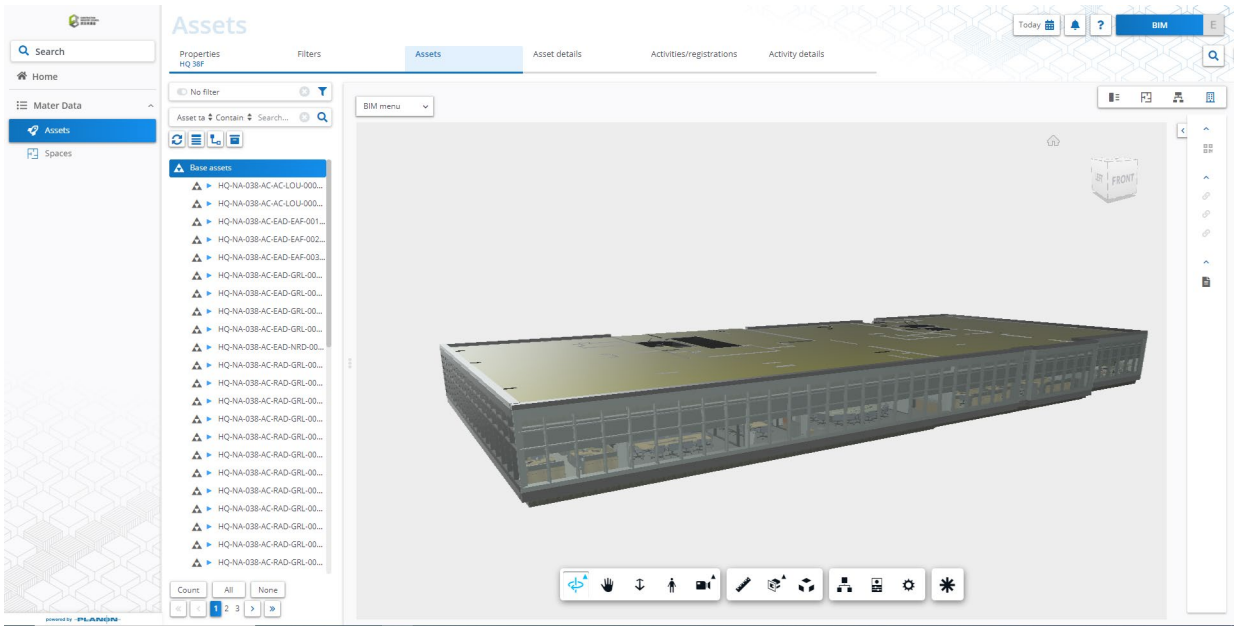
13.4. Update the equipment list and SDI template

The content of the equipment list can be replaced entirely by the Excel worksheets exported. The updated equipment list will contain the latest asset information and data from BIM model, and ready for transfer to SDI template. Since there is format requirement from SDI template for importing the asset information and data into EOMS, the format should be verified before it is transferred to SDI template.

Guidance Note: Appointing Parties may consider to arrange the maintenance and upkeep of the AIM and asset information by their operation team if the staffs were capable and available to do so, under a well-established workflow and mechanism. Alternatively, Appointing Parties may consider to outsource the works to an external vendor or professional, in project-basis or term-contract, etc., or embed the works into the consultancy agreement or construction contract when a project or property is to be renewed, renovated, undergo alterations and additions works, depending on scope, scale and size of the projects, complexity, timeframe, etc.

14. Estates Office Management System (EOMS)

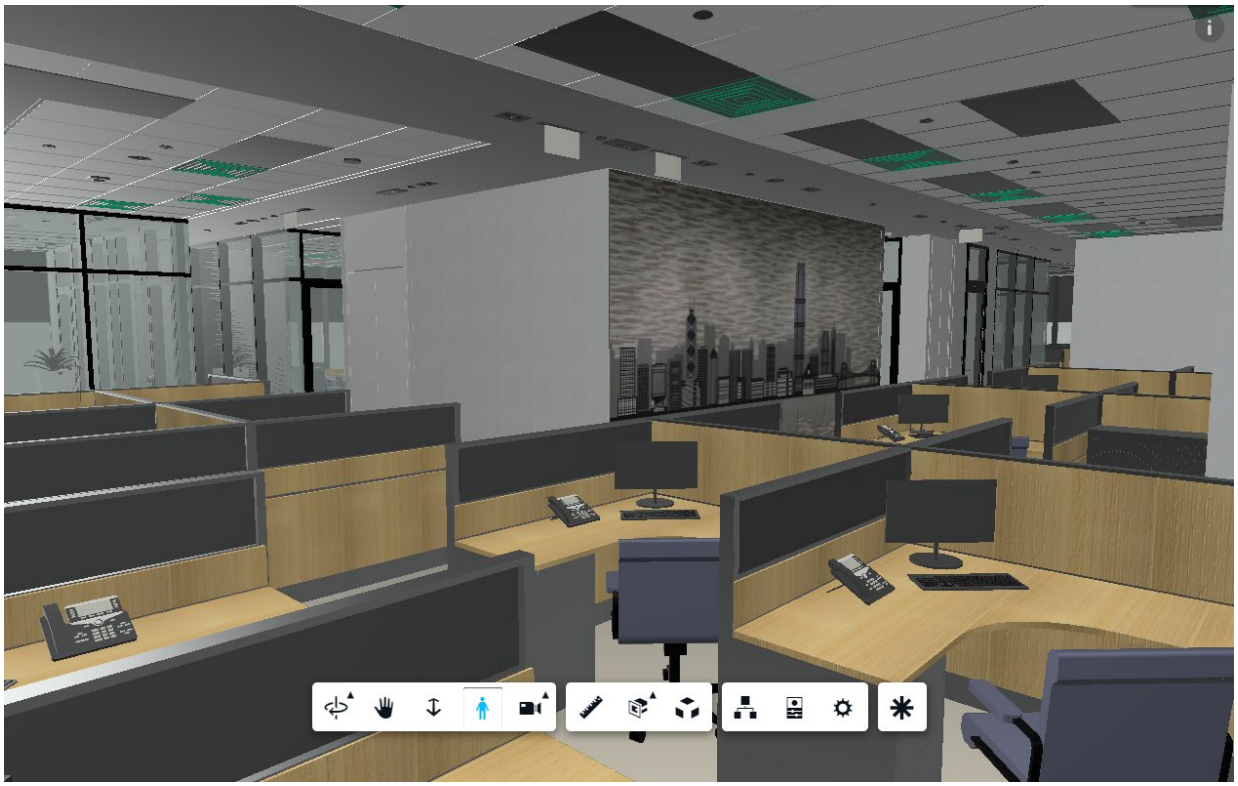
An Estates Office Management System is setup to facilitate daily works, this allows estates office colleagues to monitor and check the performance of IoT sensors, asset information and spacing analysis. The images below are captured from the EOMS interface:



Overview of the EOMS interface with the AIM of the CIC HQ

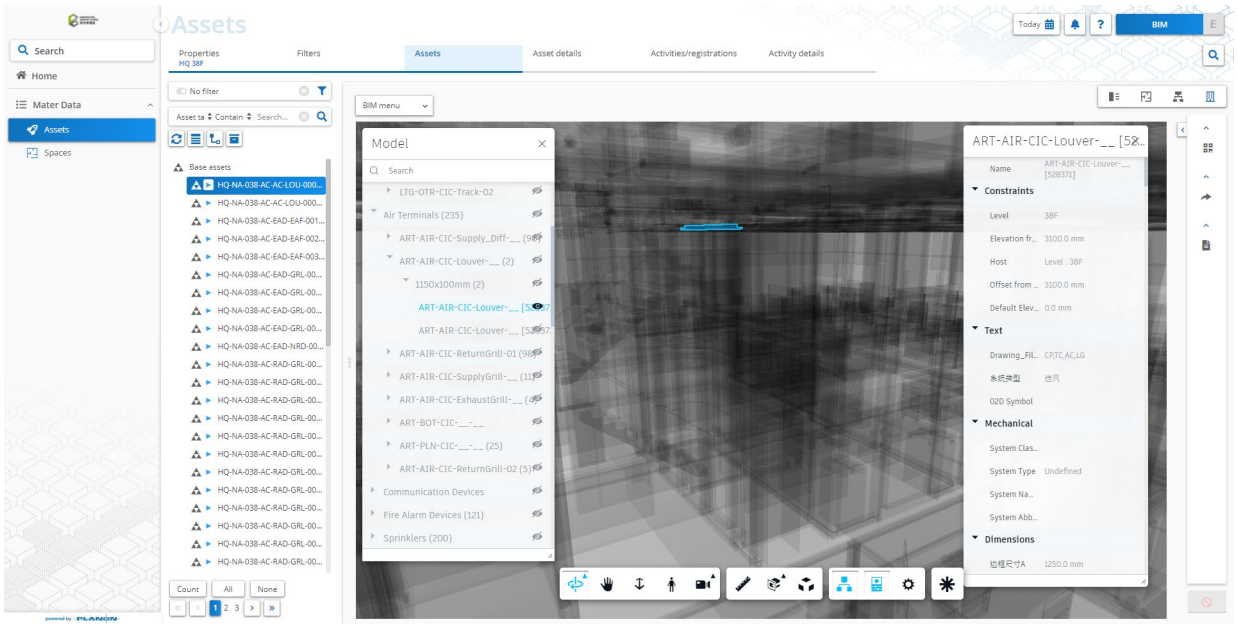
General view of the Reception Entrance at 38/F

General view of the Boardroom at 38/F

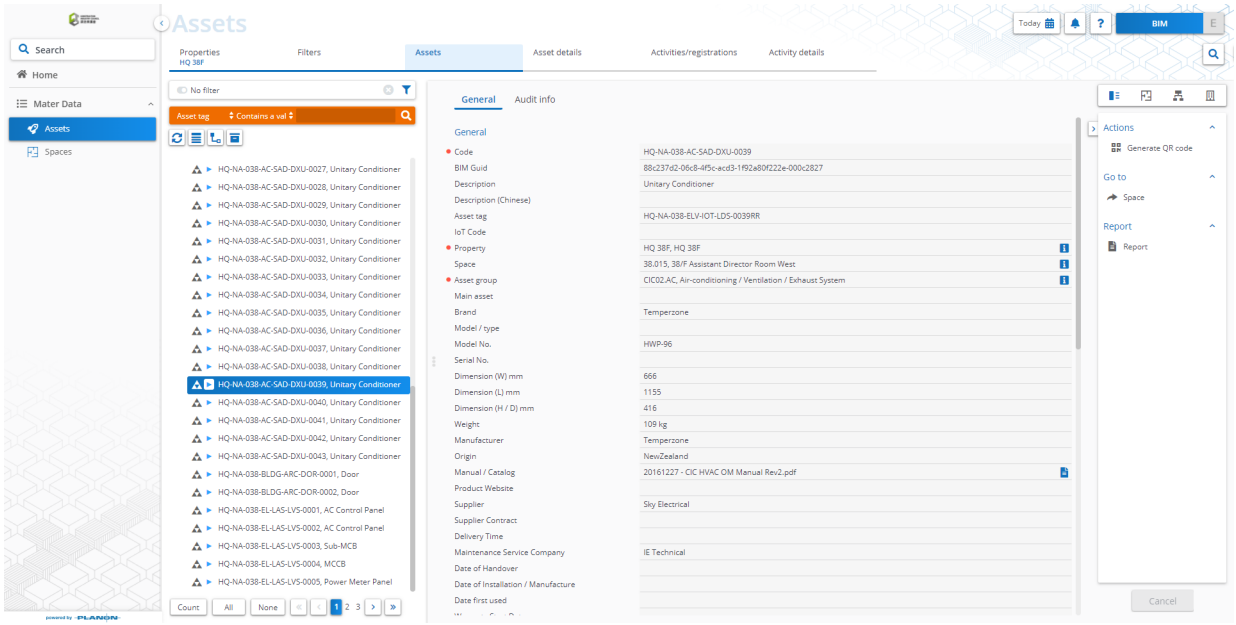


General view of the office at 38/F

General view of the pantry at 38/F



Display view of asset (BIM object) properties / attributes



Display view of asset information / properties

15. Challenges / Difficulties / Resolutions / Lessons Learnt

Perspective	Challenges / Difficulties	Resolutions / Lessons Learnt
Appointing Party (CIC) BIM	• Within such a tight schedule, this project required working closely with appointed parties on completion of work. • Technical issues were raised instantly and solved with effective working time in order to avoid delay of schedule. • Field verification has enormous impact on the quality of ABIM submission.	• Weekly meeting is organised to keep schedule on track. • Good communication and respond time were vital to drive the project forward. • Field verification is essential and became one of the core measurements at submission stage. Regular field verification is necessary to achieve and maintain a high quality of ABIM. A protocol for agreeing what assets / objects could be excluded from field verification by on-site measurement, as it may be likely to happen after the commencement of any project, e.g. assets / objects above false ceiling, which could not / will not be removed or opened. This issue may affect the verification of LOD-G and LOD-I in the acceptance of submission of ABIM.
Appointing Party (CIC) EO	• The project was required to build up and integrate the new BIM model and IoT installations with EOMS in a tight working schedule and during the outbreak of COVID-19. • As-built fit-out drawings were not accurate enough to erect the BIM model. Discrepancies on the dimensions between the as-built drawings and on-site measurement were usually occurred. • Conversion of BIM model and relevant asset data from Revit format to Forge format and input into the EOMS were faced unknown system faults leading to the fragmentary display of model.	• All parties kept up the weekly project meeting and conducted extra meetings via video conference. • Depending on the significance of the objects, project team decided to redraw them or accept the tolerance within the certain ranges. • Project team had consulted the expertise of Autodesk and resolve the problems through Trial and Error approach.
Appointed Party (ATAL) BIM	• Difficult and time-consuming to collect all existing information and verify as-built condition in an active building. • Development of a customized workflow is required for handling data to facilitate client FM purpose.	• Using multi-methods to capture site conditions and record information in a systematic way. This will largely enhance efficiency on modelling information development. • Data requirement of different parties can be met by developing customized tools and dynamo program when managing data entry process and effectively utilizing various plugins to eliminate human error.
Appointed Party (ATAL) IoT	• Difficult to arrange products delivery, site installation or testing, etc., in a tight project period. • Difficult to adjust certain aspects to meet different parties' requirements.	• Break down the project into smaller tasks and assign sufficient manpower. • Keep update progress periodically to enhance efficiency and avoid scope creep.

Perspective	Challenges / Difficulties	Resolutions / Lessons Learnt
EOMS vendor (Planon)	• Consolidating considerable amount of asset and sensor data within a limited timeframe. • Aligning data format of different assets and sensor types in an organized and easy-to-manage format	• A good preparation on technical readiness can help to shorten the time for trial and error • Effective communications among all parties is essential and useful for getting a resolution for discrepancies

16. References

1. CIC BIM Standards - General (Version 2.1 - 2021), by the CIC
2. CIC Production of BIM Object Guide – General Requirements (Version 2 – 2021), by the CIC
3. CIC BIM Standards for Architecture and structural engineering (Version 2 – 2021), by the CIC
4. CIC BIM Standards for Mechanical, Electrical and Plumbing (Version 2 – 2021), by the CIC
5. ATAL BIM Execution Plan (specific to this project)
6. Planon Integration Specification (specific to this project)
7. CIC BIM Adoption Survey 2019
8. CIC BIM Adoption Survey 2020
9. ISO 55001:2014 Asset management — Management systems — Requirements
10. ISO 41001:2018 Facility management — Management systems — Requirements with guidance for use
11. ISO 41011:2017 Facility management — Vocabulary
12. Report on 3D Spatial and BIM Data Use Case Requirements of the Hong Kong Construction Industry (2021), by the CIC
13. Construction Digitalisation Roadmap for Hong Kong (2021), by the CIC

17. Acknowledgement

Appointing Party

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Mr. Joseph Chu	
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1. Development Bureau
2. ArchSD (Architectural Services Department)
3. CEDD (Civil Engineering and Development Department)
4. DSD (Drainage Services Department)
5. EMSD (Electrical and Mechanical Services Department)
6. WSD (Water Supplies Department)
7. HyD (Highways Department)
8. International Facility Management Association

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(Please put a "✓" in the appropriate box.)

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Comprehensive	❑	❑	❑	❑	❑
Useful	❑	❑	❑	❑	❑
Practical	❑	❑	❑	❑	❑
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	❑		❑		❑
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	❑		❑		❑
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	❑		❑		❑
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