

# Building Information Modelling for Asset Management (BIM-AM)

## Acceptance and Upkeeping Guidelines for EMSD



Version 1.0  
**2022 Edition**

## Document Revision Tracking

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Annex 3	– Common Data Environment (CDE) User Guide

**List of Abbreviation:**

<b>Abbreviation</b>	<b>Definition</b>
A&A	Addition and Alternation
ADT	Asset Data Templates in Appendix B of BIM-AM SG
AI	artificial intelligence
AIM	Asset Information Model
AIMP	Asset Information Management Platform which serves as front end of departmental common data environment for files and BIM models management
AM	Asset Management
AMS	Asset Management System
AMTF	Asset Management Task Force of EMSD which set up the E&M asset data requirement for operation
API	Application Programme Interface
APT	ArchSD Project Team
ArchSD	Architectural Services Department
AQL	Acceptable Quality Level
BIM	Building Information Modelling
BIM-AM	Building Information Modelling-Asset Management
BIM-AM SG	Latest version of BIM-AM Standards and Guidelines
BIMSD	EMSD's Central BIM Team
BMS	Building Management System
CCeP-JM	Customer Centric e-Platform for Job Management
CCS	Corporate Computer System
CDE	Common Data Environment
CIC	Construction Industry Council
COBie	Construction Operations Building Information Exchange
COBieLite	Lightweight Extensible Markup Language (XML) format of COBie data
DOSS	Departmental Operation Support System
E&M	Electrical and Mechanical
EMABS	Electrical, Mechanical, Air-conditioning, Building Services
EMSD	Electrical and Mechanical Services Department
EPR	Enterprise Resources Planning
FM	Facility Management
GWIN	Government-Wide Internet-of-Things Network

<b>Abbreviation</b>	<b>Definition</b>
H/O Guide	Guidelines for the Handover of E&M Installation to EMSD
HKSAR	Hong Kong Special Administrative Region of the People's Republic of China
iBMS	Integrated Building Management System
IFC	Industry Foundation Classes
IoT	Internet of Things
MIDP	Master Information Deliverable Plan
MII	Master Information Index
O&M	Operation and Maintenance
PIM	Project Information Model
PM	Project Manager
QA/QC	Quality Assurance/ Quality Control
QR Code	Quick Response Code
RDCC	Departmental Regional Digital Control Centre
RFID	Radio Frequency Identification
RTLS	Real Time Location System
SBU	Strategic Business Units
T&C	Testing and Commissioning
VDI	Virtual Desktop Infrastructure

**List of Interpretations: -**

For common BIM terminologies, refer to CIC BIM Dictionary.

<b>Abbreviation</b>	<b>Term</b>	<b>Definition / Description</b>
ADT	Asset Data Templates	All templates have been included in Appendix B of BIM-AM SG. Common attributes as shown in ADT should be added as Project Parameters. Specific attributes as shown in ADT should be added as Object's Parameters.
AIMP	Asset Information Management Platform	It is the Contractor's submission portal for BIM-AM deliverables. The deliverables would be automatically uploaded to Project CDE for EMSD staff's approval.
	Asset relationship	This is the relationship diagram as illustrated in Figure 6-1 in BIM-AM SG.
	Attribute	It is a piece of data describing a BIM object.

<b>Abbreviation</b>	<b>Term</b>	<b>Definition / Description</b>
	Consultant	It includes the meaning of any appointed parties to deliver the services included in BIM-AM SG for which they have been assigned.
	Contractor	It includes the meaning of any contracted/ appointed parties to deliver the works included in BIM-AM SG for which they have been contracted.
	BIM Object	A building component in BIM software that can be inserted, moved and rotated into required location and orientation within models (e.g. MCB board, air diffuser, etc.).
	Level 1 System/ Equipment	The E&M systems as defined in the Appendix G of BIM-AM SG and AMTF asset templates in CCS.
	Level 2 Equipment	The E&M equipment for asset management as specified in the Appendix G of BIM-AM SG and AMTF asset templates in CCS.
SBU	Strategic Business Unit	Different strategic business units in EMSD under the Electrical and Mechanical Services Trading Fund (EMSTF)
	CDE for Project/ Project CDE	The CDE location for EMSD internal use. BIM-AM deliverables submitted by the Contractor through AIMP could then be reviewed and approved by EMSD.
	CDE for Venue Operation/ Venue CDE	The CDE location for EMSD internal use. It synchronises with EMSD internal systems for asset management, including but not limited to BIM-AM Systems and AIMP etc.

## 1. Introduction

### 1.1. Background

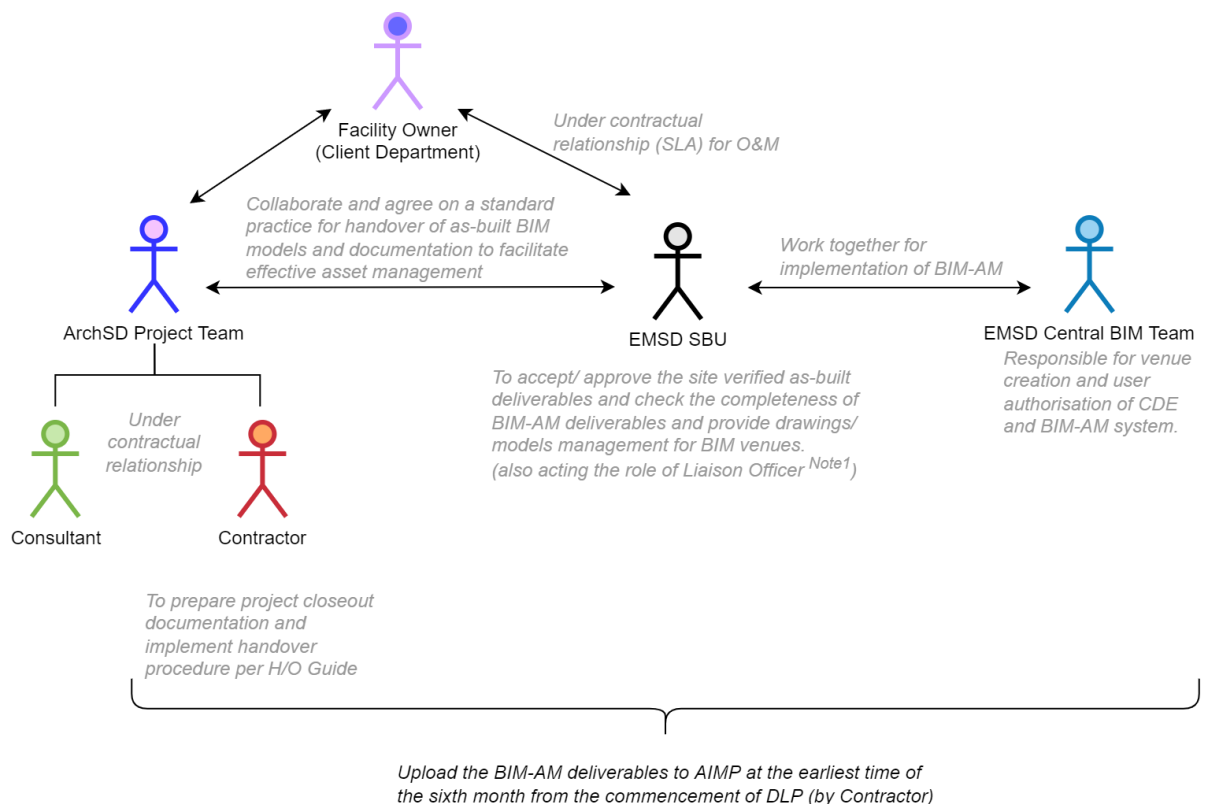
This document is only applicable to venues with BIM models.

EMSD conducted a feasibility and technical study for the enhancement of Building Information Modelling – Asset Management (BIM-AM) related strategy and adoption. During the study, a holistic lifecycle workflow from design, construction to operation stage is proposed to EMSD Strategic Business Units (SBU) (thereafter referred to as SBU) to gain a better understanding of the roles and responsibilities of each party at different stages in BIM-AM related projects. An enlarged version of the holistic lifecycle workflow could be found in Annex 1 of this document. The holistic workflow outlines three main stages and highlights the sections to be referred within EMSD BIM-AM Standards and Guidelines (thereafter referred to as BIM-AM SG) suitable for each stage. These Standards and Guidelines is listed in Section 1 for easy reference.

### 1.2. Roles and Responsibilities

The figures below describe the overall relationship of key parties under new-build projects and during operation. The detail explanation of their roles and responsibilities are listed in Table 1-1.

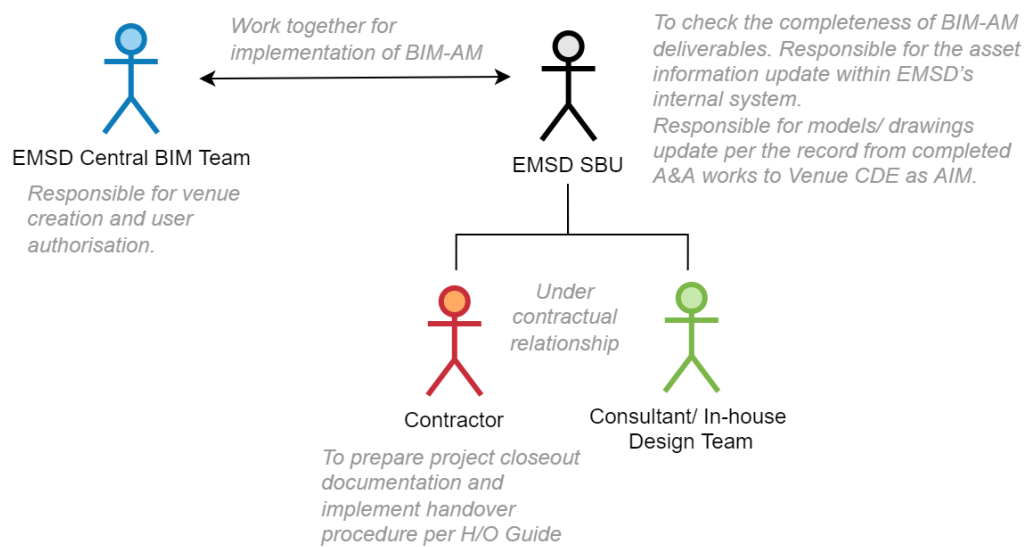
Figure 1-1 Roles and Relationship of Different Parties under New-build Projects (e.g. ArchSD as the Project Team)



Note 1: Liaison Officer is the professional staff as stated in EMSD Technical Circular for handover of ArchSD's capital works projects



Figure 1-2 Roles and Relationship of Different Parties During Operation/ A&A works (e.g. EMSD as Project Team)



The description and elaboration of detail roles and responsibilities are shown in the table below:

Table 1-1 Responsible Personnel and Their Duties

Responsible Personnel	Duties
Project Team (PT)	<ul style="list-style-type: none"> <li>To make sure BIM-AM SG and Particular Specification for BIM-AM Implementation have been included in the contractual documents;</li> <li>To perform quality assurance/ quality control (QA/QC) check of Contractor's deliverable in project level to comply with BIM-AM SG;</li> <li>To oversee the overall progress of Contractor's as-built submission;</li> <li>To approve and reject the as-built models, asset data, documents and BIM-AM deliverables submitted by Contractor.</li> </ul>
Main Contractor/ Trade Contractor (Contractor)	<ul style="list-style-type: none"> <li>To prepare BIM models and BIM objects in compliance with BIM-AM SG;</li> <li>To prepare Master Information Index (MII) and list out all drawings and models. A sample of MII could be found in Annex 2 of A/U Guide;</li> <li>To conduct all self QA/QC check for BIM-AM deliverables;</li> </ul>

Responsible Personnel	Duties
	<ul style="list-style-type: none"> <li>• To ensure the quality and accuracy of the handover deliverables before submitting to PT by conducting self-quality checks in compliance to the requirements outlined in BIM-AM SG;</li> <li>• To complete the asset information by completing the following templates: <ul style="list-style-type: none"> <li>a) Excel templates<sup>1</sup> for asset relationship and</li> <li>b) Corporate Computer System (CCS) asset templates for E&amp;M assets which are not included in the BIM models;</li> </ul> </li> <li>• To digitalise the as-built documents (including O&amp;M manuals) and upload to Asset Information Management Platform (AIMP).</li> <li>• To upload BIM models and as-built data from Contractor's Common Data Environment (CDE) to AIMP.</li> </ul> <p>For new-build:</p> <ul style="list-style-type: none"> <li>• To prepare project BIM Execution Plan including MII to incorporate EMSD's BIM-AM requirements;</li> <li>• To complete the federated AIM models<sup>2</sup>;</li> <li>• To remove all revisions in drawings and/or models in as-built deliverable.</li> </ul>
Design Consultant/ In-house Design Team (Consultant)	<ul style="list-style-type: none"> <li>• To prepare the E&amp;M system design;</li> <li>• To vet Contractor's submission and witness the T&amp;C for E&amp;M equipment;</li> <li>• To verify and make sure the accuracy of the as-built drawings and/or models complied with all design requirement.</li> </ul>
EMSD's Central BIM Team (BIMSD)	<ul style="list-style-type: none"> <li>• To provide contractual documents/ particular specification on BIM-AM related works to PT (for new-build project) or EMSD SBU (for A&amp;A project);</li> <li>• To define and update as-built information templates, deliverables and definition files for BIM-AM operation;</li> <li>• To maintain BIM-AM related systems, including user account management, user authorisation, creation of venues, system licenses and version management of BIM authorising tools;</li> </ul>

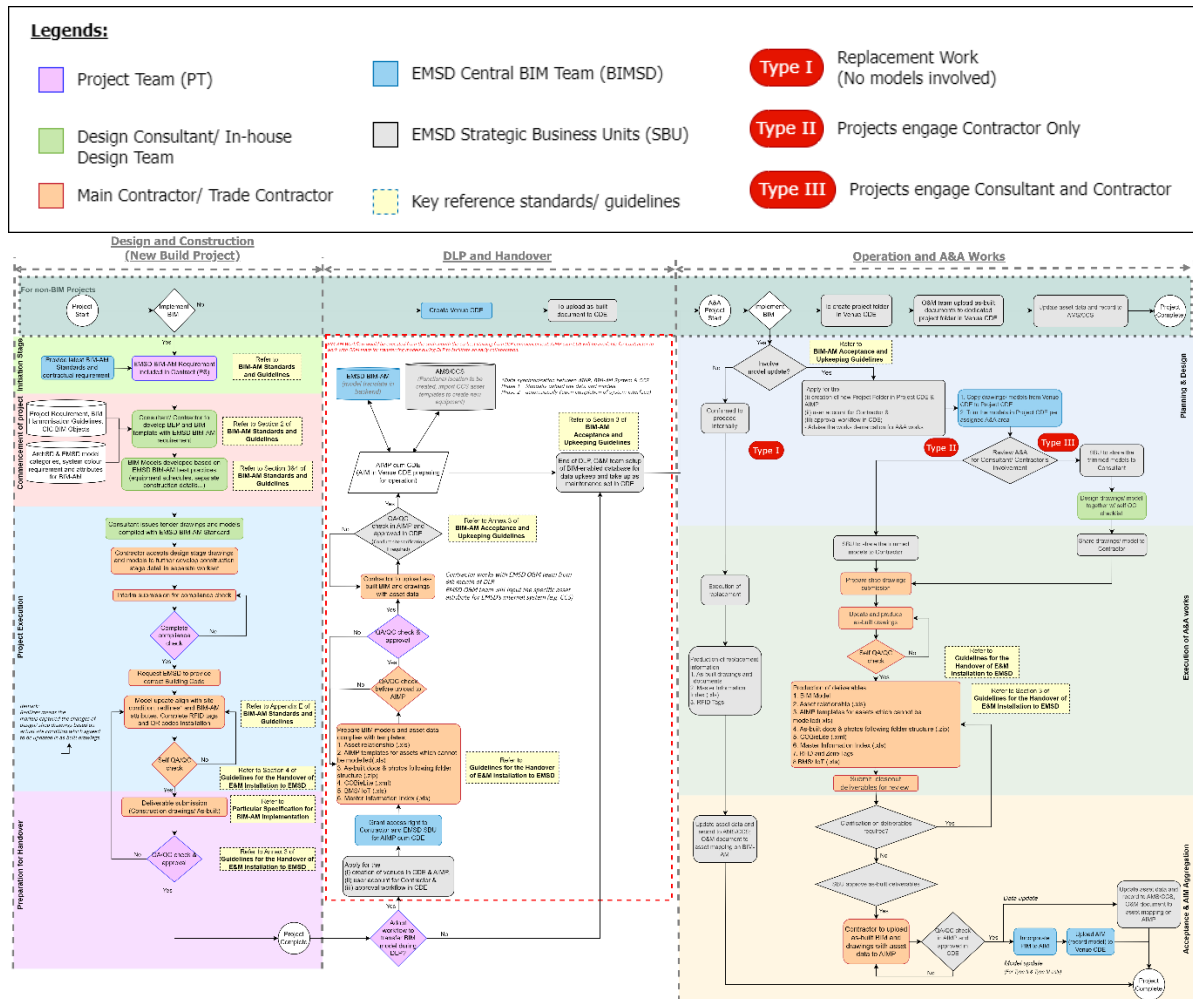
<sup>2</sup> Refer to Section 2 of BIM-AM SG

Responsible Personnel	Duties
	<ul style="list-style-type: none"> <li>• To enhance the BIM-AM related systems as per operational needs;</li> <li>• To provide helpdesk technical support for implementation and operation of BIM-AM;</li> <li>• To check, audit and control information being shared across a project relevant to Contractor's specific task;</li> <li>• To monitor and manage the workflow of in &amp; out of Asset Information Models (AIM) ;</li> <li>• To grant access to project participants on BIM-AM system to ease for asset data and models upload;</li> <li>• To update/stitch the drawings and/or models from the record of completed A&amp;A works to Venue CDE as AIM;</li> <li>• To maintain CDE for AIM models, asset data, documents and Internet of Things (IoT) data.</li> </ul>
EMSD Strategic Business Unit (SBU)	<ul style="list-style-type: none"> <li>• To facilitate the implementation of divisional BIM for asset management initiative;</li> <li>• To manage the handover of the AIM models;</li> <li>• To input CCS/AMS related data for setting up and maintaining BIM-AM database;</li> <li>• To review the completeness of as-built deliverables prior to uploading to BIM-AM platform(s);</li> <li>• To approve / reject the BIM-AM deliverables (e.g. models and COBieLite);</li> <li>• To coordinate and liaise with BIMSD for the login accounts of BIM-AM related systems.</li> <li>• To manage and upkeep the models and drawings library (including 2D plans, schematics, control diagrams) up to date in BIM venues;</li> <li>• To update the asset information within EMSD's internal system such as AMS/ CCS, AIMP and etc;</li> <li>• To work with BIMSD on getting access to BIM-AM systems for uploading drawings and/or models to EMSD's departmental CDE;</li> <li>• To manage the document library (including the update of MII after completion of A&amp;A projects) and records of O&amp;M documents.</li> </ul>

### 1.3. Holistic Workflow for BIM-AM in Acceptance and Operation

This holistic workflow outlines all key events and aligns with detailed steps in this document “Acceptance and Upkeeping Guidelines” (thereafter referred to as A/U Guide). Enlarge version of could be found in Annex 1.

Figure 1-3 Holistic Workflow for EMSD



#### 1.3.1. Design and Construction Stage

During design and construction stages for new-build project, EMSD BIM Central Team (BIMSD) shall share the latest BIM-AM requirement and Appendix Z of BIM-AM SG (Particular Specification of BIM-AM Implementation) with Project Team (PT) to incorporate into the contract as employer’s requirement for Consultant and Contractor.

#### 1.3.2. Late Construction Stage

Contractor shall approach EMSD SBU through PT during late construction stage in preparation for 2 of the handover deliverables namely:

- Site installation of RFID Tag and QR Code
- Asset relationship

For the site installation of RFID tag and QR code, the purpose of engaging Contractor early is to minimise the work required for installation of the tags in areas where accessibility could be limited after completion of construction. For example, tagging of equipment above ceiling may require parts of the installed ceiling to be temporarily removed.

For the asset relationship, earlier involvement is recommended to align which portion of the overall system schematic is part of handover to EMSD. In addition, this deliverable is unique to EMSD. Early involvement will allow Contractor to better understand how to prepare the deliverable.

#### 1.3.3. Defect Liability Period (DLP) and Handover Stage

If it is agreed by PT to adopt workflow to transfer BIM models during DLP, the BIM-AM workflow shown in the middle section of Figure 1-3 should be implemented at the earliest time of the sixth month after DLP commencement. A collaborative working environment (EMSD's AIMP cum CDE) would be available for the early involvement of EMSD SBU with Contractor in order to ensure smooth transition of Project Information Models (PIM) to Asset Information Models (AIM). Refer to Sections 3 of A/U Guide for detailed explanations of this workflow.

#### 1.3.4. Operation and Addition and Alternation (A&A) Works Stage

Three main types of A&A projects are explained in detail in Section 4. Involved parties and their roles and responsibilities are also listed in Section 1.2.

### 1.4. Reference BIM-AM SG

EMSD internal teams should refer to the following documents when reading A/U Guide.

- BIM-AM SG including appendices as follows:
  - Appendix A – Building Code (List of buildings in Hong Kong and their corresponding building code). Please noted that this Appendix is in Excel format and only illustrates the building code for the existing government facilities being maintained by EMSD. For those newly constructed venues, please liaise with EMSD BIMSD for acquiring the new building code;
  - Appendix B – Asset Information Requirement;
  - Appendix C – Asset Information Management Platform (AIMP) User Guide;
  - Appendix D – Shared Parameters File for EMSD BIM-AM;
  - Appendix E – Best Practices for BIM Modelling;
  - Appendix F – Codification for EMSD BIM Model Naming Convention;
  - Appendix G – List of Equipment and Equipment Code and Provisional Requirement of RFID tags and QR codes;

- Appendix H – Templates of point definition and point mapping (for equipment status visualisation in model);
  - Appendix I – Handover Package and Folder Structure;
  - Appendix Z – Particular Specification for BIM-AM Implementation (For EMSD internal only).
- Guidelines for the Handover of E&M Installation to EMSD – latest version, published by EMSD (thereafter referred to as H/O Guide).
  - EMSD Technical Circular No. 2/2022 Procedures in Handing/Taking Over of New Works from the Architectural Services Department (or the latest version)

## **1.5. Purpose of this Document**

This A/U Guide aims to ensure BIM-AM compliance of different project types which might happen during building operation by providing the following guidelines, whose relationship is illustrated in Figure 1-3.

### **1.5.1. Objective of Acceptance Procedures**

Acceptance procedures outlined in Section 3 are for SBU to review and accept the deliverables from new-build project so as to setup BIM-enabled database to facilitate the following BIM-AM execution during building operation.

### **1.5.2. Objective of Upkeeping Procedures**

Upkeeping procedures outlined in Section 4 are for BIMSD and SBU to upkeep and undergo A&A project as long as maintain the coherence of BIM-AM operation. The applicable types of A&A projects including:

- Type I: Replacement Works (without update on models);
- Type II: Projects Engaging Contractors Only; and
- Type III: Projects Engaging Contractors and Consultant.

## **1.6. Structure of Acceptance and Upkeeping Guidelines**

### **1.6.1. A/U Guide contains the following sections:**

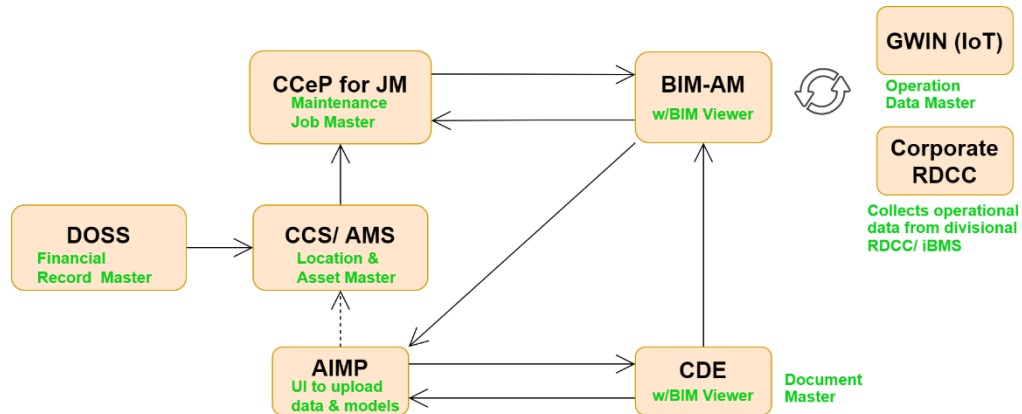
- Introduction: This section provides an overview of the purpose and structure of A/U Guide. It also mentioned the roles of responsibilities of involved parties.
- Operation Workflow between Different Systems: This section contains diagrams and brief description of major internal systems being used by EMSD for BIM-AM purpose.
- Acceptance Procedures: This section provides guidelines for SBU to accept the deliverable from Project Team and Contractor for new-build project and guidelines for setting up BIM-enabled database for BIM-AM purpose during building operation.
- Upkeeping Procedures: This section provides elaboration and guidelines on how to deal with different type of A&A projects and the upkeeping workflow.

- Other General Requirements: This section outlines the general requirements including hardware, software, drawing revisions, etc.

## 2. Operation Workflow between Different Systems

This section describes the current EMSD departmental systems being implemented. The system interface is shown in Figure 2-1.

Figure 2-1 Interfaces between Different Departmental Systems



### 2.1. BIM-AM System

The system is a novel architecture for managing building facilities information by exploiting the information interoperability and reusability among Building Information Modelling, System Topology, RFID and real-time data acquisition system interfaces including Building Management System (BMS), IoT sensors and CCTV. Cross platform mobile and desktop systems have been developed based on the proposed architecture. It provides a standard for as-built BIM from design and construction stage to become an AIM and handover to O&M stage for asset management.

### 2.2. Asset Information Management Platform (AIMP)

The system is developed by EMSD with a web-based interface and mobile apps to manage asset information (e.g. upload O&M manuals) and asset relationship (e.g. systems topologies), which are not able to be stored in the raw BIM models (e.g. .rvt). Currently, AIMP can manage over 20 systems and more than 200 E&M equipment types, and conduct data exchange with external systems through spreadsheet, XML (in form of COBieLite), Application Programme Interface (API) and message queue. It also serves as a platform to validate asset data and the submission portal for BIM-AM deliverables submitted by the Contractors.

Referred to Appendix C of BIM-AM SG for AIMP User Guide.

### 2.3. Common Data Environment (CDE)

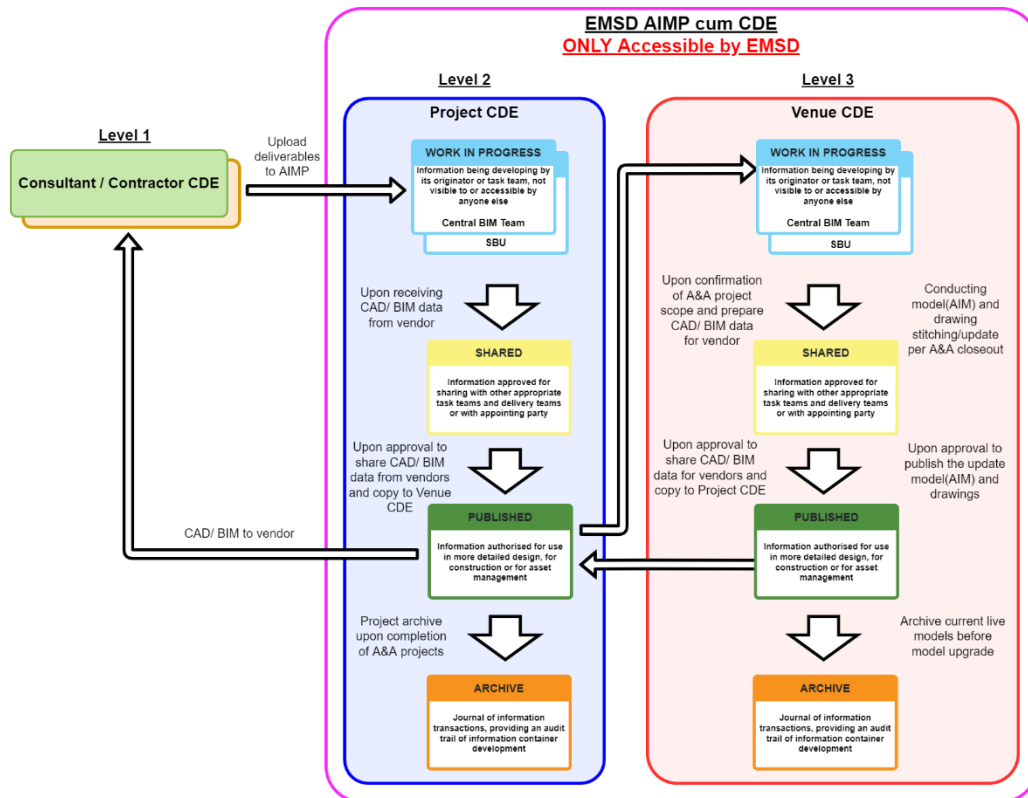
The CDE platform is a strategy to ensure the single source of truth for the project information at the organisational level for EMSD. EMSD aimed to establish an on-premises CDE for managing and sharing building information including asset data, equipment catalogues, drawings, BIM models, schematics, O&M manuals, and other documentation. With respect of the latest CIC BIM Standards recommending the use of CDE to ensure single source of truth BIM information with workflow management for multi-disciplinary collaboration, EMSD targeted to build a on-premises CDE in compliance with ISO19650 for asset information management



application to manage built asset information, facilitate quality assurance and future BIM auditing.

An overview of CDE information management process for A&A project is shown in Figure 2-2.

Figure 2-2 Three Levels CDE Information Management Process for A&A Project



The CDE User Guide could be found in Annex 3 of A/U Guide. Illustration of CDE workflow in project level can be found in Section 4.5.

## 2.4. Corporate Computer System (CCS)

CCS is an Enterprise Resources Planning (ERP) system which is SAP platform with customisation for EMSD. Several modules (FI/HR/MM/SD) of SAP R/3 and SAP BW package (with customisation packages) were implemented to cater for EMSD daily operations. Scope of functions provided by CCS includes (i) financial management, (ii) asset management, (iii) in-house maintenance management, (iv) works contract management, (v) project management, (vi) services call centre management, (vii) material and stores management, (viii) purchasing management, (ix) human resources management, (x) business intelligence, (xi) service contract management, etc. It is the critical system of EMSD which shares corporate information with other departmental systems of EMSD.

## 2.5. Customer Centric e-Platform for Job Management (CCeP-JM)

The system is a bespoke Computerised Maintenance Management System (CMMS) with web portal and mobile apps in iOS and Android mobile operating systems. It is developed by in-house staff for omni-channel maintenance job dispatch by call centre and front-line staff, recording of corrective maintenance (CM) job progress to keep customers informed and synchronise back to CCS for record keeping purpose.

## **2.6. Departmental Regional Digital Control Centre (RDCC) and Integrated Building Management System (iBMS)**

In response to the Hong Kong Smart City Blueprint and EMSD's 2nd 5-year Strategic Plan, EMSD established the RDCC (Regional Digital Control Centre) for E&M digitalisation.

The RDCC is responsible for remote real-time equipment monitoring, indicative alarm for fault responses and energy management, etc. With the ultimate goal to enhance E&M assets' operational efficiency and environmental performance by artificial intelligence (AI) and big data analytics. Frontline staff and engineers could monitor assets at multiple sites remotely via centralised dashboards with the E&M equipment status and alarms at various dispersed sites. It also serves as a connector for exchanging real-time data of site equipment with BIM-AM systems.

iBMS system connects with major electrical, mechanical, air-conditioning, building services (EMABS) systems including electrical, lighting, air-conditioning, lift & escalator, emergency generator, fire services, and general electronic installation. For digitised EMABS, with the installation of new or upgraded BMS data interface gateway, asset operation data are collected and consolidated through wired or wireless IP Local Area Network (LAN) and Virtual Private Network (VPN). A coherent platform is provided for the Building Energy Management System (BEMS) and associated applications for monitoring, reporting and autonomous (optimal) control of the EMABS systems, in order to achieve energy saving in overall building energy consumption.

## **2.7. Government-Wide Internet-of-Things Network (GWIN)**

To assist digitalisation of E&M equipment, EMSD is building a government network of wireless sensors installed throughout Hong Kong to support various smart applications for the improvement of public service quality. Traditional sensors would each require a 4G connection or BMS systems for connection to central servers. In the GWIN network, sensors are connected to gateways via the low power and private LoRa (Long Range) network. The network with low power consumption reduces the cost and complexity of installing the sensors and improves the security of the system and data without the need of using a third-party network. GWIN shall pass through registered sensors data to BIM-AM Systems for ease of real-time data retrieval.

## **2.8. Departmental Operation Support System (DOSS)**

Departmental Operation Supporting System (DOSS) is developed based on the existing Corporate Computer System (CCS) of EMSD, which will provide the functions related to (1) Finance; (2) Human Resources (HR); and (3) Procurement and Inventory related functions. Front-line users can access DOSS for procurement, stock-take and quotation related functions using a new developed user interface, while other functions of CCS (e.g. maintenance job management, asset management features) will be off-loaded to CCeP-JM, AMS and other systems.

### 3. Acceptance Procedures

The information set out in this section includes:

- Acceptance on Contractor's deliverables; and
- Overall BIM-AM workflow in DLP and handover stage.

By following these procedures, personnel from EMSD could gain an aligned understanding of how to facilitate and complete the handover process and the upkeeping activities thereafter.

#### 3.1. Acceptance on Contractor's Deliverables

Contractor's deliverables shall comply to the contractual requirement as specified in EMSD (H/O Guide) and contract particular specification (PS).

##### 3.1.1. Contractor's Major Deliverables

Contractor's major deliverables are categorised into five main aspects:

1. Asset Data
  - a. Asset Data in models
  - b. Asset Data by means of CCS/ AMTF asset templates, e.g. Level 1 system which cannot be drawn in models
2. RFID/QR Code tagging
3. As-built Documentation, including O&M document and as-built drawings and/or models
4. BMS Information (if applicable)
5. Asset Relationship

Figure 3-1 Detailed Deliverable Preparation Diagram

Stage I Detailed Deliverable Preparation diagram

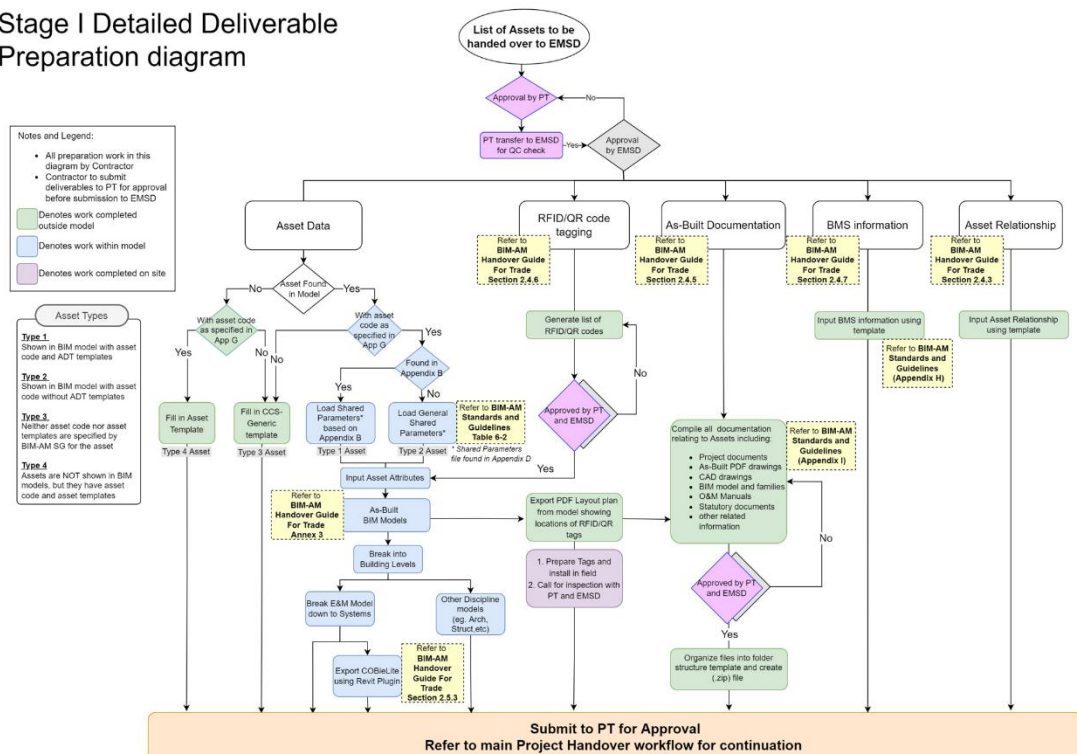


Figure 3-1 is a summary of how these deliverables are submitted to the SBU before uploading to AIMP. The enlarged version could be found in Annex 1.

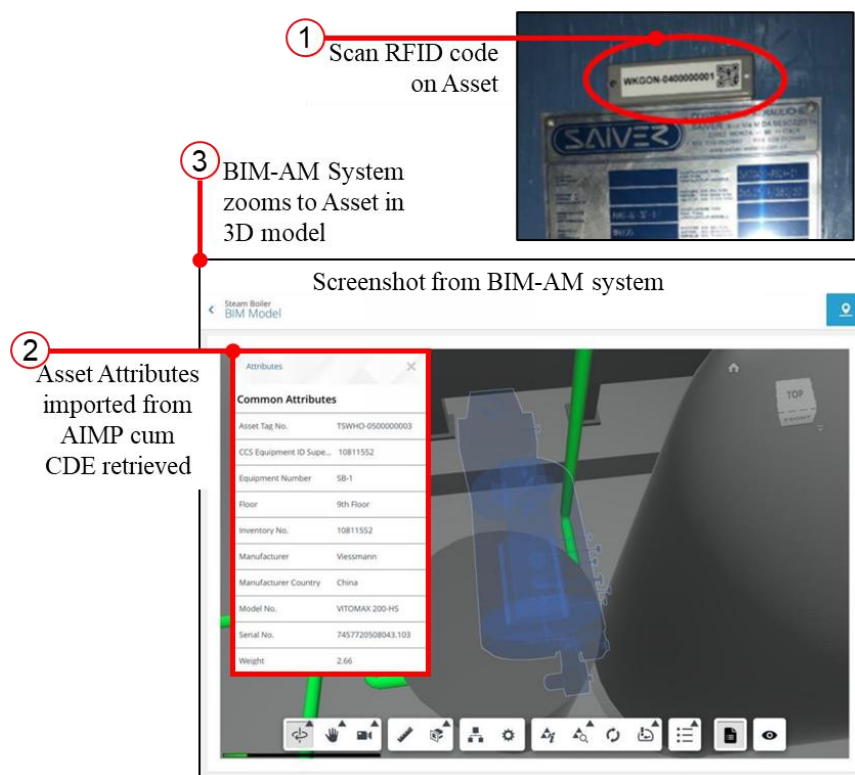
### 3.1.2. Objectives of BIM-AM Deliverables

In summary, the acceptance of these deliverables aims to achieve the following outcomes in their respective systems:

- a) Objective 1: Site Tagging for the ease of data retrieval  
Assets and locations are stuck with RFID asset tags and/or QR codes that allows easy retrieval of asset data on BIM-AM Systems by simply scanning the codes.
- b) Objective 2: File and data management at AIMP cum CDE  
A database containing as-built information and documents for E&M major assets specified in Appendix G of the BIM-AM SG and to be taken over by EMSD for O&M.
- c) Objective 3: BIM-AM operation with BIM models for O&M  
A 3D model containing asset information imported from AIMP cum CDE to BIM-AM Systems.

The figure below shows one of the results from completing all three objectives.

Figure 3-2 Illustration of Onsite Application of BIM-AM Systems



### 3.1.3. Acceptable Quality Level (AQL) and Sampling size

To define a reasonable sampling inspection mechanism based on agreed standard, the following acceptable quality level (AQL) and sampling size has been proposed for reference only. SBU shall determine the criticality of the asset information to adjust the acceptance and checking requirement.

**3.1.3.1. Acceptance on BIM Model including BIM Attributes**

100% check shall be performed by Contractor for the current major E&M equipment as specified in the Appendix G of the BIM-AM SG. The creation of BIM attributes shall be fully checked by means of Revit schedule / Extension or plugin of BIM authorising tools recognised by EMSD.

Sample check on E&M equipment in the as-built models shall be conducted by SBU as appropriate.

**3.1.3.2. Acceptance on Asset Information**

AIMP can illustrate the equipment schedules and SBU can make use of the AIMP for checking the data quality. For the verification work on asset information, it shall follow the current practice with the aids of CCS templates.

**3.1.3.3. Acceptance on RFID Tags and QR Code Zone Tags on Site**

Sampling check per equipment type (for RFID tags) per floor (for zone tags) shall be performed by SBU. In principle:

- The total numbers of assets with asset tags shall be based on an individual E&M system in a building venue.
- The selection of asset tags should be distributed across the different zones and types.
- Sample size should be in accordance with Table 3-1 below. For example, for a project with a total of 3201 to 10,000 assets (lot or batch size), 200 samples should be selected and inspected.

Table 3-1 Sample Size Acceptance

Sampling Plan for shipment inspection and acceptance level at AQL 2.5, AQL 4 and AQL 6.5

Lot or Batch size	Sample size Code Letter	Sample Size (Level-I)	Acceptable Quality level (AQL)					
			2.5		4		6.5	
			Ac	Re	Ac	Re	Ac	Re
2 – 8	A	2	0	1	0	1	0	1
9 – 15	B	3	0	1	0	1	0	1
15 – 25	C	5	0	1	0	1	0	1
26 – 50	D	8	0	1	1	2	1	2
51-90	E	13	1	2	1	2	2	3
91-150	F	20	1	2	2	3	3	4
151-280	G	32	2	3	3	4	5	6
251-500	H	50	3	4	5	6	7	8
501-1200	J	80	5	6	7	8	10	11
1201-3200	K	125	7	8	10	11	14	15
3201-10000	L	200	10	11	14	15	21	22
10001-35000	M	315	14	15	21	22	21	22

Source: ANSI/ASQ Z 1.4 The Sampling procedures and table for inspection by attributes

- Referring to column “Ac” in Table 3-1, for the maximum number of items that is non-compliant for deliverables to be acceptable and there is no need for re-inspection.

- If the number of non-compliance items exceed number shown in column “Ac”, the deliverable is not acceptable, SBU shall notify Contractor to fix these non-compliant assets and select another sample with the sample size required in Table 3-1 for random checks.

### **3.2. Overall Workflow in DLP and Handover Stage**

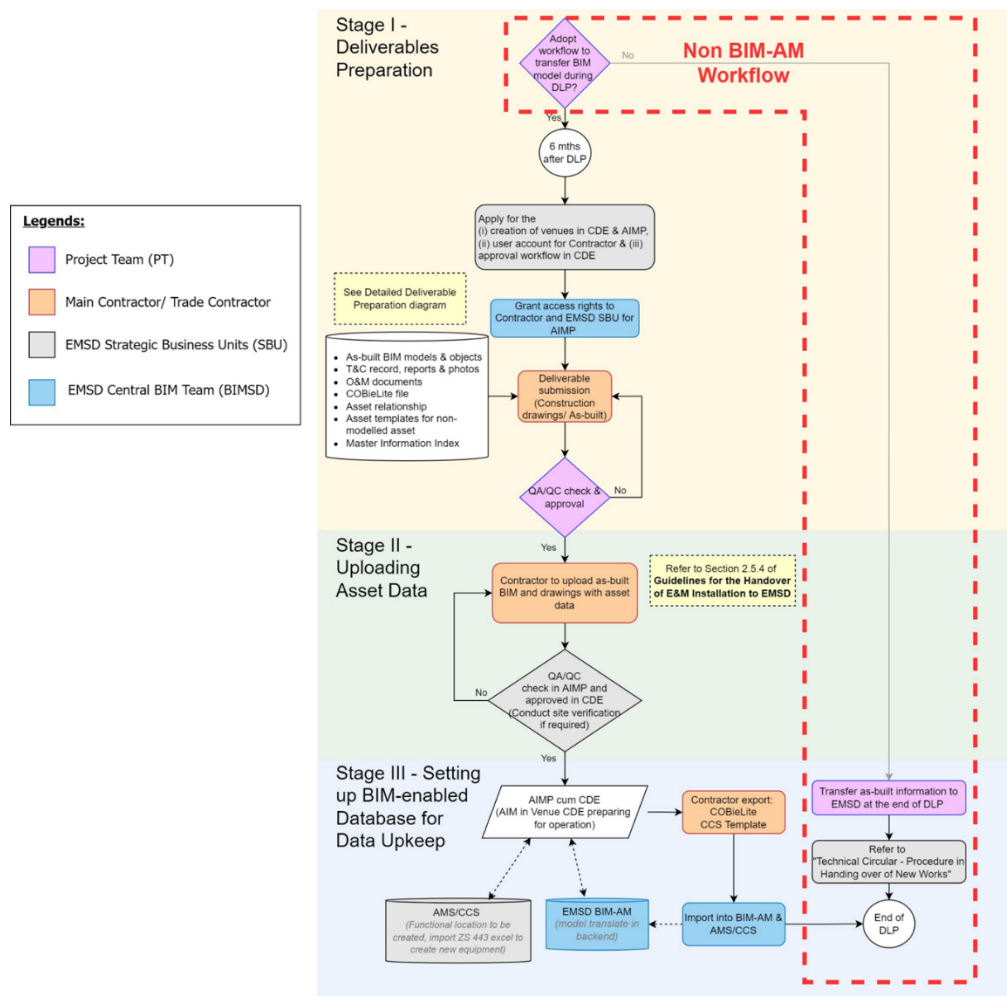
After project completion, if agreed with PT to adopt the BIM-AM workflow, SBU is able to work in a collaborative way with Contractor starting at the earliest time of the sixth month after DLP commencement. Otherwise, non-BIM-AM workflow (the area with red dashed line in Figure 3-3) will be executed. The final as-built information will be transferred to EMSD at the end of DLP. SBU can follow the procedures in EMSD Technical Circular No. 2/2022 or the latest version to take over the information from PT. Figure 3-3 shows the BIM-AM workflow during DLP and handover stage.

SBU would be notified of the date of the start of DLP by PT. Once this notification is received, SBU shall ensure Contractor has received the correct templates, including:

- As-built documentation template in the Handover Package and Folder Structure in Appendix I of BIM-AM SG;
- Asset Data Template (ADT) and shared parameter files for exporting COBieLite from BIM models; and
- Excel templates, including asset relationship, CCS templates and BMS template, if system interface of BMS and BIM-AM is applicable in the project.

SBU and Contractor will be working in collaborative environment and continuing to take over the BIM models and asset data until the end of DLP. During this period, EMSD SBU will need to involve at earlier stage rather than at the end of DLP.

Figure 3-3 BIM-AM Workflow during DLP & Handover Stage



### 3.2.1. Stage 1 – Deliverables Preparation

Initiation stage begins at the earliest time of the sixth month after DLP commencement with the following items for deliverables preparation:

- SBU shall communicate with BIMSD to grant access of AIMP to Contractor and corresponding SBU members.
- SBU shall communicate with BIMSD to define the unique Building Codes, Functional Locations and Venue master in BIM-AM system.
- SBU shall refer to Annex 3 for the CDE Use Guide and understand the approval process in CDE on the submission from Contractor. SBU shall consult BIMSD for CDE process in case of any query.
- Contractor will start to prepare and upload the BIM-AM deliverables through AIMP for SBU's approval at project CDE.
- The Contractor needs to conduct 100% QA/QC check before uploading the deliverables to AIMP.



### 3.2.2. Stage 2 – Uploading Asset Data

This is the delivery stage where Contractor prepares and completes the BIM-AM deliverables for the handover. During this stage, SBU shall be the main point of contact to Contractor for addressing any questions about using the system or populating the information required. SBU shall also review and approve the deliverables in AIMP after Contractor gives notification that the uploads are completed. This stage can last up to the end of DLP.

SBU shall coordinate with the PT to determine how Contractor can submit these BIM-AM deliverables. In general, deliverables could be divided into three portions: Model Deliverables, Template Deliverables and Document Deliverables.

Any missing information in these deliverables shall be completed in this stage before final submission. For ease of completion, it is recommended that most of the information are completed before upload, especially information in the BIM models.

#### 3.2.2.1. Asset List and RFID/QR Codes

SBU would receive equipment list showing the provision of asset tags information from PT (most likely prepared by Contractor). This list contains all the assets that EMSD would take over after DLP. SBU shall review the list and clarify with PT if any additional information is required.

SBU shall check that the RFID/QR codes are:

- Readable by the RFID/QR readers together with the mobile apps, e.g. RFID explorer;
- RFID tags are correctly encoded; and
- Affixed on the correct equipment.

SBU shall check the asset and zone tags generated and submitted by Contractor via PT based on this finalised list. Floor plans showing location of the tags to facilitate the site inspection shall be provided by the Contractor. SBU shall review these submittals to ensure:

- All major E&M assets with asset tags as specified in the Appendix G of BIM-AM SG were shown on plans;
- Zoning plan with zone tag numbers and zone boundary are properly shown; and
- Assets/Zone coding is correct.

Table 3-2 Deliverables to be Uploaded to AIMP

Portion	Description
Model Deliverables	<p>Deliverables should be submitted by Contractor with the BIM-AM model checklist in Annex 3 of H/O Guide. SBU shall check that all fields were verified with checkbox marked with sign-off by the Contractor. Particular attention should be paid to the following items.</p> <ul style="list-style-type: none"> <li>• Creation of Revit Schedules in Models</li> </ul>



Portion	Description
	<ul style="list-style-type: none"> <li>- Asset Schedule per each equipment type as specified in the Appendix G of BIM-AM SG shall be created in as-built models.</li> <li>- SBU shall check that mandatory fields are completed for equipment specific attributes based on the information requirement specified in Appendix B of the BIM-AM SG.</li> <li>• Model Geometry               <ul style="list-style-type: none"> <li>- SBU shall request Contractor to give a preview of how the model looks like when combined in order to make sure that the model sits together by this quick visual check.</li> </ul> </li> </ul> <p>SBU shall conduct checks on the model to verify the completeness of the BIM-AM model as declared in the BIM-AM model checklists. Accuracy of setting-out locations and spatial dimensions between the models and actual installation should be subject to PT's approval based on the project specifications.</p>
Template Deliverables	<p>Contractor shall complete and submit the following Excel templates:</p> <ul style="list-style-type: none"> <li>• Asset relationship;</li> <li>• CCS asset template for Level 1 or Level 2 system which cannot be modelled;</li> <li>• iBMS Templates (if applicable)</li> </ul> <p>SBU shall make comments in the templates to suit their operational needs. The Contractors shall rectify errors which impede the AIMP upload.</p>
Document Deliverables	<p>SBU shall completely check to verify:</p> <ul style="list-style-type: none"> <li>• The folder structure adopted by the Contractor follow Appendix I of BIM-AM SG; and</li> <li>• Correct documents are saved under the folders per system and equipment type to facilitate file mapping as specified in Section 6.1.3 of BIM-AM SG;</li> <li>• The BIM-AM related drawings and/or models as listed in Master Information Index (MII) can be found in the folders uploaded into AIMP.</li> </ul>

**3.2.2.2. Site Tagging Verification**

SBU will receive notification for site inspection once site tagging has been completed by Contractor. SBU shall select a random sample of RFID/QR codes to be inspected.

**3.2.2.3. Uploading to AIMP and Post-processing**

EMSD SBU shall gather the questions or technical issues from Contractor and submit to helpdesk of AIMP while using the system.

Once Contractor has completed the data, SBU shall check the AIMP data for the following:

- **Data Completeness**
  - Total number of E&M assets as shown on AIMP against the equipment list for handover;
  - Topology for major E&M equipment or asset serving critical equipment;
  - Documents linked to each asset; and
  - Asset sample checks to ensure specific equipment information have been inputted.
- **Data Integrity**
  - Topology checks against as-built schematic drawings, as far as practicable; and
  - Sample checks on documents mapping to associated assets.

**3.2.2.4. Acceptance Summary and Sample Size**

The table below summarises all the handover deliverables checks that SBU will conduct and their respective sample size:

Table 3-3 Sample Size for Each Deliverable

<b>Deliverables</b>	<b>Criteria</b>	<b>Sample Size of Checking for acceptance</b>
<b>RFID/QR Code</b>		
RFID/QR list	<ul style="list-style-type: none"> <li>• All major E&amp;M assets as specified in the Appendix G of BIM-AM SG are captured</li> <li>• Zoning plan</li> <li>• Correctness of Assets/Zone coding</li> </ul>	100%
Site Tagging Verification	<ul style="list-style-type: none"> <li>• Readable by the RFID/QR readers</li> <li>• RFID tags are correctly encoded</li> <li>• Affixed on the correct equipment</li> </ul>	Refer to Section 3.1.3

<b>Deliverables</b>	<b>Criteria</b>	<b>Sample Size of Checking for acceptance</b>
<b>Uploading to AIMP</b>		
Model Deliverables	<ul style="list-style-type: none"> <li>Mandatory equipment specific fields are completed for E&amp;M assets in Revit schedules submitted by Contractor</li> <li>Model checklist submitted</li> </ul>	Refer to Section 3.1.3
Template Deliverables	Check that the below are submitted and filled up <ul style="list-style-type: none"> <li>Asset relationship</li> <li>CCS asset template for Level 1 or Level 2 system which cannot be modelled</li> <li>iBMS templates (if applicable)</li> </ul>	Follow the current practice for the acceptance of asset information. Basic data validation based on CCS requirement would be performed in AIMP.
Document Deliverables	<ul style="list-style-type: none"> <li>Folder structure matches Appendix I of the BIM-AM SG</li> <li>Correct documents are deposited into the folders per equipment type</li> <li>Deliverables as listed in Contractor's MII can all be found in the folders uploaded into AIMP</li> </ul>	Refer to Section 3.1.3
<b>Uploading to AIMP and Post-processing</b>		
Data Completeness	<ul style="list-style-type: none"> <li>Correct numbers of E&amp;M assets</li> <li>Topology completed for major E&amp;M equipment or asset serving critical equipment</li> <li>Documents linked to each asset</li> <li>Ensure mandatory equipment specific information has been inputted into AIMP</li> </ul>	Refer to Section 3.1.3
Data Integrity	<ul style="list-style-type: none"> <li>Topology checks against as-built schematic drawings</li> <li>Correct documents mapping to respective assets</li> </ul>	Refer to Section 3.1.3

#### 3.2.2.5. AIMP Exports

SBU, together with Contractor, must confirm within the AIMP cum CDE that the uploaded information is completed and approved by SBU for O&M, and no further changes is required.



**3.2.3.4. Statutory Record**

The documentary statutory records for O&M and the related drawings and/or models shall be upkept by SBU.

## 4. Upkeeping Procedures

### 4.1. Overall BIM-AM Upkeeping Workflow

The overall BIM-AM upkeeping workflow is shown in Figure 4-1 and Figure 4-2, which describes the general information management processes, activities, and deliverables across the project lifecycle of A&A project during the building operation stage, along with the activities and the responsible parties, which should be followed by SBU when conducting A&A works.

Figure 4-1 BIM-AM Upkeeping Workflow-1

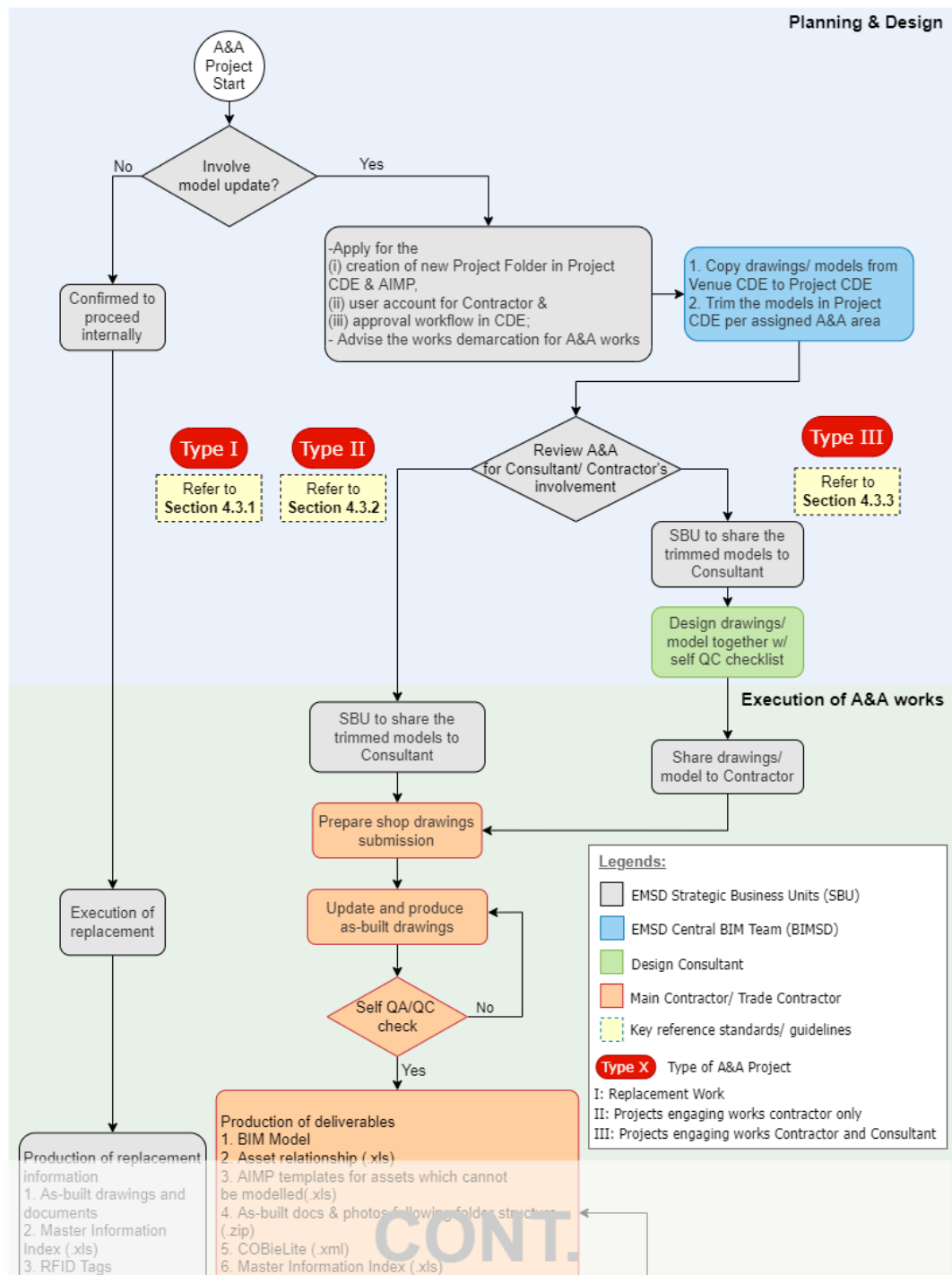
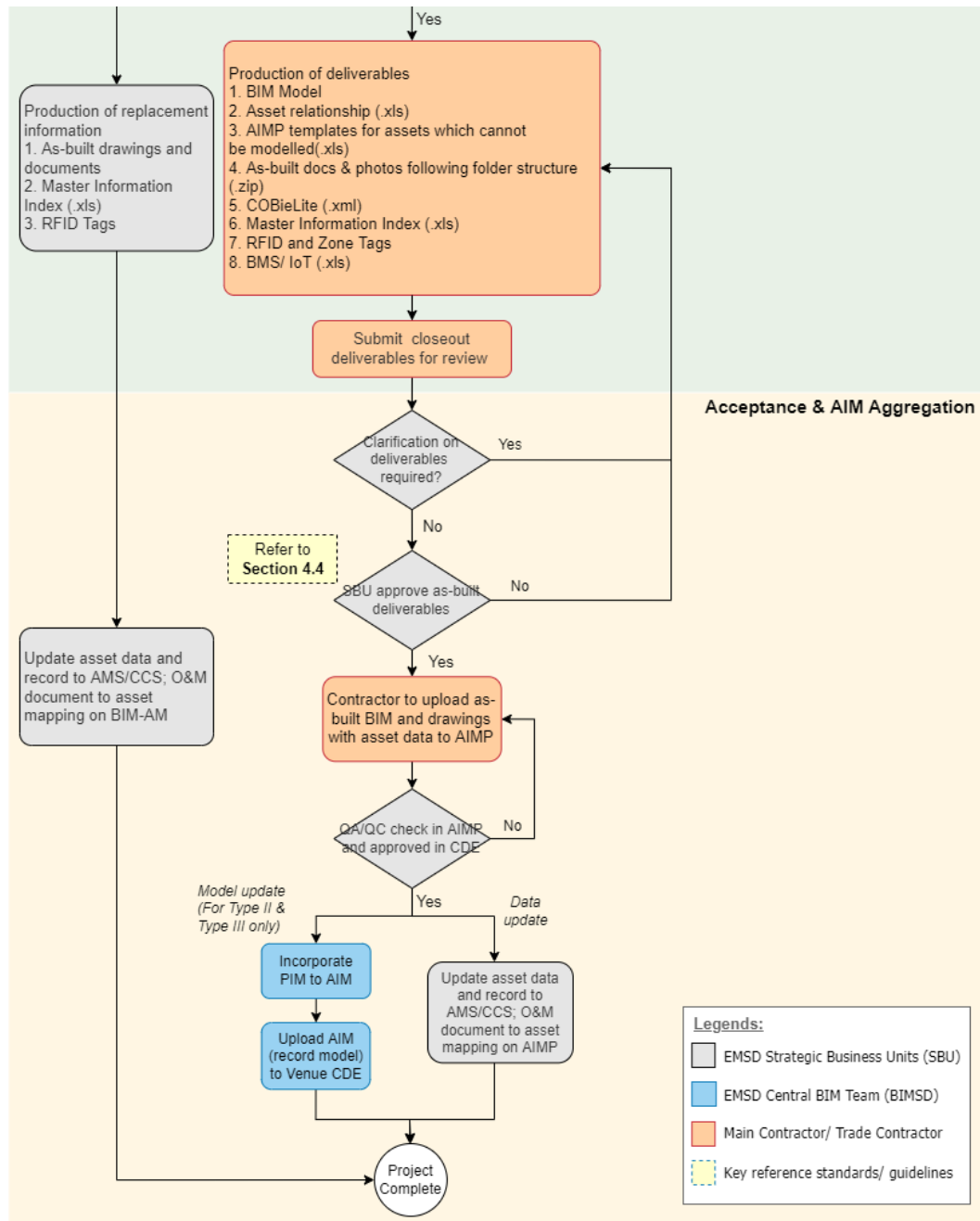


Figure 4-2 BIM-AM Upkeeping Workflow-2



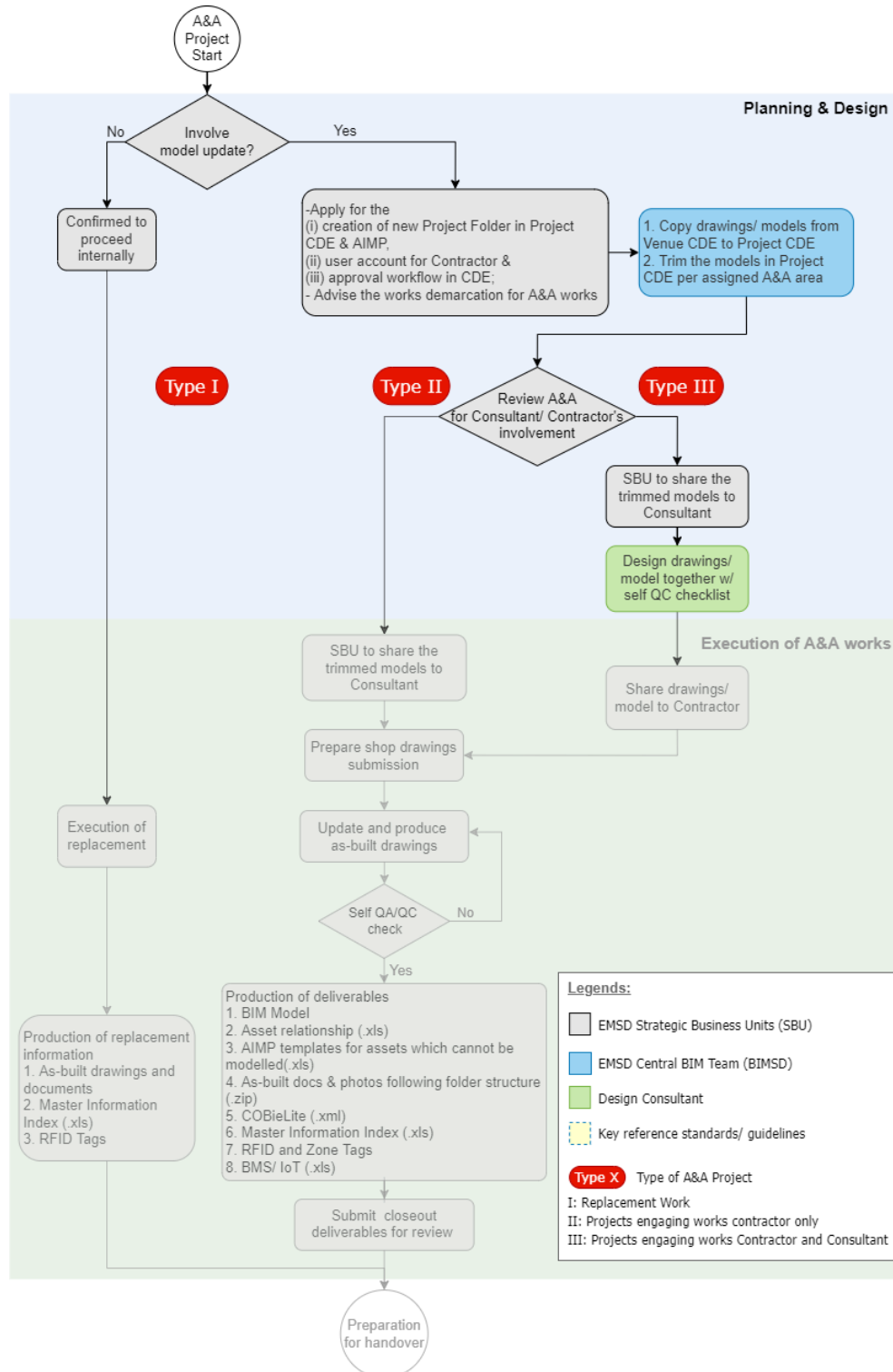
A/U Guide further elaborates the information management process in the context of three phases within the operation project life cycle including Planning & Design, Execution of A&A works and Acceptance and AIM Aggregation. Besides, the CDE information management process will be introduced to explain the digital transmission processes across the life cycle of A&A project.

Template of particular specification can be referred to Appendix Z of BIM-AM SG for the detail requirement on BIM-AM adoption.

#### 4.2. Information Management Process at Planning and Design

The information management process at planning and design phase is shown in the figure below. The crucial task at this stage is to determine how would the A&A work be conducted. The decision making would determine what kind of information management process should be adopted for the following project execution.

Figure 4-3 Information Management Process at Planning & Design Phase





**4.2.1. Project setup in Project CDE and AIMP**

When there is an A&A project which involved drawing/model update been initiated, SBU should apply for system access in Project CDE and AIMP for project execution, including:

- (i) Project folder;
- (ii) User account for Contractor; and
- (iii) Approval workflow in CDE.

Meanwhile, SBU shall determine the demarcation of A&A area and inform BIMSD for preparing drawings and/or models package for project use. BIMSD shall copy existing models from Venue CDE and trim the models per assigned A&A area. These trimmed models along with the project applicable drawings will be served as the information for existing condition and be placed in project CDE for SBU to share with Consultant / Contractor.

**4.2.2. Determine A&A Project Types**

The requirements and deliverables of BIM application may vary for each A&A project, thus different workflows would be required to well meet the project needs. This A/U Guide categorises A&A project into three types according to the following criteria as shown in Table 4-1. SBU shall choose the applicable workflow accordingly.

Table 4-1 Project Type for Applicable Workflow

<b>Project Type</b>	<b>Project Task</b>	<b>Drawings and/or BIM models Deliverable</b>
<b>Type I</b>	Replacement works [no update on models]	No
<b>Type II</b>	Projects engaging Contractor only	Yes
<b>Type III</b>	Projects engaging Consultant and Contractor, if any (works involving design drawings)	Yes

**4.2.3. Design Documents and/or Models Development**

Among the three project types described in Section 4.2.2, only Project Type III would involve design activity during the project life cycle. Consultant shall take the existing documents and/or models from SBU for design development. The detailed workflow will be described in Section 4.3.3.

**4.3. Information Management Process at Execution of A&A Works**

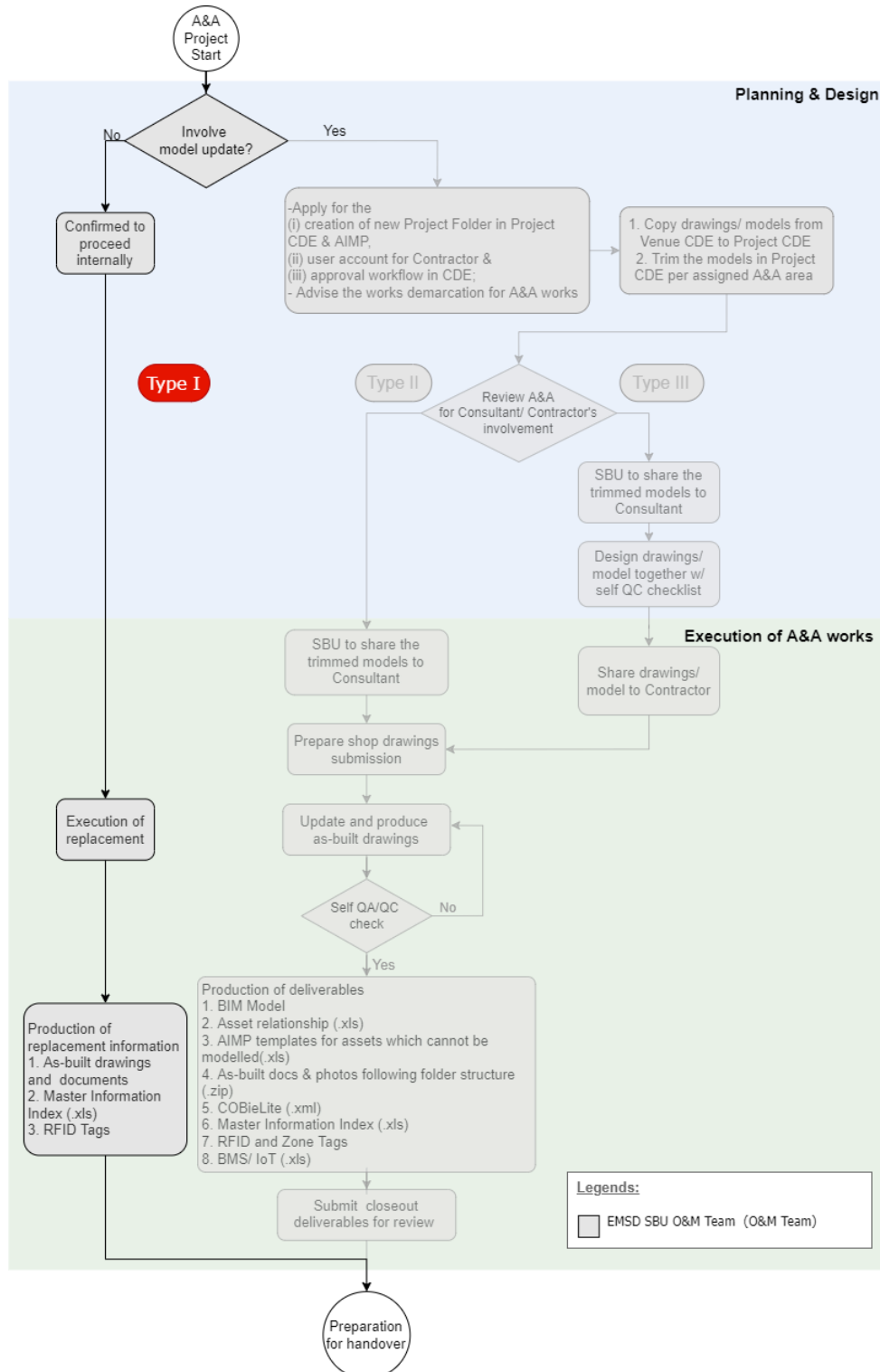
For easy reference, the information management process at execution of A&A works is introduced according to the project type defined in Table 4-1.

**4.3.1. Project Type I: Replacement Works**

The workflow shown in Figure 4-4 is applicable to small scale A&A works which would be proceed by EMSD SBU internally. The vendor shall submit the update O&M documents and handover to SBU after work completion. SBU shall collect the

replacement information and commence asset information update accordingly. Should there be graphical information happening, it is suggested to have markup drawings at least as the reference material for the following documents and/or models update.

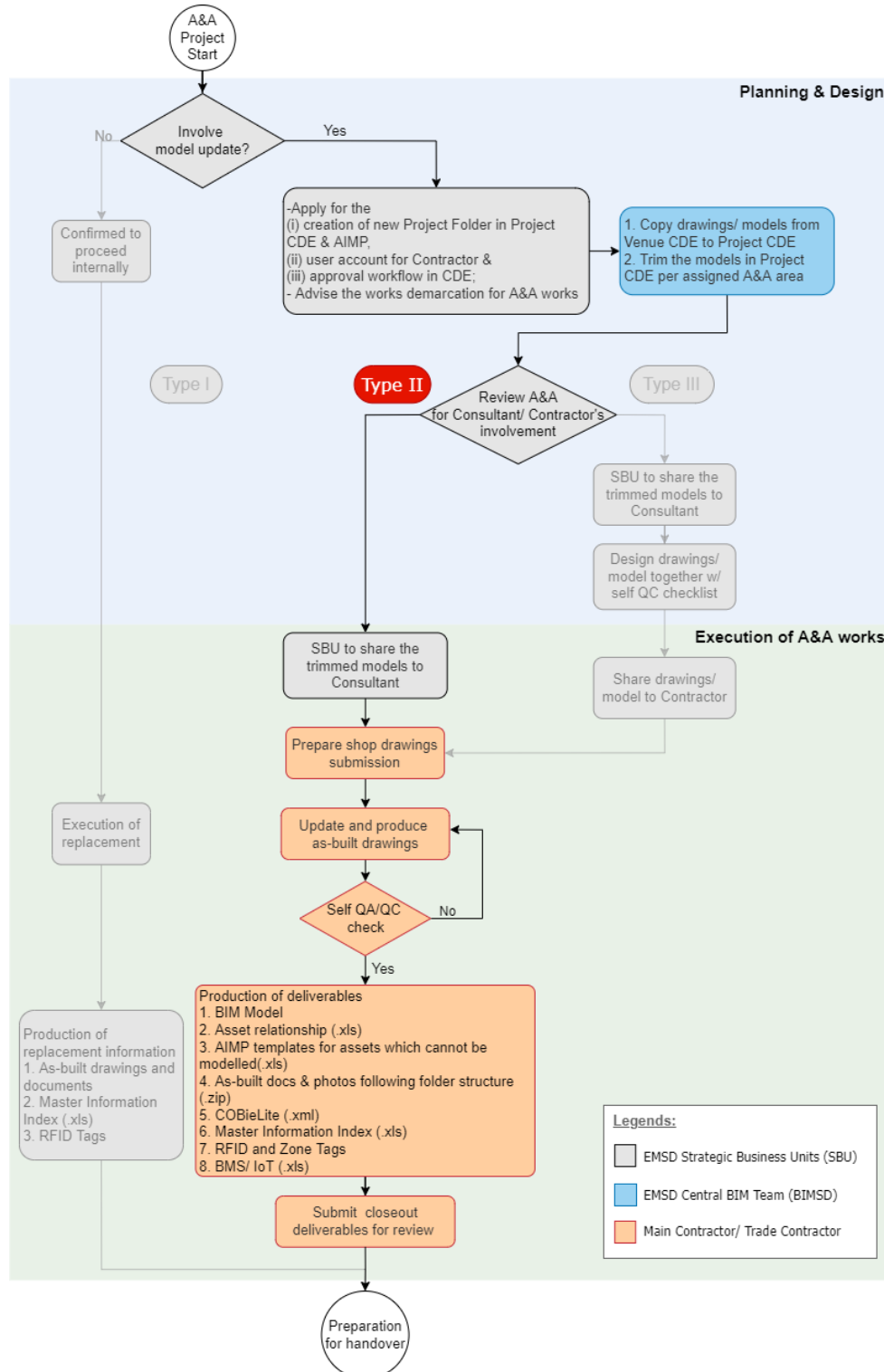
Figure 4-4 Information Management Process of Project Type I



#### 4.3.2. Project Type II: Projects Engaging Contractors Only

The workflow shown in Figure 4-5 is applicable to A&A works with certain scale which require contractor for execution. For this type of A&A works that require no design works, existing asset model(s) will be shared in Project CDE by SBU as the reference of existing condition for Contractor to conduct construction coordination and shop drawings development.

Figure 4-5 Information Management Process of Project Type II



**4.3.2.1. Existing Condition Modelling**

BIMSD is responsible for copying the drawings and/or models from Venue CDE according to the project scope and placing in the project folder in Project CDE for SBU to share with Contractor as the reference of existing condition. SBU shall make sure that Contractor conducts the site survey for verifying the existing condition as specified in the contract particular specification.

Refer to Section 4.5.1 for the CDE Process at Project Initiation.

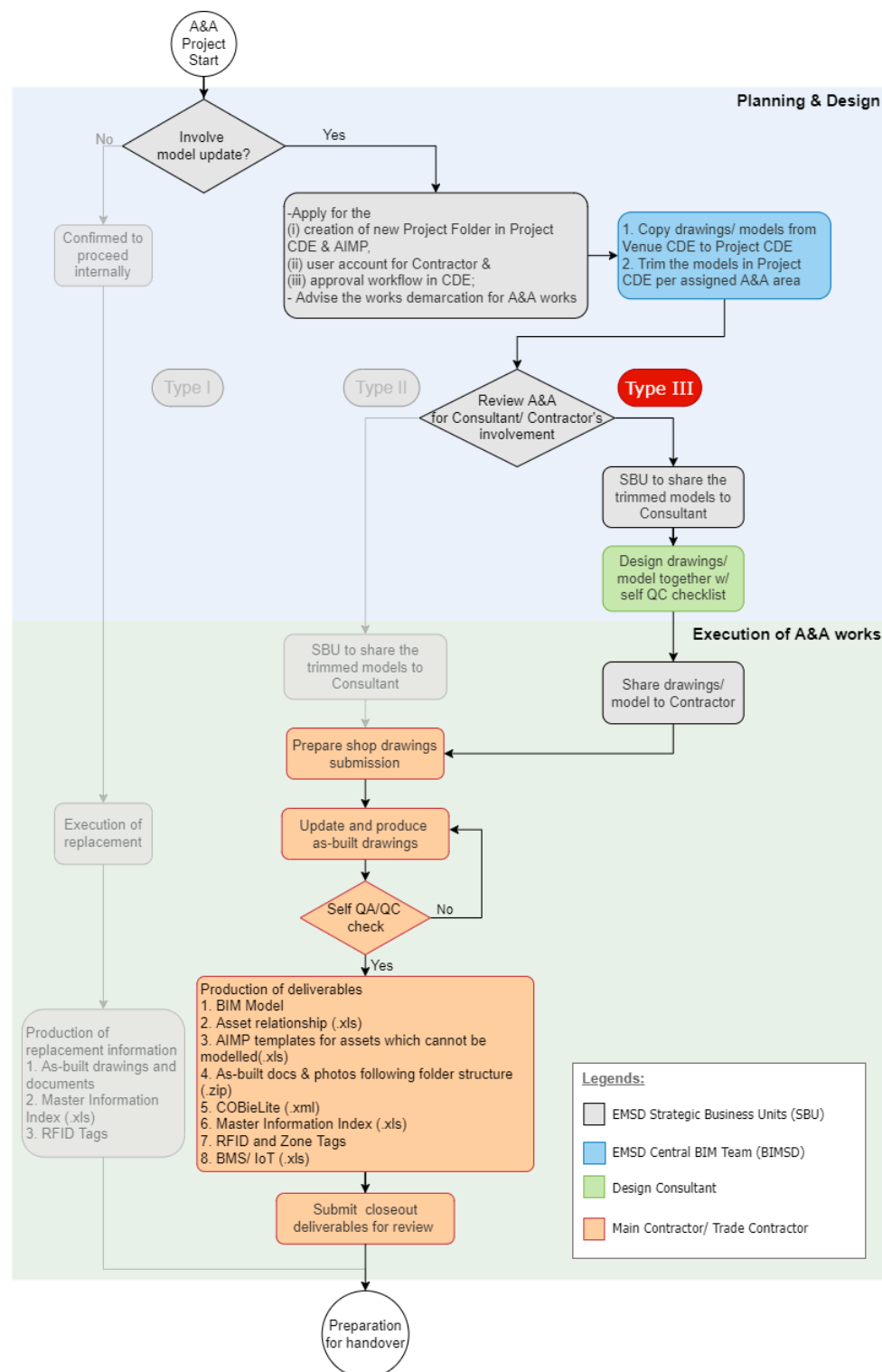
**4.3.2.2. Supervising Contractor on BIM Uses**

SBU shall supervise Contractor on BIM use including but not limited to drawing development, model collaboration, model coordination, as well as compiling as-built information for final deliverables, as specified in the contract particular specification.

**4.3.3. Project Type III: Projects Engaging Contractors and Consultants**

This workflow shown as Figure 4-6 applies to A&A works which involves both design service by Consultant and construction works by Contractor. Consultant shall use existing asset model(s) shared in Project CDE by SBU for design development and verifying statutory compliance if required. Furthermore, the models should be developed to a stage whereby production information can be utilised for the purposes of tendering. Design models by Consultant shall be provided to Contractor by SBU after bidding awarded for the following construction coordination and shop drawings development.

Figure 4-6 Information Management Process of Project Type III



#### 4.3.3.1. Model Sharing

This project type involves two models sharing activities within the information management process: at project initiation and when finalising design work.

At project initiation, BIMSD copies the documents and/or models from Venue CDE according to the project scope and places in the project folder in Project CDE for SBU to share with Consultant. SBU shall make sure Consultant has conducted site survey to verify existing conditions as specified in the contract particular specification.

Upon finalising design work, Consultant should submit final design deliverables to SBU. Should the design package be accepted, SBU shall copy design model(s) and issue to Contractor as tender set information for the following production of construction drawings, model collaboration and model coordination etc., as well as compiling as-built information for final deliverables as specified in the contract particular specification.

Refer to Section 4.5.1 for the CDE workflow for Project Initiation.

**4.3.3.2. Supervising Consultant and Contractor on BIM Uses**

SBU shall supervise Consultant and Contractor on BIM uses across the design development and construction phases for drawing development, model collaboration, model coordination, as well as compiling as-built information for final deliverables as specified in the contract particular specification.

**4.3.4. Handling RFID Tags**

The RFID tags stuck on the existing equipment to be demolished/ replaced shall be retained and reused. The list of demolished/ replaced equipment together with the associated RFID tags number shall be properly recorded for updating the AIMP and BIM-AM Systems after the completion of A&A Works. Otherwise, new RFID tags shall be provided, assigned and encoded by SBU.

**4.3.5. Preparation for Handover**

For Project Type I, SBU shall supervise the Contractor to provide the updated O&M documents after work completion.

As for Project Type II and III, SBU shall supervise Contractor to accomplish the handover procedures referring to H/O Guide.

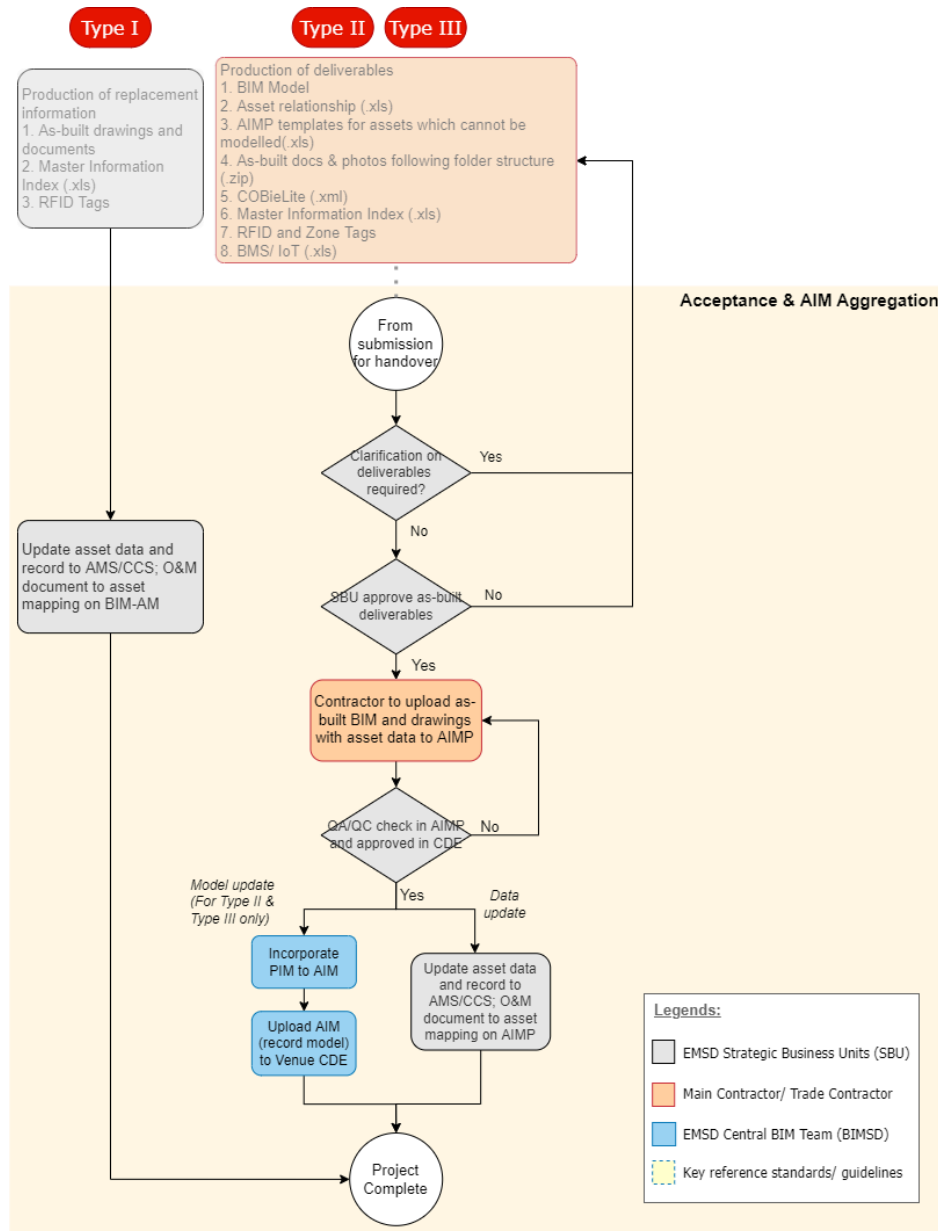
Refer to Section 4.5.2 for CDE Process at Project Handover.

**4.4. Information Management Process at Acceptance and AIM Aggregation**

The information management process at acceptance and AIM aggregation is shown in the figure below. This part of workflow involves two main purposes:

- a) For project closeout including project deliverable acceptance.
- b) For incorporating update BIM-AM information from PIM to AIM.

Figure 4-7 Information Management Process at Acceptance and AIM Aggregation



#### 4.4.1. Acceptance

For Project Type I and Type II, after Contractor uploading the final project deliverables per H/O Guide, SBU shall conduct the closeout review following the acceptance procedures outlined in Section 3.2.2.1 to Section 3.2.2.5. Should there be any clarification required, SBU shall inform Contractor for deliverable amendment if any.

After finalising the closeout review, the project deliverables with acceptance by SBU will be ready for the following updates on BIM-AM systems.

Refer to Section 4.5.3 for the CDE Process at Project Acceptance.

#### 4.4.2. AIM Aggregation

Along with the completion of A&A works, SBU is responsible for incorporating the update asset information into existing BIM-AM systems. Data update focuses on inputting O&M related document into AMS/CCS and AIMP systems. BIMSD is responsible for model update to incorporate changes on BIM models, i.e. AIM, in Venue CDE.

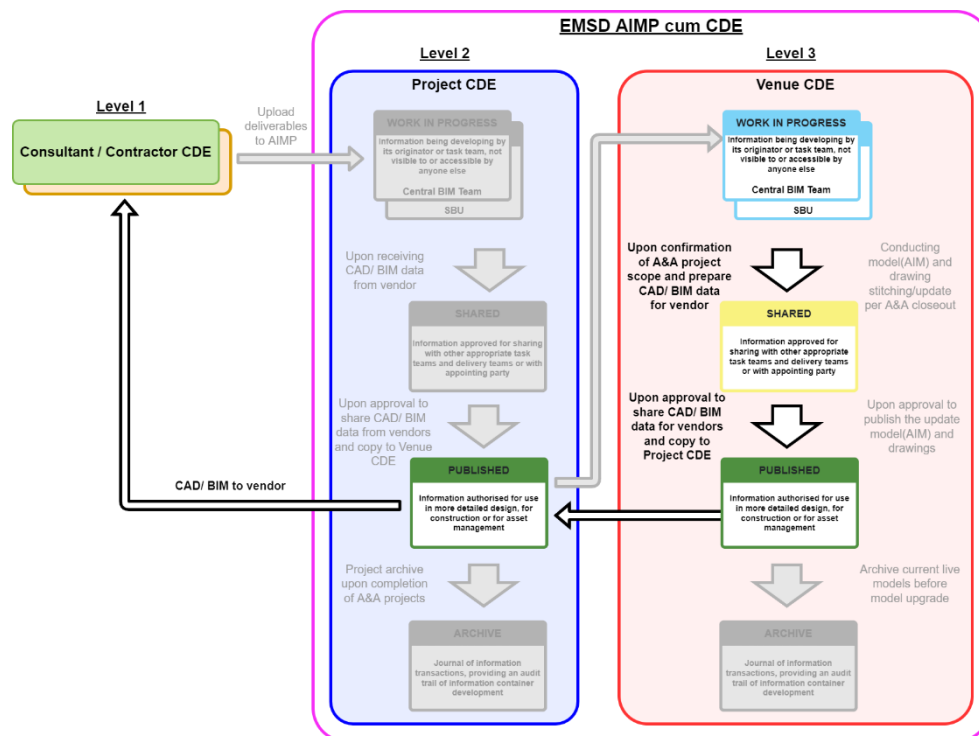
Refer to Section 4.5.4 for the CDE Process at AIM Aggregation.

### 4.5. CDE Information Management Process for A&A Project in BIM Venues

#### 4.5.1. CDE Process at Project Initiation

At project initiation, BIMSD is responsible for creating project space for A&A project at Project CDE and granting access to project participants. BIMSD shall copy the exiting model in Venue CDE and trim the copied model per A&A scope before sharing with the vendor in Project CDE for A&A project use. The CDE information workflow at project initiation is described as the figure below.

Figure 4-8 CDE Information Workflow at Project Initiation

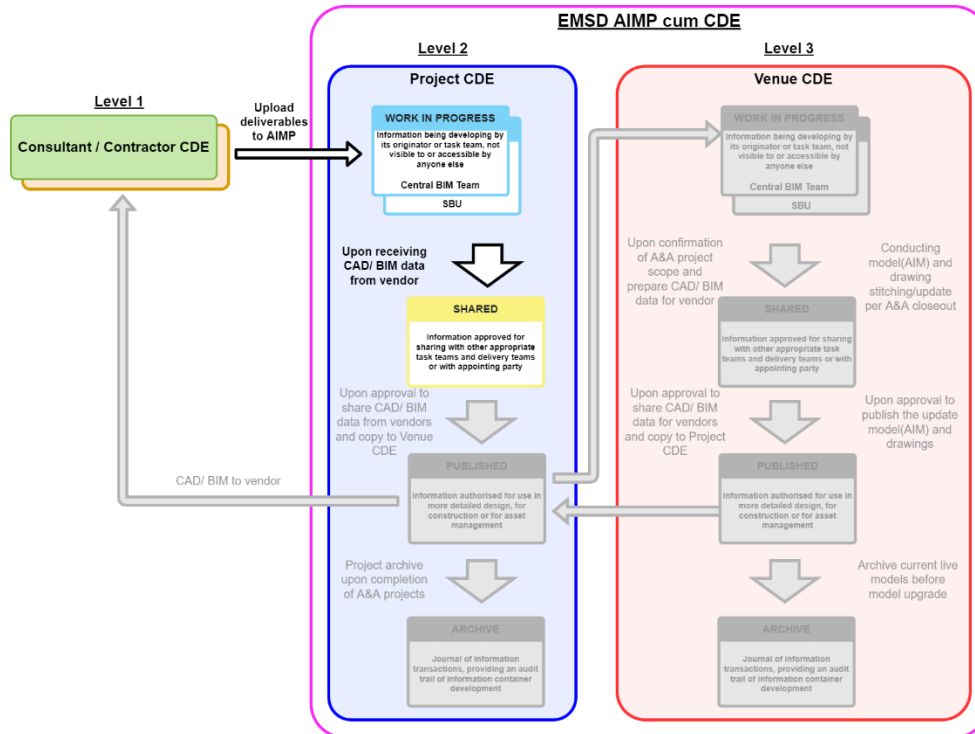




#### 4.5.2. CDE Process at Project Handover

At project handover stage, SBU shall make sure that Contractor complete the project submission per contract requirement and upload to the designated project space per H/O Guide. The CDE information workflow at project handover is described in the figure below.

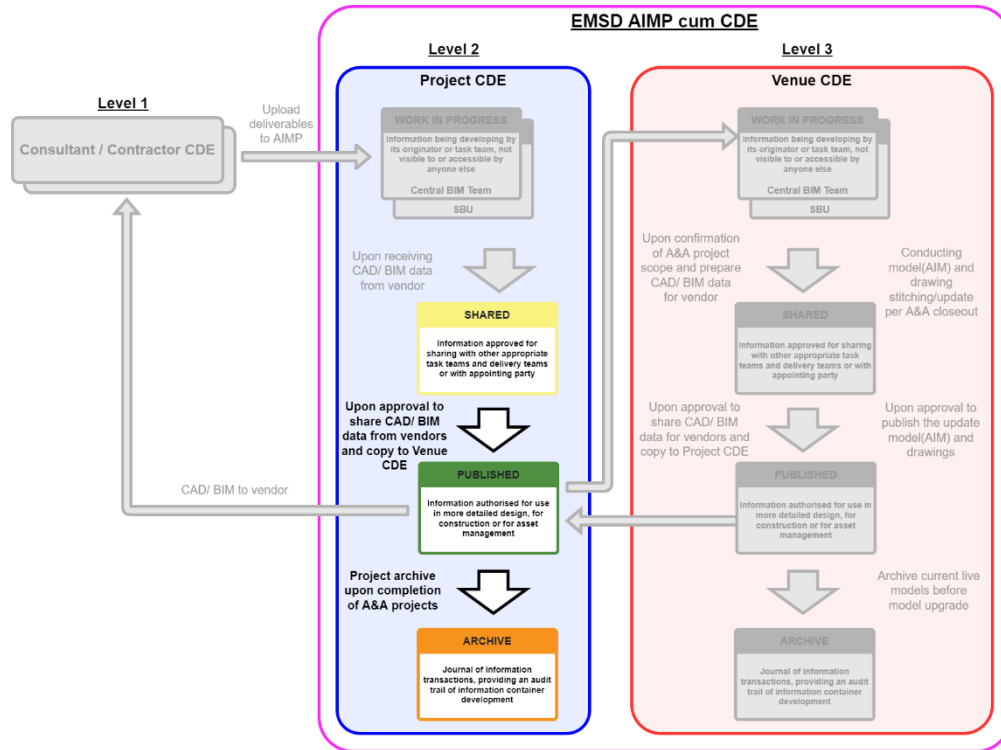
Figure 4-9 CDE Information Workflow at Project Handover



### 4.5.3. CDE Process at Project Acceptance

SBU is responsible for conducting project deliverable review and acceptance in Project CDE. Once the deliverable been accepted, SBU shall inform BIMSD for archiving the project files and duplicate one set of the deliverables for AIM aggregation use concurrently. The CDE Information Workflow at Project Acceptance is described in the figure below.

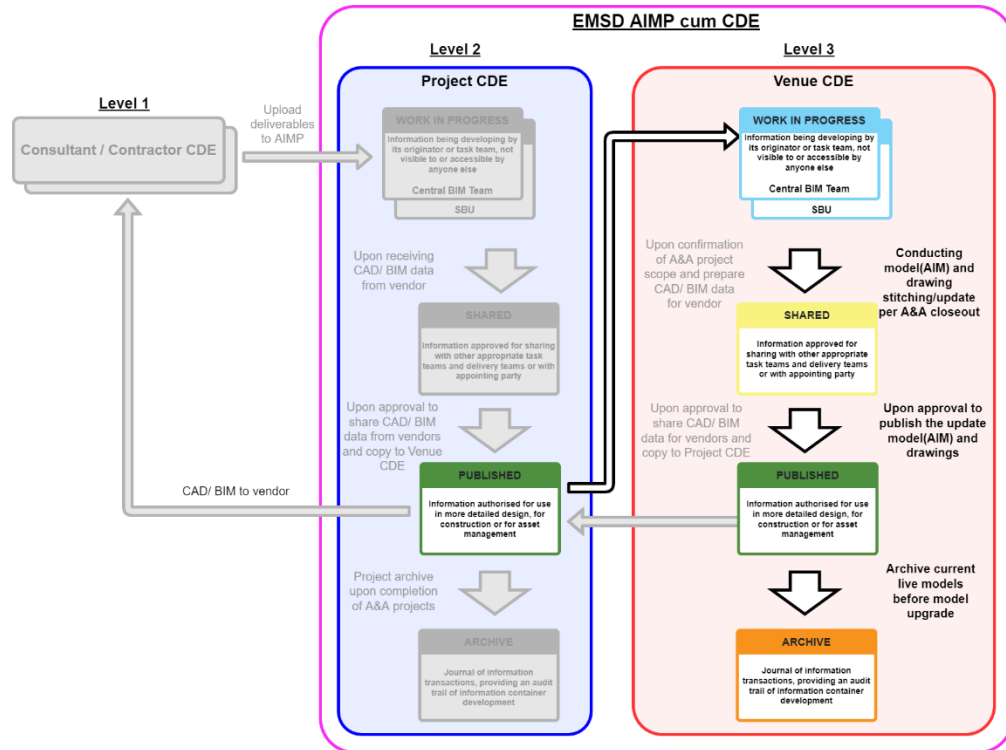
Figure 4-10 CDE Information Workflow at Project Acceptance



## 4.5.4. CDE Process at AIM Aggregation

AIM aggregation shall be carried out by BIMSD under Venue CDE to incorporate the update information from PIM to AIM. After the completion of AIM aggregation, the update AIM shall be published for operational use while the outdated AIM should be archived by BIMSD in Venue CDE as an history log. The CDE Information Workflow at AIM Aggregation is described in the figure below.

Figure 4-11 CDE Information Workflow at AIM Aggregation



## 4.5.5. Folder Creation and Management in Venue and Project CDE

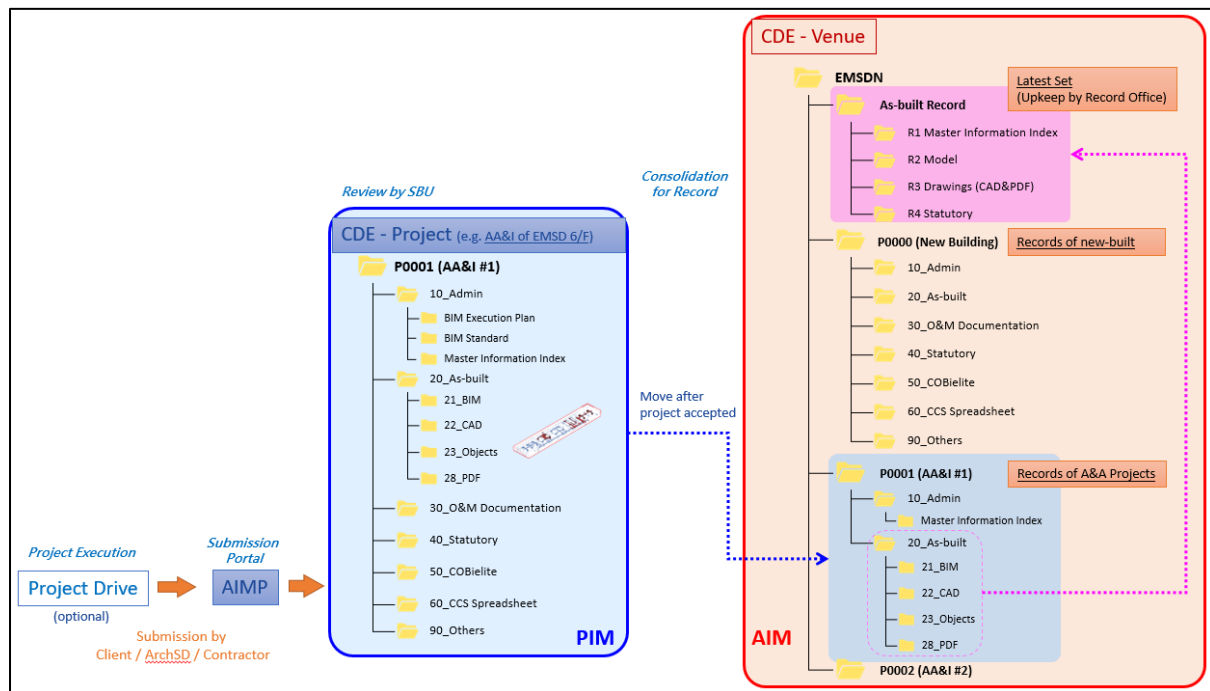
Access right to the CDE and corresponding project folder shall be provided by BIMSD upon written request by Contractor. Project information and status shall be managed by Contractor in accordance with Annex 3 – CDE User Guide. Procedures are illustrated in the figures below for reference.

Prior to BIM models transition from PIM to AIM as described in Section 4.5.4, PIM should be approved by SBU before incorporated into AIM in Venue CDE.

Figure 4-12 shown the proposed folder structure within Venue CDE and Project CDE and the process flow between folders. Each A&A project will have the same folder structure with Appendix I of BIM-AM SG. Once the PIM is approved, record office will incorporate the changes to AIM under as-built record folder.

The status code of project information from PIM to AIM, existing as-built document and associated document shall be updated in accordance with in Annex 3 – CDE User Guide.

Figure 4-12 Process flow of Incorporating PIM to AIM within CDE



## **5. Other General Requirements**

All computer hardware, software (including operating system, application software and its software recovery, final version of source codes / scripts and their compilation tools and release procedures, anti-virus software and policy settings etc.), manuals, licenses, database, database schema, data flow diagram, suitable training materials (including video) and passwords of all level / rights should be provided if specific computer programme or software is necessary for the operation and maintenance of the installed plant/system. In this connection, these required information and materials shall be uploaded to AIMP cum CDE under “90\_Others” with folder(s) for facilitating the subsequent maintenance and update.

This section outlines other general requirement when performing the upkeeping related activities for the drawings and/or models in BIM-AM platform.

### **5.1. Hardware**

SBU shall seek advice from BIMSD for the appropriate hardware specification (which is available in these links<sup>3</sup>) to achieve the BIM-AM enabled workflow in operation. Virtual Desktop Infrastructure (VDI) may be another option which can be further liaise with BIMSD.

### **5.2. Software**

SBU shall instruct Consultant and Contractor to use the same authoring and reviewing software as used for the current asset model.

For software version, SBU shall ensure the BIM models are submitted in the version currently used by EMSD. BIMSD shall review the software upgrading plan and proceed to corresponding models upgrade for AIM.

### **5.3. Drawing Revisioning**

SBU shall review whether all construction stage revisions have been removed by Contractor when producing the drawings and/or models for project closeout submission. Only as-built revision shall be kept for review.

In addition, SBU shall add the corresponding revision per A&A works into asset drawings and/or models while combing update information into existing drawings and/or models for easier track change of what has been changed during each of A&A works.

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<sup>3</sup> SharePoint and DevB links to hardware specification:

<http://kmp21/kmp21/emka/GEE/Pages/BIM/Home.aspx?RootFolder=%2Fkmp21%2Femka%2FGEE%2FKZ%5FBIMDocuments%2FGuideline%20for%20BIM%20Modelling%20Computer%20and%20Software&FolderCTID=0x012000CACB3A39E5C6284B963FD1D7415CADDB&View=%7B4ADC4D78%2D9876%2D4F32%2D8205%2DA05B48F9F3A6%7D>

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End of the Guidelines