CONSTRUCTION INDUSTRY COUNCIL
建造業議會

BIM

CIC BIM Standards

General

(with Hong Kong 'Local Annex' of ISO 19650-2:2018)

Version 2024

Disclaimer

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Document Revision Tracking

Issue Date	Notes
September 2015 Edition	Title of the document is CIC BIM Standards (Phase One)
August 2019 Edition	Title of the document is renamed from “CIC BIM Standards (Phase One)” to “CIC BIM Standards - General”. This amendment revision is to in line with the new BIM Standards for MEP & Underground Utilities.
December 2020 Edition	Major Enhancements
November 2021 Edition	Minor correction / refinement
December 2024 Edition	Minor correction / refinement, addition of the LOD-G+ concept

Summary of major amendments for August 2019 Version:

Item	Related section in First version	Description of the changes
1.		The “CIC BIM Standards (Phase One)” was renamed to “CIC BIM Standards - General”.
2.	Section 2.1.4, Building Services (MEP) Modelling Guidelines	More details could be found in the CIC BIM Standards for Mechanical, Electrical and Plumbing (MEP) which focuses on the MEP discipline.
3.	Section 2.1.5 Utilities Modelling Guidelines	More details could be found in the CIC BIM Standards for Underground Utilities (UU) which focuses on UU discipline.
4.	Section 3.1 LOD Definitions	A sentence “For LOD for Mechanical, Electrical and Plumbing and Underground Utilities model elements, refer to the CIC BIM Standards for MEP and the CIC BIM Standards for UU respectively.” is added.
5.	Section 3.2 LOD Responsibility Matrix	“Tender stage” was added in the LOD responsibility matrix.
6.		The wording “QTO” is replaced by “UOM”.
7.		For the category code, “OmniClass system” was recommended instead of “Uniformat system”
8.		All MEP-related sections were revised to refer to the CIC BIM Standards for Mechanical, Electrical and Plumbing (MEP).
9.		All UU-related sections were revised to refer to the CIC BIM Standards for Underground Utilities (UU).
10.	Section 3.3 LOD Specification	The column “Data” was removed for all LOD specifications.
11.		In Section 3.3, MEP-related LOD specifications were revised to refer to CIC BIM Standards for Mechanical, Electrical and Plumbing (MEP).
12.		In Section 3.3, UU-related LOD specifications were revised to refer to the CIC BIM Standards for Underground Utilities (UU).

Summary of major Enhancements for December 2020 Edition:

Item	Major Enhancement	Description of the changes
1.	ISO 19650 Information Management	Introduction to ISO 19650 Information Management principle, workflow and requirement.
2.		Client is to align with ISO 19650 as Appointing Party and expressed as both in this edition.
3.		BIM Implementation Plan has been termed as BIM IP for Appointing Party / Client or Lead Consultant. BIM Execution Plan has been termed as BEP instead of PXP.

Item	Major Enhancement	Description of the changes
4.	Common Data Environment (CDE)	Introduction to CDE function, principle, check gateways and requirements.
5.	Level of Information Need (LOIN)	Define Level of Graphics (LOD-G), Level of Information (LOD-I) and Level of Documentation (DOC).
6.	BIM Uses	Additional BIM Uses added
7.	Information Management Workflow across Project life cycle	Illustrate common practices and workflows for different project stages.
8.	BIM Audit	Define BIM Audit process and requirements.
9.	Modelling Methodology and Requirements	Combined section Modelling Methodology and section Component Presentation Style & Data organisation from version 2019. Minor updates on the modelling methodology.
10.	openBIM	Introduction to openBIM
11.	BIM Object Coding and Classification	Introduction to OmniClass® Coding
12.	Way Forward	Introduction to the potential BIM related systems and integrations in the industry

Summary of minor Correction/ Refinement for Version 2.1

Item	Correction	Description of the changes
1.	Typo	Minor typos fixed without affecting the integrity of content.
2.	Chapter 2 Information Requirements	Duplicated items “Security Information Requirements” deleted in the diagram.
3.	Section 2.6.3	LOD-I requirements tally with Works Departments BIM Harmonisation standard.
4.	Figure 1 Project Information Delivery	Figure reconfigured on the OIR, AIR hierarchy to tally with the hierarchy mentioned in text.
5.	Section 3.7.1	Wording LOD Responsibility Matrix renamed to LOID Framework (LOD-G, LOD-I and DOC) for consistency.
6	Figure 20, Figure 21	Change the “Main” Contractor to “Lead” Contractor to standardize terms.. Clarify in the high level matrix diagrams on the auditing function to BIM Manager at As-built stage.
7.	Fig 39	Design workflow amended, BIM IP instead of BEP is required from the Appointed Party
8.	Fig 41, 46	LOD-G 500 no longer used
9.	Draft BIM IP	Renamed all the term “Draft” BIM IP to “Pre-appointment” BIM IP to clarify and differentiate from the formal IP.
10.	Fig 43, 44, 45, 46, 47,48, 49, 50	Standardized the Design Information Model (DIM), construction Project Information Model (cPIM) As Built Information Model (ABIM) and Asset Information Model (AIM) abbreviations to tally with all text.
11.	Annex 1	Clarification of ‘Local Annex’ added.
12.	Section 3.6 and 3.7	Switch Section 3.6 and 3.7

Summary of major amendments for 2024 Version:

Item	Related section in First version	Description of the changes
1.	2.6.2 Level of Graphics (LOD-G)	LOD-G+ concept was added.
2.	Section 7 openBIM	More initiative on using openBIM were added.

BIM Standards Contents

Foreword

Foreword

In 2020, we have reached another milestone for BIM adoption in Hong Kong, embracing ISO 19650. I was glad to see the release of Construction Industry Council (CIC) BIM Standards - General (Version 2 - December 2020) in 2020, which contains major enhancements to align with ISO 19650's Information Management principles, workflows and requirements, also providing Hong Kong 'Local Annex' of ISO 19650-2:2018. Users will find this new version differs substantially when compared to the August 2019 publication.

Based on feedback obtained since the release of Version 2 in 2020, together with the release of new templates of information requirements, we are pleased to issue the CIC BIM Standards - General (Version 2.1 - 2021) this year.

The objective of this CIC BIM Standards – General is to provide principles and workflow of information management using BIM, mainly including information management framework, information requirements, BIM implementation planning, introduction and functional requirements of CDE, information management workflow for stages in project life cycle, and modelling methodology and requirements, to facilitate prompt adoption of BIM by the construction industry in Hong Kong.

Users are advised to go through the CIC BIM Standards and customise them for their specific project applications. The target users are the Appointing Parties / Employers / Clients / Owners (later referred to Appointing Parties) or their agents in the construction industry in Hong Kong who plan to use BIM on projects. The document will help them to prepare their BIM documentation.

Background

In 2014, the CIC published a report named "Roadmap for the Strategic Implementation of Building Information Modelling (BIM) in Hong Kong's Construction Industry" with an aim to establishing a blueprint for the promotion and adoption of BIM in Hong Kong's Construction Industry. The BIM Roadmap suggested 17 initiatives in nine areas with three imminent actions. Establishment of a local BIM standards is one of the imminent actions aiming to set out a common platform and language for Hong Kong's BIM practitioners. The CIC's BIM Standards will be implemented in stages. The first Standards, renamed as CIC BIM Standards – General was published in September 2015.

Since then, BIM practitioners have gained more practical project experience, and there has been much wider adoption of BIM in various areas of the Architecture, Engineering, Construction, Owner and Operator (AECOO) industry in Hong Kong. With the release of the Technical Circular (Works) Nos. 7/2017, 18/2018, 9/2019 & 12/2020 by the Development Bureau (DEVB) of The Government of the Hong Kong Special Administrative Region (HKSAR), capital works projects with project estimates more than $30 Million are mandated to use BIM from 1st January 2018 onwards. All along the CIC has been continuing to develop and establish the CIC BIM Standards for specific BIM usages and disciplines, and to conduct consultations with relevant stakeholders, as an established practice.

With the establishment of the Task Force on BIM Standards under the Committee on BIM on 21 November 2017, the CIC has been identifying and aligning the common practices as well as setting up new standards and guidelines to facilitate better implementation and adoption of BIM in project execution. The full suite of CIC BIM standards have been published and/or updated covering specific BIM usages or disciplines separately.

As at December 2021, the full suite of CIC BIM Standards is as follows:

(i) CIC BIM Standards – General (August 2019); (Version 2 - December 2020) and (Version 2.1 - 2021)
(ii) CIC BIM Standards for Architecture and Structural Engineering (Version 2 - December 2020); and (Version 2.1 - 2021)
(iii) CIC BIM Standards for Underground Utilities (August 2019); and (Version 2 - 2021)
(iv) CIC BIM Standards for Mechanical, Electrical and Plumbing (August 2019); and (Version 2 - 2021)
(v) CIC BIM Standards for Preparation of Statutory Plan Submissions (December 2020); and (Version 1.1 - 2021)
(vi) CIC Production of BIM Objects Guide – General Requirements (August 2019); and (Version 2 - 2021);
(vii) CIC BIM Dictionary (December 2020); and (2021);
(viii) CIC BIM Exchange Information Requirements (EIR) Template (December 2020); and (Version 1.1 - 2021);
(ix) CIC BIM Special Conditions of Contract (September 2021);
(x) CIC BIM Services Agreements (September 2021); and
(xi) CIC BIM Guide for using BIM in generation of MEP digital drawings for statutory submissions (2021).

In addition, different publications of the CIC BIM Standards – General can be outlined as follows:

- CIC BIM Standards (Phase One) (September 2015) is our first publication.
- CIC BIM Standards – General (August 2019), is an update of our first publication with the title renamed and minor amendments to the Standards aiming to align the first edition of the CIC BIM Standards for Underground Utilities (August 2019) and CIC BIM Standards for Mechanical, Electrical and Plumbing (August 2019).
- CIC BIM Standards – General (Version 2 – December 2020) is our new edition. Objective is given in the paragraphs above.
- CIC BIM Standards – General (Version 2.1 – 2021) is an update of the new edition. Objective is given in the paragraphs above.

As regards implementation, Appointing Parties together with their Appointed Parties may consider their individual cases as follows:

(a) For projects due for commencement in 2022, it is advisable to adopt the CIC BIM Standard General (Version 2.1 – 2021) as far as practicable.
(b) For projects adopting Version 2 – December 2020, it is advisable to upgrade to Version 2.1 – 2021.
(c) For existing projects at an early stage using August 2019 version, Appointing Party and Appointed Parties may consider each case on its own merits as to whether or not they wish to adopt the Version 2.1 – 2021.
(d) For existing projects at an advanced stage using August 2019 version, it is advisable to continue with the use of the August 2019 publication.

For avoidance of doubt, may I clarify the current situation regarding the full suite of CIC BIM Standards publications as follows:

(a) Other CIC BIM Standards issued in 2021 will align with CIC BIM Standards – General (Version 2.1 – 2021).

(b) Other CIC BIM Standards issued in 2020 will align with CIC BIM Standards – General (Version 2 – December 2020).

(c) Both August 2019 and Version 2 – December 2020 of CIC BIM Standards - General, together with their corresponding suite of other BIM Standards, will be kept in use.

Based on feedback obtained since its Version 2 released in 2020, we are pleased to issue CIC BIM Standards – General (Version 2.1 - 2021) this year. Feedback on the CIC BIM Standards – General from practitioners subsequent to the issuance of this publication will be considered in future revisions.

On behalf of the CIC, I would like to thank everyone who has contributed to producing this CIC BIM Standards – General and subsequent updates, in particular to the members of the Task Force on BIM Standards.

Ar. Prof. Ada FUNG, BBS
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Committee on Building Information Modelling
Construction Industry Council

December 2021

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.

Definition of Abbreviations

Abbreviations	Definition	Section
ABIM	As-Built Information Model	**Section 2** – 2.16, 2.17 **Section 3** – BIM Use 20, 21, 23, 24 **Section 4** – 4.6.3 **Section 5** – 5.4
AIM	Asset Information Model	**Section 1** – 1, 1.2.2, **Section 2** – 2.2, 2.16, 2.17 **Section 3** – 3.5, BIM Use 24 **Section 4** – 4.1.3, 4.6.3 **Section 5** – 5.4, 5.6 **Annex 1** – LA.4.2 Status
AIR	Asset Information Requirements (Appendix D2)	**Section 1** – 1.1, 1.2.2 **Section 2** – 2.1, 2.2, 2.4, 2.5, 2.6.1, 2.6.3, 2.6.6 **Section 3** – 3.6.1, 3.7.2 **Section 4** – 4.6.3 **Section 5** – 5.5 **Annex 2** – 1, 2, 3 **Appendix A**
API	Application Programming Interface	**Section 2** – 2.2 **Section 3** – BIM Use 19 **Annex 3** – 2, 6
AR	Augmented Reality	**Section 3** – BIM Use 25, 26
BCF	BIM Collaboration Format	**Section 3** – 3.6.19 **Section 4** – 4.4.10 **Section 7**
BEP	BIM Execution Plan (formerly known as PXP)	**Section 1** – 1.1 **Section 2** – 2.6.7, 2.6.8, 2.13 **Section 3** – 3.6.5, 3.6.6, 3.6.10, 3.6.12, 3.6.20, 3.7, 3.7.1, 3.7.2, **Section 4** – 4.4.1 **Section 5** – 5.8.2, 5.8.3, 5.8.4, 5.8.7 **Section 6** – 6, 6.1, 6.1.2, 6.13, 6.17.3 **Annex 2** – 2 **Appendix A**
BIM	Building Information Modelling	**Section 1** – 1, 1.1, 1.2, 1.2.1, 1.2.2, 1.2.3, 1.2.4 **Section 2** – 2, 2.3, 2.5, 2.6, 2.6.1, 2.6.2, 2.6.3, 2.6.5, 2.6.6, 2.6.7, 2.6.8, 2.7, 2.10, 2.11, 2.14, 2.16, 2.17 **Section 3** – 3, 3.1-3.5, 3.6, 3.6.1-3.6.5, BIM Use 1-26, 3.6.6-3.6.14, 3.6.18-3.6.21, 3.7 **Section 4** – 4.1.1, 4.2.3, 4.2.5, 4.3.1, 4.4.7, 4.4.10, 4.4.11, 4.5, 4.5.3-4.5.7, 4.6.3 **Section 5** – 5, 5.1-5.6, 5.8.1-5.8.7 **Section 6** – 6, 6.1-6.14, 6.17, 6.17.3, 6.17.6 **Section 7** **Section 8** **Annex 2** – 1-7 **Annex 3** – 1-6, 7.1,7.2, 8 **Appendix A** **Appendix B**
BIM IP	BIM Implementation Plan	**Section 1** – 1, 1.1, 1.2 **Section 2** – 2.5, 2.6, 2.7, 2.14

Abbreviations	Definition	Section
		Section 3 – 3, 3.1-3.5, 3.6, 3.6.18, 3.7, 3.7.1 **Section 4** – 4.2.3 **Section 5** – 5.8.2, 5.8.5, 5.8.7 **Section 6** – 6.6-6.8, 6.9.1-6.9.5
CAD	Computer Aided Drafting	**Section 3** – 3.6.20 **Section 4** – 4.1.1, 4.5 **Section 6** – 6.11, 6.14, 6.14.2
CAFM	Computer Aided Facilities Management	**Section 2** – 2.17
CBWD	Combined Builder's Works Drawings	**Section 3** – BIM Use 3 **Section 5** – 5.3, 5.4
CDE	Common Data Environment	**Section 1** – 1.1, 1.2.3 **Section 2** – 2.5, 2.9, 2.14 **Section 3** – 3.2, BIM Use 19, 3.6.8, 3.6.10, 3.6.14, 3.6.15, 3.6.18, 3.6.19, 3.7, 3.7.2 **Section 4** – 4, 4.1, 4.1.2-4.1.4, 4.2, 4.2.2, 4.2.3-4.2.5, 4.2.7-4.2.10, 4.2.12, 4.3, 4.4.1, 4.4.3, 4.4.4, 4.4.6, 4.4.7, 4.4.11, 4.5, 4.5.1, 4.5.5, 4.5.7, 4.6, 4.6.1, 4.6.2 **Section 5** – 5.8.2, 5.8.4 **Annex 1** – LA.2.1, LA.2.2, LA.3.1, LA.4.1, LA.4.2 **Annex 2** – 1 **Annex 3** – 5 **Appendix A**
CFD	Computational Fluid Dynamic	**Section 3** – BIM Use 10, BIM Use 22
CIC	Construction Industry Council, Hong Kong	**Section 2** – 2.6.2, 2.6.3, 2.6.8, 2.7, 2.10 **Section 4** – 4.4.7 **Section 5** – 5.2, 5.4 **Section 6** – 6.9, 6.9.1, 6.9.2, 6.9.4, 6.9.5, 6.10, 6.11 **Annex 2** – 1, 3 **Appendix B**
CICBIMS	Construction Industry Council Building Information Modelling Standards – General	**Section 1** – 1.1 **Section 2** – 2.7 **Section 3** – **3** **Section 6** – 6, 6.11
CNC	Computer Numeric Control	**Section 3** – BIM Use 14
cPIM	Construction Project Information Model	**Section 1** – 1 **Section 2** – 2.14 **Section 5** – 5.3, 5.8.7
COBie	Construction Operations Building Information Exchange	**Section 2** – 2.2 **Section 3** – 3.6.8 **Section 4** – 4.6.3 **Section 5** – 5.4, 5.6 **Section 8** **Annex 1** – LA.5.1
CQMS	Construction Quality Management System	**Section 3** – BIM Use 19
CR	Construction Record	**Section 4** – 4.4.1 **Annex 1** – LA.4.2
DfMA	Design for Manufacture and Assembly	**Section 3** – BIM Use 13 **Section 5** – 5.8.7
DIM	Design Information Model	**Section 2** – 2.15

Abbreviations	Definition	Section
		Section 5 – 5.2, 5.3
dPIM	Design Project Information Model	**Section 2** – 2.14 **Section 5** – 5.2, 5.3, 5.8.7
DOC	Level of Documentation	**Section 2** – 2.6.1, 2.6.4
DWSS	Digital Work Supervision System	**Annex 3** – 2
EDMS	Electronic Document Management Systems	**Section 2** – 2.17
EIR	Exchange Information Requirements	**Section 1** – 1.1, 1.2.3 **Section 2** – 2.2, 2.3, 2.5 **Section 3** – 3.4, 3.6.4, 3.6.17, 3.7.1, 3.7.2 **Section 4** – 4.2.8, 4.2.10, 4.6.3 **Section 5** – 5.8.1, 5.8.7 **Annex 1** – LA.5.1 **Appendix A**
GIS	Graphical Information System	**Annex 3** – 6, 8 **Appendix A**
HIM	Heritage Information Modelling	**Section 3** – 3.6.5, BIM Use 26
ICT	Information and Communication Technologies	**Section 3** – 3.6.3
ID	Information Identification / Information Container Identifier	**Section 4** – 4.4.7
IDM	Information Delivery Manual	**Section 4** – 4.3.1
IFC	Industry Foundation Classes	**Section 2** – 2.2 **Section 3** – 3.6.8, 3.6.20 **Section 4** – 4.3.1, 4.6.3 **Section 5** – 5.8.2 **Section 6** – 6.6 **Section 7** **Annex 1** – LA.5.1 **Annex 3** – 6
IFD	International Framework for Dictionaries	**Section 2** – 2.6.6
IWMS	Integrated Workplace Management Systems	**Section 2** – 2.17
JSON	JavaScript Object Notation	**Section 2** 2.2
LOD-G	Level of Graphics	**Section 1** – 1.1 **Section 2** – 2.6, 2.6.1, 2.6.2, 2.6.7, 2.6.8 **Section 4** – 4.2.5, 4.5.1 **Section 5** – 5.2, 5.3, 5.8.4 **Annex 2** – 2
LOD-I	Level of Information	**Section 1** – 1.1 **Section 2** – 2.2, 2.5, 2.6, 2.6.1, 2.6.3, 2.6.8 **Section 3** – 3.6.6, 3.6.14, 3.6.17, 3.6.18, 3.7.2 **Section 4** – 4.2.5, 4.2.8, 4.5.1 **Section 5** – 5.2, 5.3, 5.8.3 **Section 6** – 6.9.1, 6.9.2, 6.9.3, 6.9.4, 6.9.5 **Appendix A** **Appendix C**
LOIN	Level of Information Need	**Section 2** – 2.1, 2.6, 2.6.1, 2.6.3, 2.6.4, 2.6.5, 2.6.6

Abbreviations	Definition	Section
	(formerly known as Level of Development (LOD))	**Section 3** – 3.6.4, 3.6.12, 3.6.17, 3.7.2 **Section 4** – 4.2.5 **Section 5** – 5.2, 5.3 **Annex 2** – 2
MEP	Mechanical, Electrical and Plumbing	**Section 2** – 2.6.2, 2.6.3, 2.6.8 **Section 3** – 3.6.1, BIM Use 3 **Section 5** – 5.4 **Section 6** – 6.9, 6.9.4 **Annex 2** – 2, 3
MiC	Modular Integrated Construction	**Section 3** – BIM Use 13 **Section 5** – 5.8.7 **Annex 1** – LA 3.6
MIDP	Master Information Delivery Plan	**Section 1** – 1.1, 1.2.3 **Section 2** – 2.13, 2.14 **Section 3** – **3.6.16**, **3.6.18**, 3.7.2 **Section 4** – 4.4.3 **Section 5** – 5.2, 5.3 **Appendix A**
MMC	Modern Methods of Construction	**Section 5** – 5.8.7
MR	Mixed Reality	**Section 3** – BIM Use 25
NFC	Near Field Communication	**Section 2** – 2.6.6 **Section 3** – BIM Use 26
OIR	Organisational Information Requirements (Appendix D1)	**Section 1** – 1.1 **Section 2** – **2.1**, 2.2, 2.4, 2.5, 2.17 **Appendix A**
PDT	Product Data Template	**Section 2** – **2.6.3**, 2.13
PDS	Product Data Sheet	**Section 2** – **2.2**, **2.6.6**, 2.16
PIM	Project Information Model	**Section 1** – 1.2.2, 1.2.3, 1.2.4 **Section 2** – 2.14, 2.15, 2.16 **Section 3** – 3.4, 3.6.7 **Section 4** – 4.1.3 **Section 5** – **5.1**, **5.2** **Annex 1** – LA 4.2 **Appendix A**
PIR	Project Information Requirements (Appendix D3)	**Section 2** – **2.3**, 2.5 **Section 3** – 3.6.4, 3.7.2 **Section 4** – 4.1, 4.2.10 **Annex 1** – LA.6.1 **Appendix A**
QR Code	Quick Response Code	**Section 2** – 2.2, 2.6.6
QTO	Quantity Take-off	**Section 3** – 3.6.5, BIM Use 8 **Section 5** – 5.3, 5.8.3
RFID	Radio Frequency Identification	**Section 2** – 2.2, 2.6.6 **Section 3** – BIM Use 26
ROI	Return on Investment	**Section 2** – 2.3
SIR	Security Information Requirements (Appendix D4)	**Section 1** – 1.1 **Section 2** – **2.4**, 2.5, 2.12 **Section 3** – 3.6.10, 3.7.2 **Section 4** – 4.6.2
SMP	Standards, Methods, and Procedures	**Section 1** – 1.2.3, 1.2.4 **Section 2** – **2.7**

Abbreviations	Definition	Section
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TIDP	Task Information Delivery Plan	**Section 1** – 1.1, 1.2.3, 1.2.4 **Section 2** – 2.6.4, 2.13 **Section 3** – 3.6.6, **3.6.16**, **3.6.17**, **3.6.18**, 3.7.2 **Section 5** – 5.2, 5.3 **Appendix A**
UAV	Unmanned Aerial Vehicle	**Section 3** – BIM Use 26
VR	Virtual Reality	**Section 3** – BIM Use 25
WIP	Work in Progress	**Section 4** – **4.2**, **4.2.1**, 4.2.2, 4.2.3, 4.2.5, 4.2.7, 4.4.1, 4.4.2, 4.4.9, 4.4.11, 4.5, 4.5.3, 4.5.5, 4.5.7 **Section 5** – 5.4 **Annex 1** – LA.4.2, LA.4.3 **Appendix A** **Appendix C**
XML	Extensible Markup Language	**Section 2** – 2.2

The above abbreviations are not exhaustive. Reference should be made to the CIC BIM Dictionary for additional abbreviations and definitions.

While list of cross references to the relevant sections for the above abbreviations are provided, hyperlinks are provided only for terms that have been specifically defined in this Standards, and for the defining and major referenced sections of such abbreviations.

The CICBIMS requirements are expressed in sentences in which the principal auxiliary verb is “shall”. Recommendations are expressed in sentences in which the principal auxiliary verb is “should”. Use of the auxiliary verb “can” indicates that something is technically possible, and the auxiliary verb “may” indicate permission.

Introduction

Purpose

The CIC BIM Standards – General (CICBIMS) is designed to enable an Appointing Party / Client to specify, manage and assess BIM deliverables by architects, engineers, surveyors and contractors in Hong Kong. The use of the CICBIMS should ensure that project deliverables produced using the BIM processes achieve an agreed level of quality.

The principle of the development of the CICBIMS is that the planning, implementation, management and checking of the use of BIM on a project requires Appointing Party's / Client's direction, involvement, and leadership along with design consultant and contractor collaboration. The CICBIMS is also characterised by information management throughout the whole project delivery cycle as indicated in Figure 1.

Figure 1 Project delivery cycle ISO 19650-1:2018(E)

Key

- **A** - Start of the delivery phase – transfer of relevant information from Asset Information Model (AIM) to Project Information Model (PIM)
- **B** - Progress development of the design intent model into the virtual construction model
- **C** - End of the delivery phase – transfer of relevant information from PIM to AIM

Note:
The Delivery phase is referenced to ISO 19650-2.
The Operational phase is referenced to ISO 19650-3.
This document supports the Delivery phase and incorporates the principles associated with the Operational phase.

The ISO 19650 Series of standards

The ISO 19650 Series: *Organisation and digitisation of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling* – presently includes the following published standards:

- ISO 19650-1:2018, Part 1: Concepts and principles (First Edition, 2018);
- ISO 19650-2:2018, Part 2: Delivery phase of the assets (First Edition, 2018);
- ISO 19650-3:2020, Part 3: Operational phase of the assets (First Edition, 2020); and
- ISO 19650-5:2020, Part 5: Security-minded approach to information management (First Edition, 2020).

The CICBIMS takes on board the principles of the above four published ISO standards, but detailed implementation of the CICBIMS relates specifically to ISO 19650-2:2018, Part 2: Delivery phase of the assets. An Appointing Party / Client may need to refer to ISO 19650-3:2020, Part 3: Operational phase of the assets, and ISO 19650-5:2020, Part 5: Security-minded approach to information management, for detailed requirements or clarification.

Hong Kong 'Local Annex' of ISO 19650-2:2018

Annex 1 of this document serves as the Hong Kong 'Local Annex' of ISO 19650-2:2018 with the rest of this document providing guidance upon its implementation.

The role of the Hong Kong 'Local Annex' is to clarify the implementation of the CICBIMS within the HKSAR. This 'Local Annex' assists users in understanding the implementation of ISO 19650-2:2018 in Hong Kong by translating the key terms and expanding on the requirements.

The key components of the **Hong Kong 'Local Annex'** relating to ISO 19650-2:2018 are:

- Information Identification / Information Container Identifier (ID);
- Information container metadata;
- Status codes;
- Revisions;
- Classification;
- Information Model exchange;
- Level of Information Need (LOIN); and
- Project Information Requirements (PIR).

Building Information Modelling (BIM) is a process of generating and managing building information during the planning, design, construction, operation and maintenance stages of a building or an asset throughout its life cycle. Typically, the process uses three-dimensional building modelling software(s) to increase the productivity of consultants and contractors during design and construction. All the information collected / generated during these stages can be utilised during the operation and maintenance stage.

The process produces Information Model(s), which encompasses building geometry, spatial relationships, geographic information, quantities, properties and other assigned metadata of building elements. Information Model shall then be utilised by different stakeholders at different stages for different purposes.

The CICBIMS establishes a process for adopting BIM on building and infrastructure projects in Hong Kong. Appointing Parties / Clients, project managers, architects, engineers, surveyors, contractors, manufacturers and facility managers can refer to the CICBIMS to understand their roles and responsibilities on a project.

Every project, whether this defines just a specific stage (e.g.: Design) or the entire life cycle of a facility that adopts BIM, shall have a clearly defined outcome from the BIM process. The purpose of the BIM process should be set out and agreed by the Appointing Party / Client with the design consultants and contractor at the beginning of a project or project stage.

The successful delivery of the BIM process to meet the established targets requires careful planning, detailed BIM specifications and a defined set of procedures and methodologies for the implementation of the BIM process.

The production of Information Model(s) is carried out by architects, engineers, surveyors, and contractors with different software applications and at different times during the phases of the project development. The Appointing Party / Client should appoint a professional BIM Manager to lead and support the BIM process. The BIM Manager could be an architect, engineer, surveyor, contractor, or an independent BIM professional with relevant practical construction knowledge and design coordination experience.

The CIC BIM Standards – General (CICBIMS) may be used as a Framework by the Appointing Parties / Clients, architects, engineers, surveyors and contractors as it contains information and advice on how to implement BIM on a project. There are other BIM publications issued by CIC and other organisations which form a comprehensive collection to suit various industry needs.

The hierarchy of these publications are illustrated in Figure 2 below:

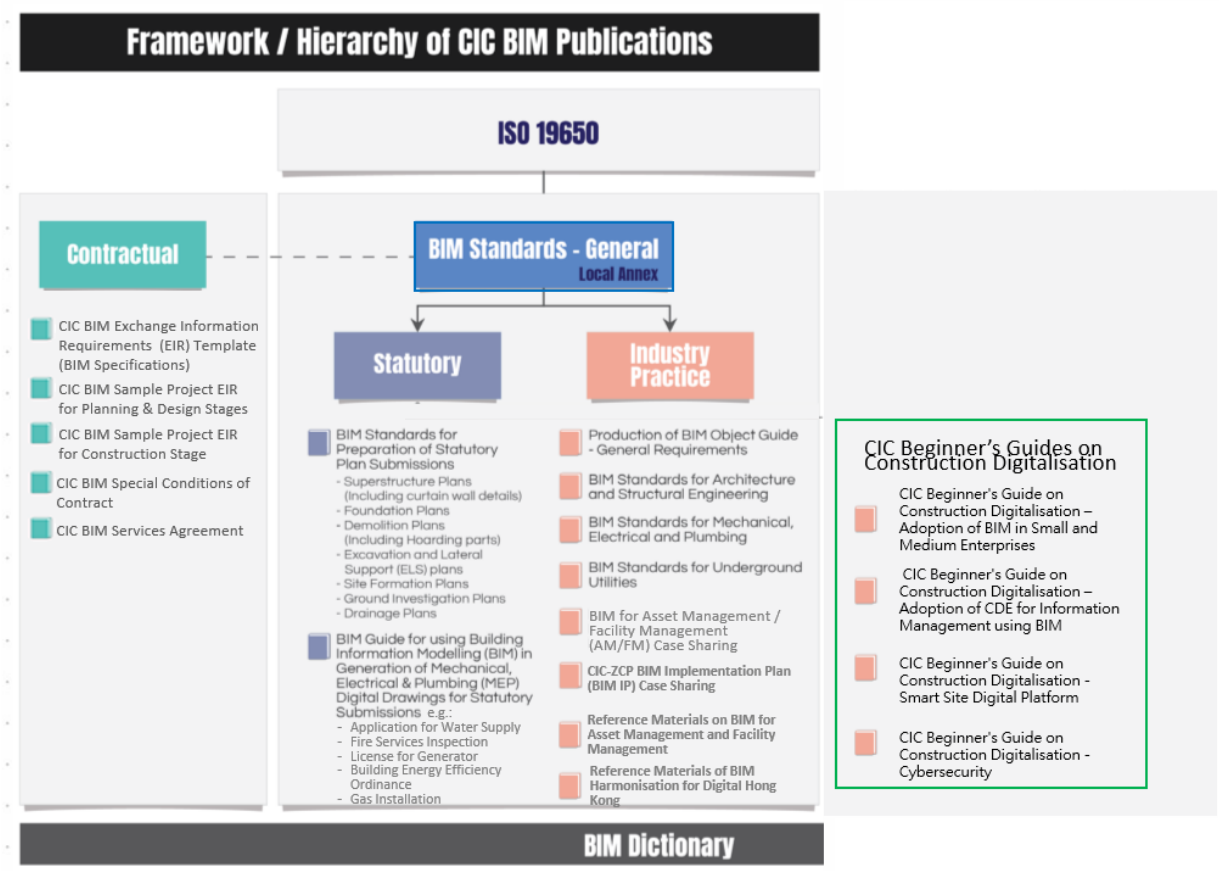

Figure 2 Framework / Hierarchy of CIC BIM Publications

It shall be noted that this CIC BIM Standards General shall be used in conjunction with the ***CIC BIM Exchange Information Requirements (EIR) Template (BIM Specifications) Version 1.1 - 2021, CIC BIM Special Conditions of Contract and BIM Services Agreement***.

1 Information Management [aligned with ISO 19650]

The process of information management as identified in ISO 19650 requires the Appointing Party / Client to define their BIM information requirements prior to the appointment of a Delivery Team for relevant stage(s) of a project, i.e., planning, design, construction, or operation.

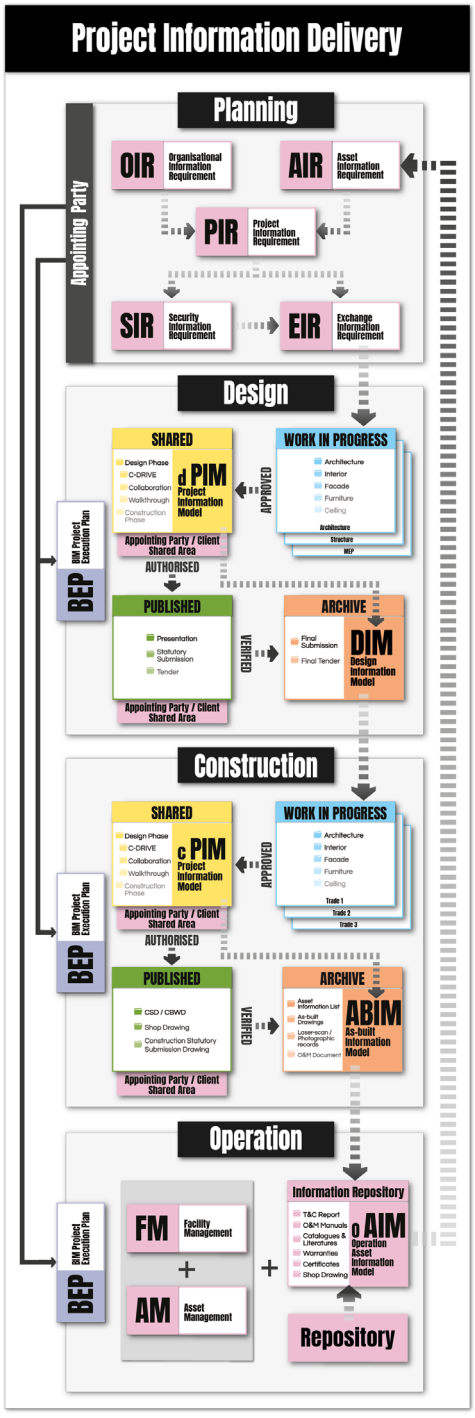

Figure 3 Project Information Delivery

The concept is that these BIM Requirements developed and modified throughout the project life cycle, with the information developed at each stage being used to enrich the requirements for the next project or project stage.

As well as the information requirements being developed by the Appointing Party / Client, shared resources are identified. These can include existing information about a site or built asset, and also models and drawings of the asset or previous project stage undertaken. Therefore, the BIM deliverables produced at the design stage are provided as shared resources within the construction stage from which the Contractor can develop appropriate construction models.

Likewise, the construction models should be filtered to provide the Asset Information Model (AIM) as part of the shared resources to facilitate the operations stage.

If the project is procured as a Design / Build / Operate project the BIM Requirements should be delivered in a manner to facilitate the different needs over the full project life cycle. In conventional practice, design, construction and operation activities are dealt with as separate projects, in which case the completed BIM deliverables and BIM Implementation Plan from one project stage should be used to develop the BIM Requirements for the next project stage.

It should also be noted that the requirements of ISO 19650 should be applied in a way that is proportionate and appropriate to the scale and complexity of the asset or project.

Standardisation of many of the requirements, templates and tools facilitates the ease of use and helps in developing an appropriate approach whilst achieving the recognised benefits.

1.1 Framework and Workflow

The information management framework identifies eight specific activities to be undertaken in relation to a project. No information is provided regarding the definition of a project or stages within a project, which are left to industry to interpret. The activities identified are defined as:

1. Assessment and need;
2. Invitation to tender;
3. Tender response;
4. Appointment;
5. Mobilisation;
6. Collaborative production of information;
7. Information Model delivery; and
8. Project close-out.

The framework also identifies three parties which are:

1. Appointing Party / Client (Employer);
2. Lead Appointed Party (Lead Consultant or Lead Contractor); and
3. Appointed Parties (Task Teams).

The activities and parties are illustrated in Figure 4. Whilst the framework as set out in ISO 19650 allows for multiple Lead Appointed Parties and Delivery Teams, it is recognised that this sometimes fails to achieve the benefits of collaboration, therefore a single Lead Appointed Party should be identified for each project stage. Since the project stages usually overlap, particularly design and construction, the Lead Appointed Party for design should remain in that function for the design stage even though they may have a secondary function as part of the construction stage.

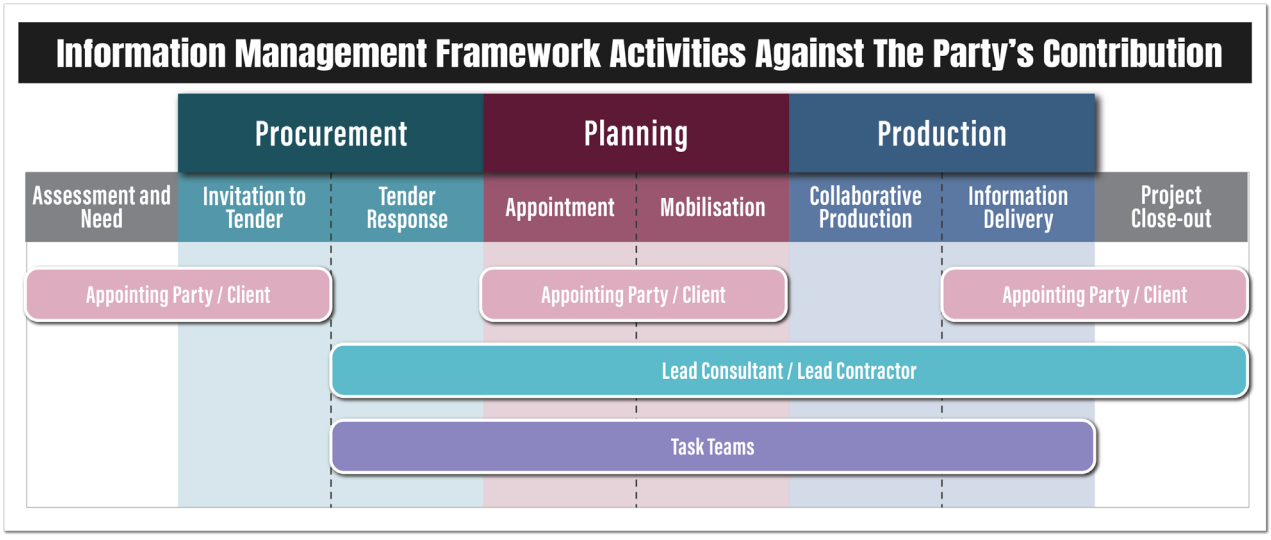

Figure 4 Information Management Framework activities against the party's contribution

Associated with each party is delivery of a series of resources or content generally provided as documentation of the requirements or responsibilities. Within the CICBIMS, the Appointing Party's / Client's resources or content are grouped under the title of BIM Requirements. For the Delivery Team (Lead Consultant / Lead Contractor and Task Teams)

this is identified as the BIM Project Implementation Plan (BIM IP). The BIM IP is initially identified as the Pre-appointment BIM IP prior to appointment and is then expanded into the project BIM IP post appointment. Table 1 identifies the resources and content to be produced by each party as well as the documentation set they belong to.

Note: No internationally agreed terms are defined for the collection of the Appointing Party's / Client's requirements or the collection of the responses from the Delivery Team.

Resource or Content	Produced by	BIM Documentation set	Implementation
Organisational Information Requirements	Appointing Party / Client	BIM Requirements	Per Organisation
Asset Information Requirements	Appointing Party / Client	BIM Requirements	Per Organisation
Security Information Requirements	Appointing Party / Client	BIM Requirements	Per Project
Project's information requirements	Appointing Party / Client	BIM Requirements	Per Project
Project's information delivery milestones	Appointing Party / Client	BIM Requirements	Per Project
Exchange information requirements	Appointing Party / Client	BIM Requirements	Per Project
Level of Information Need	Appointing Party / Client	BIM Requirements	Per Project
Project's information standard	Appointing Party / Client	BIM Requirements	Per Project
Project's information production methods and procedures	Appointing Party / Client	BIM Requirements	Per Project
Reference information	Appointing Party / Client	BIM Requirements	Per Project
Shared resources	Appointing Party / Client	BIM Requirements	Per Project
Project's information protocol	Appointing Party / Client	BIM Requirements	Per Project
Security Management Plan	Appointing Party / Client	BIM Requirements	Per Project
Proposed schedule of software, hardware, CDE and IT infrastructure	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Appointment
(Pre-appointment) BIM execution plan	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Appointment
High level responsibility matrix	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Appointment
Proposed information delivery strategy	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Appointment
Proposed federation strategy	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Appointment
Capability Assessment of Task Team	Per Task Team	BIM Implementation Plan – Pre-appointment	Per Task Team
Summary of the Delivery Team's capability and capacity	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Appointment
Proposed mobilisation plan	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Project
Risk register	Lead Consultant / Lead Contractor	BIM Implementation Plan – Pre-appointment	Per Project

Resource or Content	Produced by	BIM Documentation set	Implementation
Delivery Team's BIM execution plan	Lead Consultant / Lead Contractor	BIM Implementation Plan	Per Project
Detailed responsibility matrix	Lead Consultant / Lead Contractor	BIM Implementation Plan	Per Project
Information delivery strategy	Lead Consultant / Lead Contractor	BIM Implementation Plan	Per Project
Schedule of software, hardware, CDE and IT infrastructure	Lead Consultant / Lead Contractor	BIM Implementation Plan	Per Project
Lead Consultant's / Lead Contractor's Exchange Information Requirements	Lead Consultant / Lead Contractor	BIM Implementation Plan	Appointed party appointment
Task Information Delivery Plan (TIDP)	Per Task Team	BIM Implementation Plan	Per Task Team
Master Information Delivery Plan (MIDP)	Lead Consultant / Lead Contractor	BIM Implementation Plan	Per Project
Lessons learned	Appointing Party / Client	Asset Management Strategy	Per Project

Table 1 Schedule of required Resources and Content defined under ISO 19650-1

As illustrated in Figure 5, the principles of the framework place the burden of responsibilities onto the Appointing Party / Client to define what they want at each stage of the life cycle, based upon the information they have, establishing the principles of "Starting with the end in mind". Detailed explanation of each item of the resource or content requirements is provided later within the guidance.

Note: The framework allows for the Appointing Party / Client to take on a third party to undertake the relevant obligations on their behalf. This is the recognised approach where the Appointing Party / Client does not have the appropriate resources.
Similarly, a Lead Appointed Party (Lead Consultant or Lead Contractor) may also take on a third party to undertake their obligations where they do not have the appropriate resources.

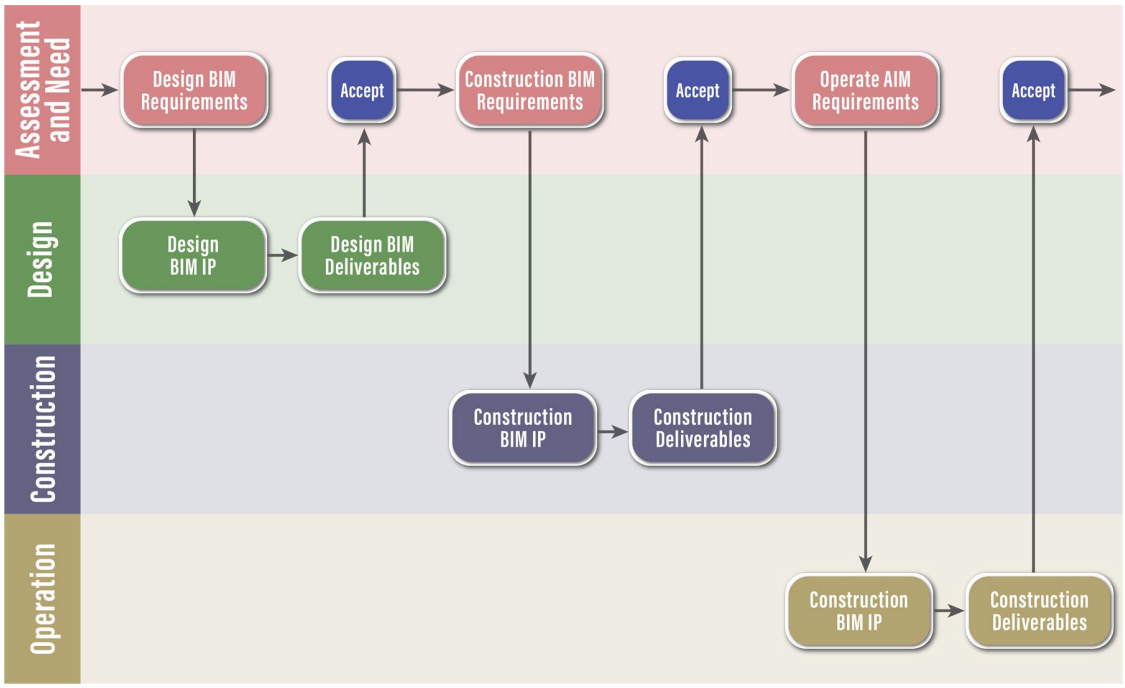

Figure 5 Life cycle BIM Requirements and BIM IPs showing Appointing Party / Client input through Assessment and Need

Figure 6 below summarises the BIM framework and workflow throughout a complete project life cycle:

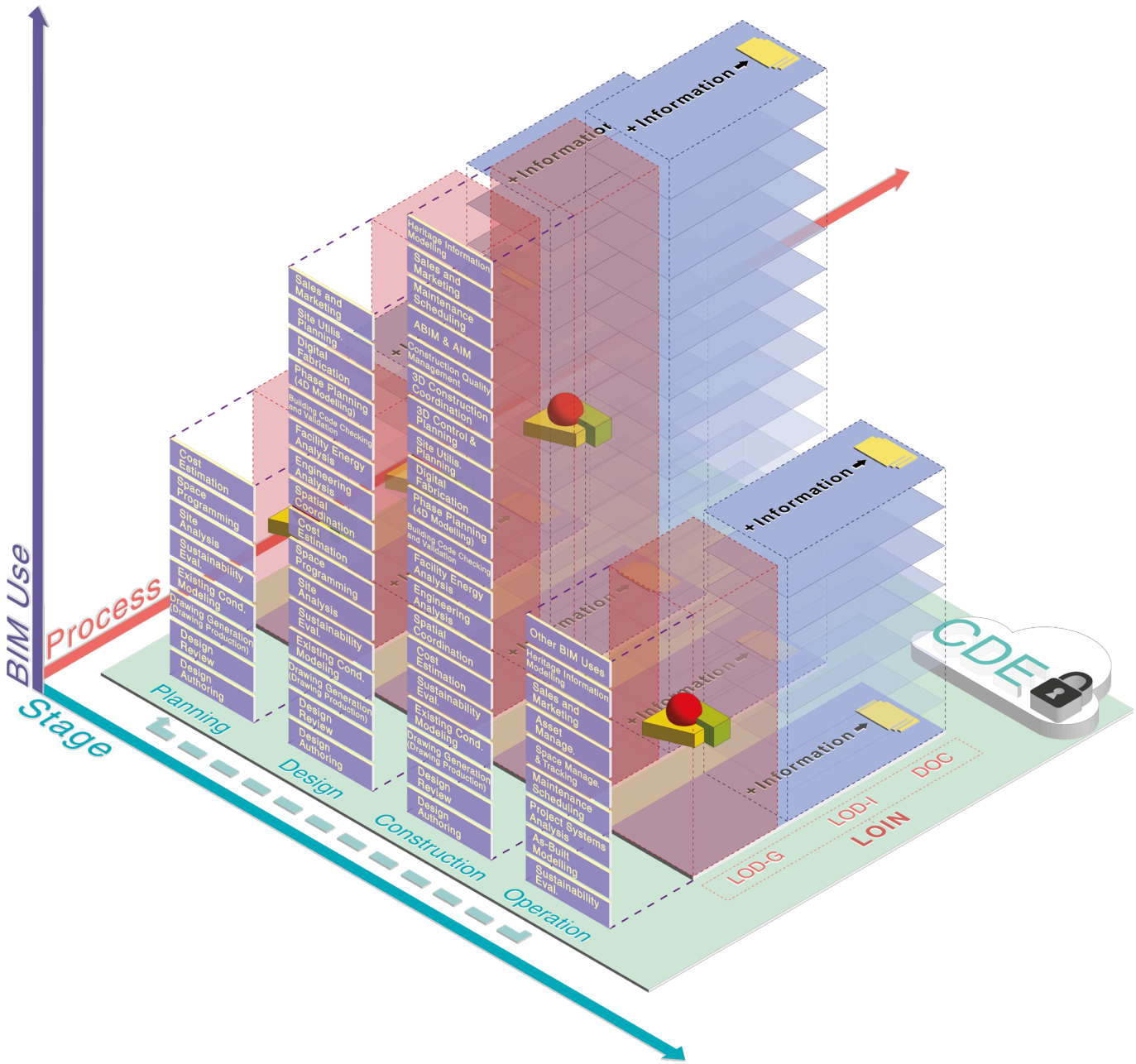

Figure 6 Summary diagram of BIM framework and workflow

1. **Stage:** Information should flow throughout the Project Life Cycle: planning, design, construction and operation. Experience in adopting the BIM Uses in the operation stage should form the requirements for the organisation's next project.
2. **BIM Use:** Different BIM Uses across different phases.
3. **Process**: For every BIM Use, there is a process that involves Geometry (LOD-G), Information (LOD-I) and Documentation (DOC). (See Section 2.6 Level of Information Need)
4. Through the different stages, it is desirable that all the Information Exchange should happen within a controlled virtual environment – the **Common Data Environment (CDE).**

1.2 Parties

As illustrated in Figure 7, an essential aspect of effective information management are clear definitions of ownership, responsibility and accountability among the following parties and project functions:

- **Appointing Party / Client** (Employer)
  - Appointing Party / Client delivery management function;
  - Appointing Party / Client information management function;
  - Asset information management function; and
  - Security information management functions.

- **Lead Appointed Party** (Lead Consultant / Lead Contractor)
  - Project delivery management; and
  - Project information management.

- **Appointed Parties** (Task Team management functions)
  - Task management;
  - Task information management;
  - Interface management; and
  - Information authoring.

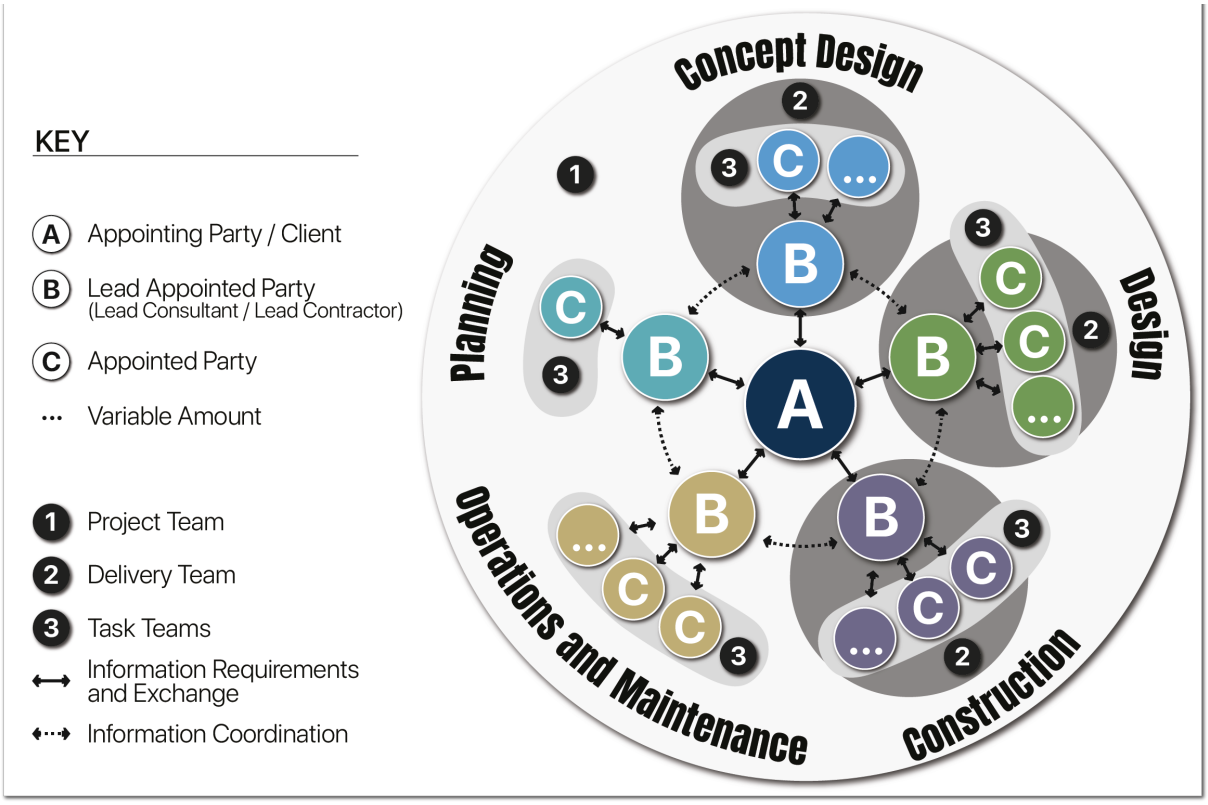

Figure 7 Relationship of Parties

Prior to the appointment of any parties, it is important to establish the capability and capacity of those undertaking these information management functions. Résumés, individual certification, and professional memberships are acceptable methods of reviewing capability. Functions can be handled differently depending upon the size and complexity of a project, while information management responsibilities are likely to be only a part of the functional responsibilities that an individual will undertake on a project. For example, an individual may undertake the responsibilities of Project Information Management and Task Team information management whilst their predominant role is the project Architect, as well as undertaking Lead Consultant's responsibilities.

On small simple projects, it is likely that a single individual may take on multiple functions. On large complex projects, the opposite may apply and multiple individuals may be required to undertake a single information management function. Whichever is the case, the functions should be clearly documented within the information management assignment matrix as part of the BIM IP.

A clear definition of the tasks and those responsible should be identified in the information management assignment matrix provided by the Appointing Party / Client as identified under Appendix A. This should then be expanded by the Delivery Team and managed throughout the project.

1.2.1 Project Information Management Functions

The Appointing Party / Client is required to assign their information management functions to appropriate Appointed Parties to ensure the BIM Requirements are defined and delivered. The project information management functions should be assigned to the Lead Appointed Party for the specific project stage being undertaken. During the design stage, the functions should be undertaken by the Lead Consultant, and during the construction stage, the functions should be undertaken by the Lead Contractor.

Information delivery management should ensure that the right teams produce the correct information at the right time to meet the design and/or construction management requirements. Information management is not a silo and should take on board design management and/or construction management needs depending upon the project stages being undertaken.

1.2.2 Appointing Party / Client Management Functions

The initial burden of information management lies with the Appointing Party / Client, who should facilitate the process by defining their needs as the BIM Requirements. It is recognised that few Appointing Party / Client have the appropriate knowledge or skill base to undertake this work, and therefore, the process allows for a third Party to undertake this work on behalf of the Appointing Parties / Client.

Where the Appointing Party / Client outsources this work, they should identify a clear scope of services for the function to be undertaken.

A clear definition of the tasks and those responsibilities should be identified in the information management assignment matrix provided by the Appointing Party / Client as identified under Appendix A.

Appointing Party / Client Delivery Management Function
The Appointing Party / Client has a requirement to define their BIM Requirements and an

obligation to only accept compliant information. There is also the obligation to accept information on behalf of the Appointing Party / Client to meet project milestones.
These are identified as Tasks to be assigned to a Delivery Management Function.

This Delivery Management Function is likely to be undertaken by those with job titles such as project manager, Appointing Party's / Client's agent, or their representative.

Appointing Party / Client Information Management Function
The Appointing Party / Client also needs to identify an Information Management Function which will ensure that the information requirements are clearly defined and documented, plus supporting the delivery function. This will also ensure access to the Appointing Party's / Client's shared resources, information formats, and that deliverables are all identified. Ongoing reviews are also part of the tasks likely to be assigned to those undertaking this function. Verification of information against the requirements is also an appropriate task.

This Information Management Function is likely to be undertaken by those with job titles such as Appointing Party's / Client's BIM Manager, document controller or their representative.

Appointing Party / Client Security Management Function
The initial burden of information security lies with the Appointing Party / Client, who should undertake the security triage process, and if a risk is assessed then appoint somebody to undertake the security functions on behalf of the Appointing Party / Client.

This Security Management Function is likely to be undertaken by those with job titles such as quality manager or security officer.

Appointing Party / Client Asset Management Function
The Appointing Party / Client has a requirement to define their Asset Information Requirements (AIR) and ensure delivery against this. This will identify an Asset Management Function who will also identify what information is required from the Project Information Model (PIM) for the Asset Information Model (AIM).

This Asset Information Function is likely to be undertaken by those with job titles such as operations manager or facilities manager.

1.2.3 Lead Consultant / Lead Contractor

Depending upon the project stage, the function of the Lead Appointed Party should be undertaken by either the Lead Consultant or the Lead Contractor. They have specific duties to undertake and are responsible for:

- Task Team(s) appointments and defining the information production responsibilities of each team;
- Defining the Volume Strategy and assigning the appropriate level of definition (Volume Module);
- Developing and gaining consensus for the project Standards, Methods, and Procedures (SMP);
- Responding to the Appointing Party's / Client's information requirements within the BIM Implementation Plan;
- Documenting and validating the information requirements within the Lead Appointed Party's EIR(s); and

- Reviewing the PIM against the Appointing Party's / Client's information requirements and authorizing its contractual delivery on behalf of the Delivery Team.

This function is likely to be undertaken by those with job titles such as Lead Architect, Lead Engineer or Lead Contractor.

Project Information Delivery Management Function
The Lead Appointed Party is responsible for specific delivery management tasks associated with information management as well as the traditional design and construction management tasks. The information delivery duties to be undertaken may include:

- Compiling and managing the Master Information Delivery Plan (MIDP) from the Task Teams' Task Information Delivery Plan (TIDP);
- Assessing Task Teams' capacity to deliver information in accordance with the MIDP;
- Assuring the PIM is delivered in accordance with the MIDP;
- Managing risks associated with the delivery of the PIM; and
- Ensuring effective communication between the Appointing Party / Client, Lead Consultant / Lead Contractor, and each of the Task Teams.

This Delivery Management Function is likely to be undertaken by those with job titles such as project manager or delivery manager.

Project Information Management Function
The Lead Appointed Party is responsible for specific information management tasks as well as the information delivery tasks. The information management duties to be undertaken may include:

- Assessing Task Teams' capability to produce information in accordance with the SMP;
- Ensuring the availability of the Common Data Environment to all Task Teams;
- Assuring the PIM is produced in accordance with the project SMP;
- Managing risks associated with the production of the PIM; and
- Reviewing and authorizing the PIM on behalf of the Lead Appointed Party.

This Project Information Management Function is likely to be undertaken by those with job titles such as BIM Manager or Project Manager.

1.2.4 Task Information Management Functions

Task Teams are responsible for ensuring that information is delivered accurately and on time to meet project programs and requirements. the Information Management Functions breakdown for each Task Team can be generally described as:

- Team management;
- Information management;
- Interface management; and
- Information authors.

Task Team Management
The Task Team management function is responsible for the Task Team delivery and there are specific management tasks that need to be assigned or to be undertaken including:

- Task information management role appointments;

- Developing the Task Information Delivery Plan (TIDP);
- Ensuring the availability and capacity of competent resources to execute the TIDP;
- Approving the information produced by the Task Team against the task brief;
- Assigning the appropriate status (suitability) of the information shared by the Task Team; and
- Identifying and where necessary escalating risks associated with the delivery of the PIM.

This function is likely to be undertaken by those with job titles such as Architect or Engineer.

Task Information Management
Each Task Team is responsible for timely delivery of information to meet project needs. The information management functions for each Task Team may include:

- Ensuring the Task Team is producing information in accordance with the project SMP;
- Assuring (pass/fail) that the information produced by the Task Team is compliant with the project SMP (before being shared);
- Providing education and support to information authors with respect to the project SMP; and
- Identifying and where necessary escalating risks associated with the production of the PIM.

This function is likely to be undertaken by those with job titles such as BIM Coordinator or Document Controller.

Interface Management
Each Task Team is responsible for spatial coordination of information with other Task Teams. The interface management functions for each Task Team may include:

- Resolving spatial coordination issues with other Task Teams;
- Escalating unresolved coordination issues to the Lead Consultant / Lead Contractor; and
- Keeping the Task Team updated with agreed resolutions and progress of ongoing resolutions.

This function is likely to be undertaken by those with job titles such as BIM Manager / BIM Coordinator, Architect, or Engineer.

Information Authoring
The key function of each Task Team is the production of information (i.e., Information Authoring). Those undertaking the function of authoring information have the following obligations:

- Creating files and ensuring the appropriate file attributes are captured correctly;
- Producing and/or amending information in accordance with the BIM Requirements;
- Producing and/or amending information in accordance with the BIM IP;
- Ensuring graphical models (each Task Team produces) are spatially coordinated (clash avoidance) and escalating any interface issues to the BIM Manager;
- Ensuring all elements of the PIM are fully coordinated with each other (graphical, non-graphical and documentation); and
- Checking submitted information prior to review and approval in accordance with the TIDP.

This function is likely to be undertaken by all those working within a Task Team.

1.3 Information Management Process

The Information Management Assignment Matrix shown in Appendix A Information Management Assignment Matrix Example, identifies each of the information management functions mapped to Information Tasks. This provides clear ownership and responsibility against each function.

Examples of how this can be applied to projects are found in Section 3.

2 Information Requirements

The BIM Requirements are a collection of the content and resources identified by the Appointing Party / Client as shown in Figure 8. The BIM Requirements set out the how, what and when from the Appointing Party's / Client's perspective to specify what should be provided by the Delivery Team. A complete view of all the resources and content, who provides these and what document set they belong to is given in *Table 1 Schedule of required Resources and Content defined under ISO 19650*. This section provides an explanation of each item of the content and resources which make up the BIM Requirements.

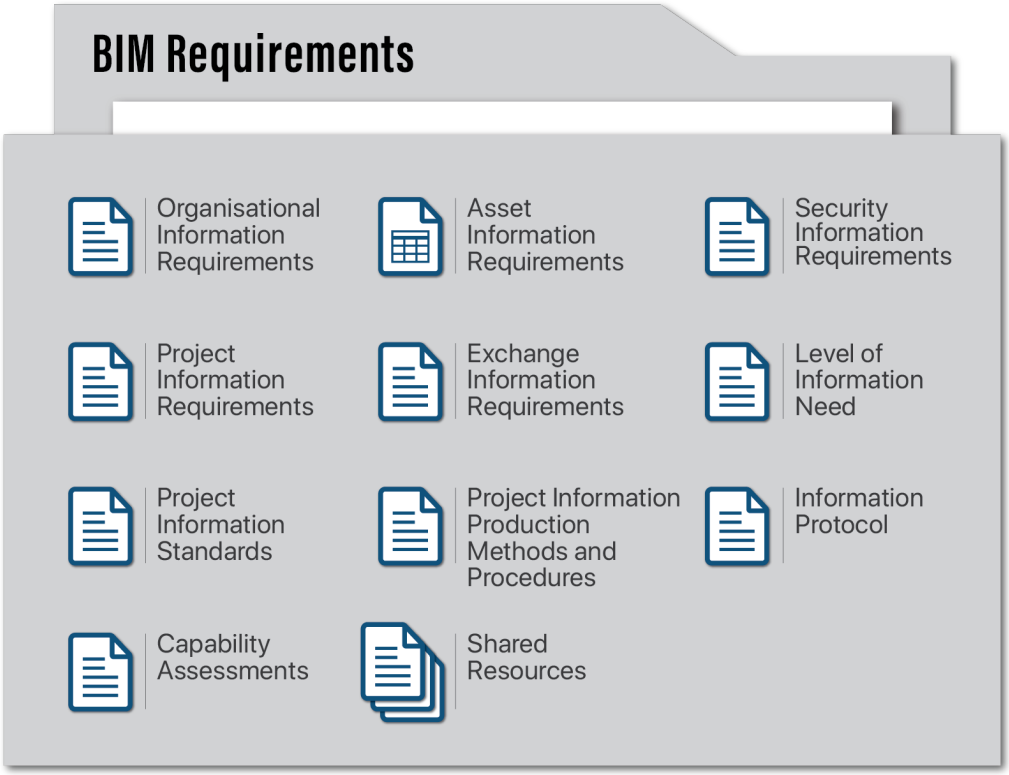

Figure 8 Contents of the BIM Requirements

The purpose of the BIM Requirements is to set out the need for "starting with the end in mind" and should aid in providing at least the following:

- The Appointing Party's / Client's strategic goals for implementing BIM;
- The Level of Information Need (LOIN) is required to meet the Appointing Party's / Client's requirements, and purposes along with the requirements to facilitate their decision making and business needs;
- The file formats, data types, software requirements and modes of delivery to enable a life cycle approach to information management;
- A clear ownership and responsibility strategy along with quality assurance procedures to facilitate trust in the information delivered; and
- A clear definition of the Appointing Party's / Client's requirements to facilitate reduction of waste and effort by the Delivery Team whilst reducing information costs for the Appointing Party / Client over the project life cycle.

2.1 Organisational Information Requirements (OIR) (Appendix D1)

Organisational Information Requirements (OIR) are aimed predominantly at defining the information required by an organisation to answer or inform high-level strategic objectives rather than asset level or project specific objectives. OIR can be defined at multiple tiers of an organisation's hierarchy and based upon a wide range of organisational activities. The intention is to allow the cascading of requirements down through organisations and the flow of information up these tiers to inform decision making. The requirements may be needed for multiple decision making, which can include:

- Policy decisions;
- Portfolio planning;
- Regulatory obligations;
- Strategic asset management; and
- Strategic business operations.

The high-level activities which may need to be considered in formulating OIR can include, but are not limited to:

- Capital investment and life cycle costing;
- Health and safety compliance and management;
- Security management;
- Emergency management and contingency planning;
- Environmental management;
- Sustainability;
- Supply chain management;
- Space utilisation;
- Risk assessment and management;
- Maintenance and repairs;
- Asset modifications;
- Asset operations;
- Human resources, skills development, training and competencies;
- Technologies adoption; and
- Value management.

To facilitate a digital approach for decision making, the OIR should be developed in a digital format. This will facilitate data verification and defining support solutions.

2.2 Asset Information Requirements (AIR) (Appendix D2)

Asset Information Requirements (AIR) should provide the basis for the commercial, managerial, and technical aspects of producing and managing asset information and should include the standards, methods, and procedures to be implemented by the Delivery Team. The AIR should provide the detailed specification for the delivery of the Asset Information Model (AIM) and take on board the considerations identified under Section 2.16 on AIM.

The AIR should include the detailed asset information deliverables required to answer the asset related OIR. The AIR should also be expressed in a manner to allow inclusion in asset management appointments to support better organisational decisions. The AIR should facilitate the cascading of requirements across multiple appointments and the amalgamation of data deliverables to provide a consolidated response to the OIR.

The AIR needs to specify precise information for each asset, whether that be an entire building, a zone, space, or individual object (component), such as a door or piece of furniture. As a minimum the AIRs should include regulatory requirements, health and safety information, security, operations and maintenance (O&M) aspects, as well as provide a unique identifier for each asset type. The use of identified classifications systems and schema associated with assets will facilitate the cascading of requirements.

A specific Asset Information Requirement is best delivered as a data template and is equally applicable to products as well as spaces, zones, or an entire building. The development of standardised data dictionaries to hold and manage data requirements facilitates enhanced information management, e.g., by allowing standardised document delivery through reporting in open industry formats such as OpenOffice, but also digital formats such as JSON and XML via open application programming interfaces (APIs). This in turn can facilitate automated verification of deliverables against requirements.

Delivery of the AIR against each project milestone should be established within the level of information need. The format of delivery of the AIR should also be clearly defined and established in the EIR. Model information can be provided by open data format options, such as the Construction Operations Building Information Exchange (COBie) and IFC 2X3 using the Basic FM Handover View. Manufacturers and suppliers can also provide standardised product data sheets based upon industry templates which could in turn be accessible via URLs, QR codes, Bar codes or RFID tags.

2.3 Project Information Requirements (PIR) (Appendix D3)

Project Information Requirements (PIR) should explain the information needed to either answer or inform high-level strategic objectives that the Appointing Party / Client may have in relation to each facility. The PIR should take on board the life cycle requirements of projects, including the project management and asset management processes.

In formulating the PIR, the Appointing Party /Client should consider the following:

- The project scope;
- BIM Uses;
- Project Plan of work;
- Procurement route and process;
- Appointing Party's / Client’s milestones and decision points; and
- The Appointing Party's / Client’s decision and response requirements.

The PIR should be project- and stage-specific and prepared against each of the Appointing Party's / Client’s key decision points. The PIR can also include within its contents:

- Organisational key performance indicators;
- Strategic briefing requirements;
- Business case needs (e.g., Project Return on Investment (ROI));

- Project specific tasks required by the Appointing Party / Client; and
- Identified Project Stakeholders.

The PIR can exist as a separate document or can be included with the Appointing Party's / Client's briefing documentation or Exchange Information Requirements (EIR). The PIR cascade should be noted, i.e., a Lead Appointed Party's PIR should be produced taking on board their requirements and either enhancing or replacing the Appointing Party / Client within the Lead Consultant's / Lead Contractor's PIR.

2.4 Security Information Requirements (SIR) (Appendix D4)

ISO 19650-5:2020 provides the basis for identifying the Security Information Requirements (SIR) in terms of what is considered to be a sensitive asset, product, or service, using the following criteria:

- Is part of the critical national infrastructure;
- Is a national security, defence, law enforcement or diplomatic function;
- Is a commercial site related to significant volumes of currency, valuable materials, pharmaceuticals, chemicals, petrochemicals, or gases;
- Is used or can be used to host events of security significance; and/or
- Constitutes a landmark, nationally significant site, or crowded place.

The Appointing Party / Client shall apply the security triage process as outlined in ISO 19650-5:2020 to establish whether a security-minded approach is required to the project, asset, or service. The outcome of the triage process should be documented within the information requirements and where required the appropriate actions and functions shall be put in place.

As illustrated in Figure 9, the triage process should identify whether the following action need to be undertaken depending upon the results:

1. Initiate the security-minded approach;
2. Develop a security strategy;
3. Develop a security management plan;
4. Develop a security breach/incident management plan; and
5. Work with appointed parties to implement any or all of the above.

The Appointing Party / Client shall also develop a security strategy which shall include the outcome of the security triage process and follow the requirements of ISO 19650-5:2020.

Security Management Plan

Where a Security Management Plan is required it should set out the SIR for sharing and/or publishing of:

- New information;
- Modified information; or
- Existing information.

The Plan shall include whether these items relate to individual documents or the Information Model as a whole.

The Security Management Plan should develop the:

- SIR;
- Requirements for implementing any security mitigation methods;
- Requirements for logistical security;
- Requirements for information dissemination; and
- Requirements for a security breach / incident management plan.

The Security Management Plan should assist in coordinating the AIR and OIR and must consider activities during the design and construction stages of the asset as well as the operational stage.

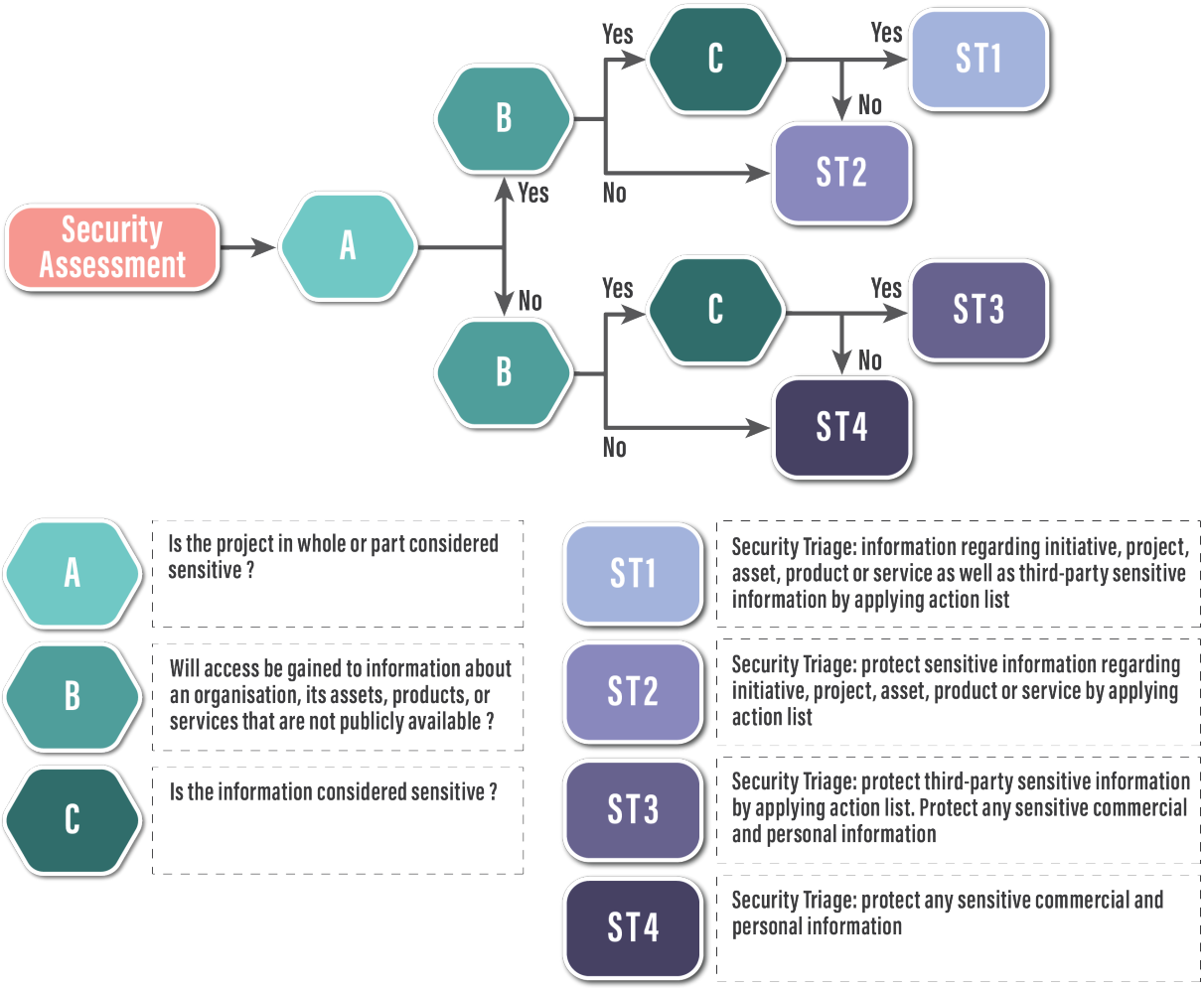

Figure 9 The Security Triage Process

2.5 Exchange Information Requirements (EIR)

The Exchange Information Requirements (EIR) should set out the managerial, commercial, and technical aspects of information delivery. The managerial and commercial aspects should include the information standards, methods, and procedures. The technical aspect of the EIR should specify the proposed approach and responses undertaken in relation to the PIR and should be aligned with the project milestones or stages

The EIR should cascade from the Appointing Party / Client to the Lead Consultant / Lead Contractor and then from the Lead Consultant / Lead Contractor to each Task Team. Each appointment shall include an EIR and as these cascade the division of the requirements can support specific task delivery. The Lead Consultant / Lead Contractor should augment the Appointing Party's / Client's EIR with their own requirements if necessary, so as to meet their own BIM Uses identified for the project. Within a Delivery Team, it should be recognised that not all information is created for the benefit of the Appointing Party / Client and this should be addressed in the cascading requirements.

The EIR shall consider the OIR, AIR, PIR and the SIR as well as the following as a minimum set of contents:

Information Management

- Standards and classification;
- Information functions (roles and responsibilities);
- Planning of work;
- BIM Uses;
- Cyber security;
- Spatial coordination and clash detection;
- Collaboration process;
- CDE implementation;
- Systems performance;
- Compliance plan (acceptance and auditing criteria);
- Delivery strategy for asset information;
- Training requirements; and
- Health and safety.

Technical

- Software platforms;
- Data exchange formats;
- Coordinate systems, units and levels;
- Level of Information Need; and
- Model exclusions and inclusions.

Commercial

- Acceptance Criteria;
- Milestones and Project Deliverables;
- Appointing Party's / Client's strategic purposes;
- Responsibilities Matrix; and
- BIM Capability Assessment.

The BIM Implementation Plan (BIM IP) provided by the Delivery Team should respond

directly to the contents of the BIM Requirements to provide a question/answer approach to the requirements.

To establish the project EIR, please refer to CIC BIM Exchange Information Requirements (EIR) Template (BIM Specifications).

2.6 Level of Information Need

Information Models should be developed progressively from preliminary design to final as-built models according to distinct phases and stages throughout the process. This section contains tables that indicate the level of development required at each stage of the design, tender, construction, and as-built stages.

The Level of Information Need (LOIN) (formerly known as Level of Development (LOD)) enables Appointing Parties / Clients, architects, engineers, contractors, quantity surveyors and facility managers to clearly specify the content of models at each stage of a project.

LOIN should only be used to describe model elements and not models as a whole. An element has only progressed to a given LOIN when all the stated requirements have been met. There is no direct link between LOINs and project stages. Building systems are developed at different rates through the design process. For example, the design of the structural system proceeds ahead of the design of interior layouts. At the end of scheme design, the model may include many elements at LOD-G 200, but may also include many at 100, as well as some at 300.

The Appointing Party / Client and/or BIM Manager shall specify in the design stage BIM IP, what the LOIN for each model element shall be when models are handed over from the design team to the Contractor.

BIM Purpose / Use

To ensure that BIM deliverables meet the needs of the entire project team, the purposes to which the Information Model is to be used should be established at the beginning of the project. The purposes, referred to here as BIM Uses will initially set out the Appointing Party's / Client's requirements and should also cascade to include specific requirements from the Appointed Party (Lead Consultant / Lead Contractor) and may also include other Task Team requirements. Each proposed BIM Use requires effort and therefore carries a cost, and whilst some of these can be alleviated by early definition others may create specific requirements which can only be achieved using possible different software solutions and skills.

The Appointing Party / Client should review the proposed BIM Uses with technical experts at an early stage regarding the cost-benefit implications for each use.

BIM Uses should be reviewed from both the Appointing Party's / Client's and the Delivery Team's points of view. Task Teams should expand the definitions of each use to clarify the BIM needs at each project stage using a model delivery table. This should include the correct level of granularity to facilitate effective delivery, as illustrated in Figure 10 and Figure 11 below.

2.6.1 LOIN Definitions

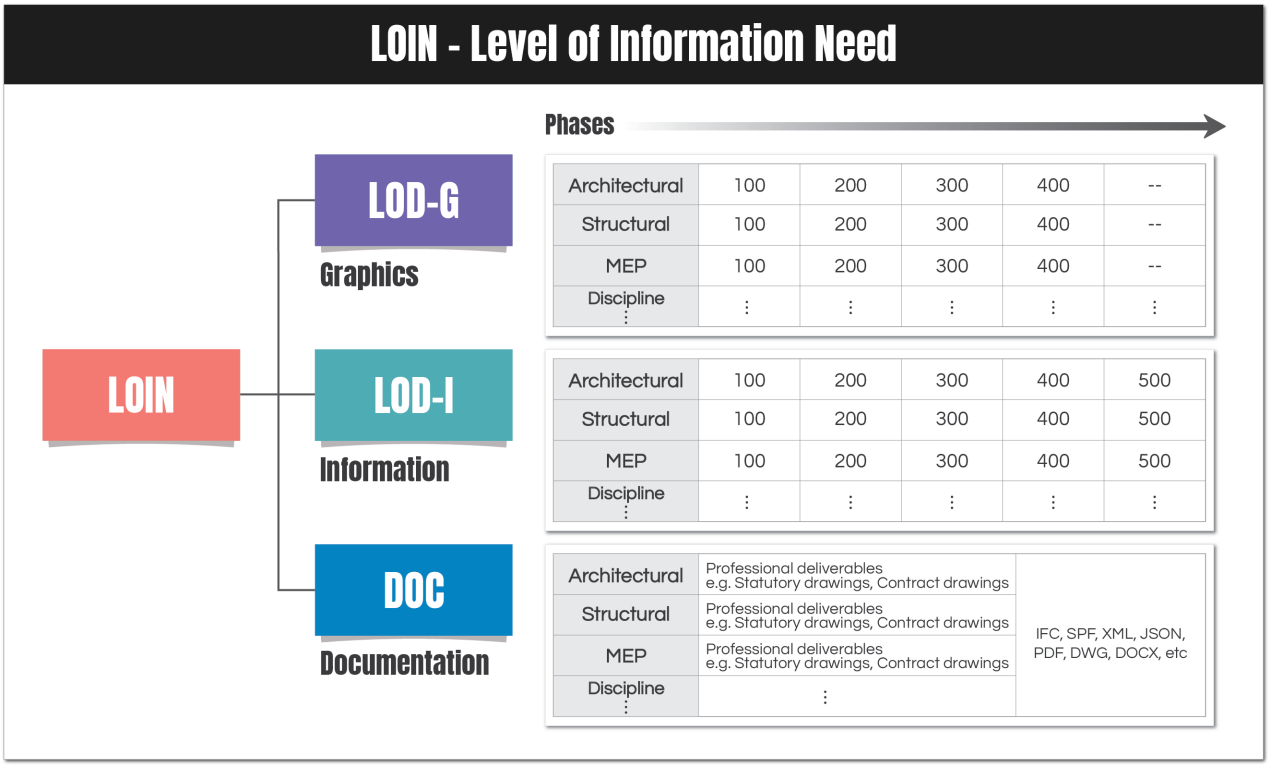

Figure 10 LOIN - Level of Information Need

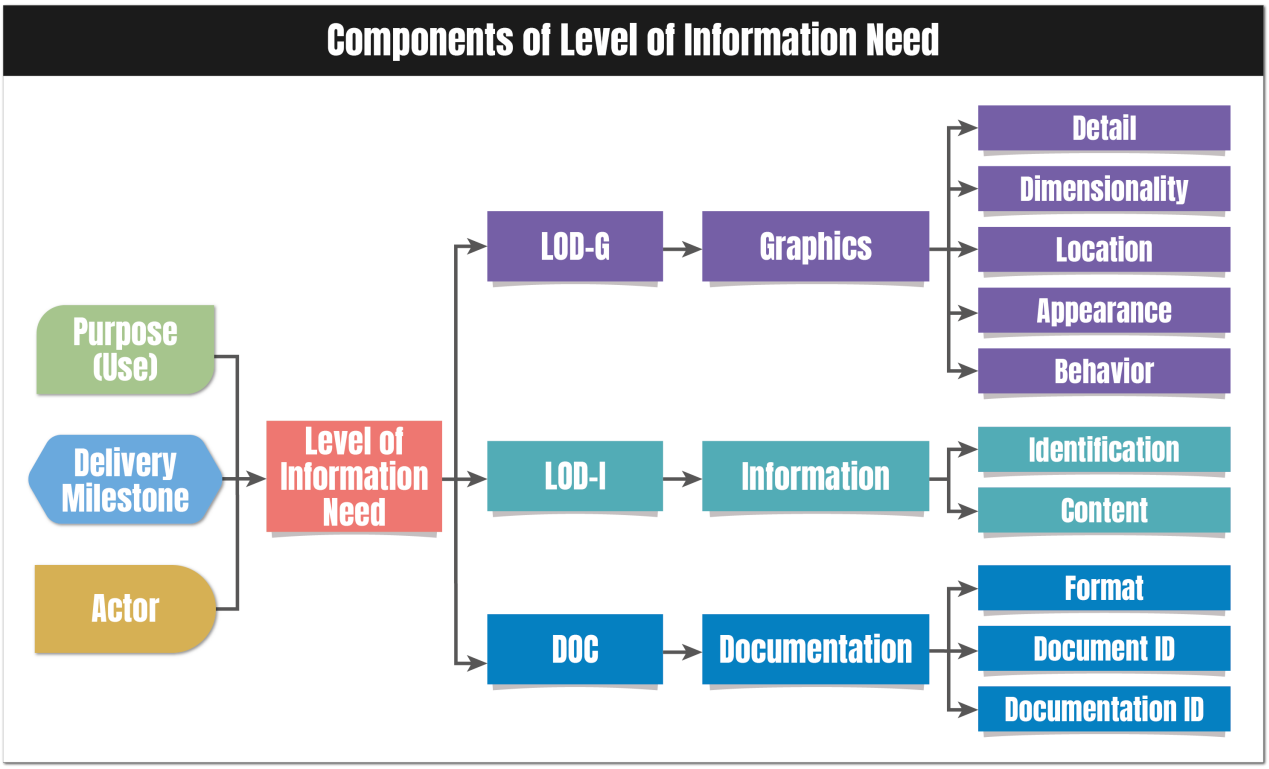

Figure 11 Model Delivery Table - Components of Level of Information Need

Developing BIM Uses and having a flexible approach to information modelling drives the need to investigate different ways to deliver the relevant information and ensure it is fit for purpose. The LOIN refers to the following three components of the Information Model,

Level of Graphics (LOD-G)
The Level of Graphics (LOD-G) refers to the graphical representation which deals with geometric representation, symbology, and visualisation. This is generally related to the deliverable (scale of documentation) which controls the graphical precision of the elements represented. This in turn enables identification of which parts of the objects can be disregarded or simplified while keeping the object functional to meet the BIM Uses.

Level of Information (LOD-I)
The Level of Information (LOD-I) identifies the properties to be attached to each type of object to meet the intended uses. Properties can include requirements, specifications, product definitions, object methods, parametric parameters, materials, generic or manufactured product criteria etc. The LOD-I requirements should be associated with the AIR identified for a specific project stage which should be fulfilment of one specific use case.

Level of Documentation (DOC)
The Level of Documentation (DOC) refers to the kind of documentation to be associated with the uses to meet the identified requirements. Each Task Team should understand their deliverable requirements against a specific use. The LOIN use table should identify which discipline / role is responsible for the DOC and the detail will then reside within that Task Team information delivery table.

Inter-relationship between LOD-G, LOD-I and DOC
The three concepts of LOD-G, LOD-I and DOC are not mutually exclusive. For instance, the degree of accuracy or precision of one level could also be linked to the other two levels. The needs for each level can be driven by the different purposes and parties who may have their own specific requirements of accuracy, geometry, information, and documentation.

It should be noted that the LOIN has nothing to do with the status of the information in the delivery process, but is related to the granularity of the information required for a dedicated purpose such as a BIM Use or deliverables against a milestone.

Identify the Purposes
Information Models may be used for many different purposes through the information life cycle. The intended uses of each model will have an impact on how the model is created. Typical uses are defined in Section 3.6.5 of this Standards, and shall be identified in the BIM Requirements.

These purposes for information delivery feed into the LOIN. The purposes should be specified to identify why the information is needed. To achieve the same purpose, the graphical information, non-graphical information, and documentation may vary for different objects within the model. For example, in the early stages of a project objects with high levels of graphical information would be needed for visualisation purposes, but later in a project a simple graphical representation would be sufficient.

The definition of the LOIN is independent of the listed prerequisites. Properties may be created based upon templates made available at the project, Appointing Party / Client, region or country level. If consistent values are required, they may be associated with properties using lookup tables or data sources as standardised predefined value lists to aid data validation. This approach aids data consistency by removing possible input errors.

Not all values of properties may require completion when instantiated within a project at specific stages. The extent of completion of values shall be consistent with the project stage as defined within the LOIN.

The LOIN provides a method for describing the information to be exchanged according to the EIR. The EIR specify what, when and how information is needed. The provision of information from the EIR is in the form of information delivery.

This procedure means that BIM objects should provide flexibility in the delivery of both graphical and non-graphical information to meet the needs of project EIR.

2.6.2 Level of Graphics (LOD-G)

Graphical representation can mean many things within a model and should be subdivided as there can be different needs for modelling (3D), drawing (2D), and visualisation. The geometry for drawings is often dependent upon symbology which sometimes varies depending on the selected scale. Four generic levels of graphical representation are identified as LOD-G notations. These are numbered from LOD-G 100 to LOD-G 400 and defined in Table 2 below.

LOD-G	Definition
100	The model element is graphically represented within the model by a **symbol** or generic representation or rough 3D shape.
200	The model element is graphically represented within the model as a **generic system, object, or assembly** with approximate quantities, assumed size, shape, location, and orientation. The assumed spaces required for access and maintenance shall be indicated.
300	The model element is graphically represented within the model as a **specific system, object or assembly** in terms of quantity, size, shape, location, and orientation. The model shall include details of the spaces required for handling installation, operation and maintenance, and the interface details for checking and coordination with other models / objects.
400	The model element is graphically represented within the model as a **specific system, object or assembly** in terms of size, shape, location, quantity, and orientation with **detailing for fabrication, assembly, and installation.**
500	Not used. See Section 2.6.7 and 2.6.8.

Table 2 LOD-G Definition

For LOD-G of the Architectural, Structural, Mechanical, Electrical and Plumbing (MEP) and Underground Utilities (UU) model elements, refer to the respective CIC BIM Standards.

LOD-G+ Concept

In response to the evolving needs of industry stakeholders and the demand for greater flexibility in graphical representation, we introduce the "LOD-G+" concept. This addition allows for the customisation and expansion of the existing Levels of Graphics (LOD-G) framework, enabling stakeholders to define their own specific graphical representation requirements that may not be adequately addressed by the standard LOD-G levels (100, 200, 300, 400).

Definition of LOD-G+

LOD-G+ refers to a customisable level of graphical representation that allows project teams and stakeholders to create tailored definitions based on unique project requirements, industry standards, or specific use cases. This concept is designed to accommodate the diverse needs of various disciplines and project types, ensuring that all relevant graphical information can be effectively communicated and utilised.

Implementation of LOD-G+
To implement the LOD-G+ concept, project teams should:

- Identify the specific needs that are not met by the existing LOD-G levels.
- Collaborate with relevant stakeholders to develop customised LOD-G+ definitions.
- Document the LOD-G+ criteria and ensure that all team members are informed and trained on the new standards.
- Integrate the LOD-G+ definitions into the project's information delivery process, ensuring alignment with the EIR and the LOIN.

It is essential that whenever LOD-G 200+ or LOD-G 300+ is used, the definitions and criteria are clearly communicated and agreed upon among all project teams to ensure consistency and understanding throughout the project lifecycle.

By adopting the LOD-G+ concept and its extensions, the industry can enhance the flexibility and effectiveness of graphical representations in BIM, ultimately leading to improved communication, collaboration, and project outcomes.

2.6.3 Level of Information (LOD-I)

Level of Information (LOD-I) is the description of non-graphical information in a model element and will evolve as the project progresses. LOD-I requirements should be defined and agreed beforehand as identified within the AIR. Provision of a data dictionary against which product data templates can be prepared facilitates the delivery of verifiable data. As the required LOD-I varies for each project, this Standards does not aim to provide an exhaustive list of information for each model element, but instead indicates a suitable approach for adoption.

To specify LOIN, and how information is to be delivered, the specifiers should identify the following prerequisites:

- Purposes of the information to be delivered;
- Information delivery milestones;
- Parties who will request and deliver information; and
- Objects in one or more breakdown structures.

The LOD-I required for the model elements should be determined based on their intended usage and should NOT be over specified. This Standards indicates a suitable approach by giving examples of minimum LOD-I associated with typical elements/objects at five levels from LOD-I 100 to LOD-I 500 as shown in Table below. (where M means "Mandatory" and R means "Required".)

No.	Type	Attribute Name	Description	LOD-Information					Proposed Input Format
				100	200	300	400	500	
1	Project Information (Appointing Parties specific)	Organisation Name	Client name (per agreement/ contract)	M	M	M	M	M	Alphanumeric
		Project Issue Date	Project Commencement date	M	M	M	M	M	MMM YYYY (eg. Nov 2021)
		Project Address	The street address of the project	M	M	M	M	M	Alphanumeric
		Project Name	The project name as shown on the drawing sheet's title block	M	M	M	M	M	Alphanumeric
		Project Number	The project number as shown on the drawing sheet's title block	M	M	M	M	M	Alphanumeric
2	General Properties	CAT Code	Departmental category **(see Remark 1)**	R	R	R	R	R	Alphanumeric
		Locations	Location (e.g. district code for outdoor object)		R	R	R	R	Alphanumeric
		Departmental Unique ID	The unique ID for departmental information management		R	R	R	R	Alphanumeric
3	Design Properties	Material	Singular materialor all materials pertaining to the assembly		R	R	R	R	Alphanumeric
		Material Grade	Material grade(e.g.		R	R	R	R	Alphanumeric

No.	Type	Attribute Name	Description	LOD-Information					Proposed Input Format
				100	200	300	400	500	
			concrete grade, steel grade)						
		Design Capacity	Design capacity		R	R	R	R	Alphanumeric
		Number	Room Number **(see Remark 2)**		R*	R*	R	R	Alphanumeric
		Name	Room Name **(see Remark 2)**			R*	R	R	Alphanumeric
4	Classification Properties **(see Remark 3)**	OmniClassCode	OmniClass code			R	R	R	Alphanumeric
		OmniClassTitle	OmniClass title			R	R	R	Alphanumeric
		OmniClass Version	OmniClassversion			R	R	R	Alphanumeric
5	Manufacturer' sEquipment Properties	Brand Name	Brand name				R	R	Alphanumeric
		Manufacturer Name	Manufacturername				R	R	Alphanumeric
		Model Number of element / equipment	Model number				R	R	Alphanumeric
		Equipment Capacity	Equipmentcapacity				R	R	Alphanumeric
		Asset ID	Asset ID				R	R	Alphanumeric
		Contract Number of the Equipment	The equipment's contract number				R	R	Alphanumeric
6	Condition Properties	Certified Completion Date	Certified completion date				R	R	MMM YYYY (eg. Nov 2021)
		Handover Date	Handover date				R	R	MMM YYYY (eg. Nov 2022)
7	Verification Property	Verification	Verification method (input A for "field verifiedby visual inspection" and B for "field verified by a measured survey")					R	Text (e.g. A or B)

Remarks:

1. Category (in the form of the shared parameter "CAT Code" under "General Properties") could facilitate grouping and data filtering. In addition, "category" may refer to:
   a) The use of appropriate category or object types when creating BIM objects to minimize data loss (especially LOD-G) during open format exchange.
   b) BIM Object naming's abbreviation code fields 1 & 2 to facilitate BIM object library management and consistency of information container ID naming.
2. R* - Room Name and Room Number are required when statutory and contractual drawings are produced.
3. Individual Appointing Party's classification(s) in addition to or instead of OmniClass could be defined by respective Appointing Parties.
4. It is recommended that a full list of element-specific LOD-I should be clearly defined before a project commences.
5. Design Properties should be defined in line with any agreement or Appointing Party / Client Information Requirements provided for individual projects.

An example of a Product Data Template is included in Table below for reference:

Actuator Product Data Template				
Select	**Property**	**Description / Remarks**	**DataType**	**Unit**
		Equipment Attributes		
☐	AdditionalSparePartName	Additional Spare Part Name:Name of additional spare part of the equipment	String	NA
☑	Address	Address:Address of the site / facility	String	NA
☐	AssetCode	Asset Code:Asset Code of the equipment	String	NA
☑	BrandName	Brand Name:Name of the Brand	String	NA
☑	CommissionDate	Commission Date:Date of equipment commission	Date /Time	NA
☐	DistrictCodeRegion	District Code / Region:District Code of Asset Location ("Region" for WSD)	String	NA

Table 3 Sample Product Data Template

For LOD-I of the Architectural, Structural, Mechanical, Electrical and Plumbing (MEP) and Underground Utilities (UU) model elements, refer to the respective CIC Building Information Modelling Standards.

2.6.4 Level of Documentation (DOC)

Type	Description	Example of Attributes	LOD-Information				
			100	200	300	400	500
Specification / Properties	Product specification and other external document in the form of a hyperlink	O & M Manual				R	R
		Test Report				R	R
		Warranties				R	R
			R: Required				

Table 4 Sample DOC

The LOIN for the kind of documentation is associated with the uses to meet the professional deliverables. Each Task Team / discipline will understand their deliverable requirements against a specific use, e.g., presentation styles such as colour, font, 2D symbols associated with a certain particular drawing production, information to be shown on a standard title block, etc.

The LOIN use table should identify which discipline / role is responsible for the DOC and the detail will then reside within the Task Information Delivery Plan (TIDP). Professional domain knowledge must be applied to DOC as deliverables when statutory and contractual liabilities are involved.

2.6.5 LOIN Impact on BIM Objects

It is not possible nor practical to provide Generic or Product Library BIM objects that satisfy all the possible purposes of a project. However, the use of a linked data approach can facilitate the delivery of the appropriate data requirements, specifications, or product data to meet specific work stage information needs. The use of work stage specific levels of information to support the graphical / non-graphical and documentation requirements defines the BIM Objects and facilitates preparation of a project BIM Object library, in accordance with ISO 22014[1].

It is the addition of further data using a linked data approach that facilitates an effective and efficient data strategy through the project life cycle.

2.6.6 The Role of Verification and Validation

LOIN should be specified clearly and unambiguously to allow both manual and machine-readable verification and validation processes. A machine-readable specification based upon a data dictionary (ISO 12006-3[2] IFD) holding the LOIN reduces time and human errors when verifying and validating information deliveries. To facilitate such verification, digital information requirements need to be developed. The ability to compare object requirements against delivered data using Project Data Templates (PDT) and Product Data Sheets (PDS) as identified in ISO 23386[3] and ISO 23387[4] facilitates object verification and eventually, validation.

The PDT should create the basis upon preparation of AIR to fulfil the LOD-I requirements. Product manufacturers will then facilitate the delivery of the required LOD-I through their standardised PDS, also based upon the same PDT. Machine readable delivery of AIR against the LOD-I can then be achieved by linking data, allowing verification and also third-party validation of data plus values.

The use of standardised URLs linked to bar codes, QR codes, Near Field Communications (NFC) or RFID tags can then facilitate access to this information throughout the asset lifecycle.

[1] ISO/DIS 22014 Library objects for architecture, engineering and construction
[2] ISO 12006-3:2007 Building construction — Organisation of information about construction works — Part 3: Framework for object-oriented information
[3] ISO 23386 BIM and other digital processes used in construction — Methodology to describe, author and maintain properties in interconnected data dictionaries
[4] ISO 23387 BIM - Data templates for construction objects used in the life cycle of built assets — Concepts and principles

2.6.7 Field Verification

Field verification of the model elements is important for most projects in Hong Kong. In most local and international BIM standards, “field verified” is the key interpretation for the definition of LOD 500. However, in terms of geometry, a model element cannot be modelled with more details than those required for fabrication (LOD-G 400). Therefore, the criterion for field verification of a model element should preferably be detached from LOD-500, e.g.: a model element with LOD-G 300 can also be field verified.

In practice, it may not be possible to field verify all model elements in the project, and the methodology and grading of field verification may vary subject to the Appointing Party’s / Client’s considerations and requirements. Different methods of field verification should be stated in the BEP, e.g.: by visual inspection, measured survey, 360° panorama images, photogrammetry, laser scanning or any other measures agreed by the project Appointing Party / Client.

2.6.8 LOD Responsibility Matrix

The LOD Responsibility Matrix should be used to prepare the BIM Execution Plan (BEP) at different stages of a project. This involves defining both Level of Graphics (LOD-G) and Level of Information (LOD-I) to be achieved at each stage so that the project team can produce a high-quality model with appropriate information.

Descriptions of the fields in the LOD Responsibility Matrix are shown in Table below.

Field	Description
Required	Yes (Y) or No (N)
UOM	Unit of Measurement
Classification	This code can be used for Quality Assurance and review of models. The OmniClass Table 23 system code* can be used for this field if there are no other specific requirements from the project Appointing Party / Client. See Section 8.0 BIM Object Coding and Classification for more information.
AUT	Model Author
G	LOD-G
I	LOD-I
V	Method for field verification of the object/equipment. It is subject to the agreement of the project Appointing Party / Client. Appointing Party / Client or design consultants should define clearly which field verification method should be used for each model element or specify “N/A” (“Not Applicable”) to indicate that field verification is not required for that model element.

*China Guobiao (China GB), UK Uniclass and US Omniclass have been considered to be the classification system of model elements

Table 5 LOD Responsibility Matrix Fields

Sample templates of the LOD Responsibility Matrix are shown in:

- *CIC BIM Standards for Architecture and Structural Engineering;*
- *CIC BIM Standards for Mechanical, Electrical and Plumbing (MEP); and*
- *CIC BIM Standards for Underground Utilities*

for respective model elements**.** The model elements included in the outline sample matrix in Table below are not exhaustive.

LOD Responsibility Matrix (sample format)

Field										
Model elements	**Required**	**UOM**	**Classification**	**Project stage e.g.: Detailed Design**			**Project stage e.g.: As-Built**			
				AUT	**G**	**I**	**AUT**	**G**	**I**	**V**
Element 1	Y / N									
Element 2	Y / N									
Element …	Y / N									

Table 6 Outline Sample of LOD Responsibility Matrix

If tender stage is specified in the LOD Responsibility Matrix, it is assumed to be from a traditional “Design-Bid-Build” contract type / procurement method. If another contract type / procurement method is used, the matrix should be adjusted accordingly to suit the project.

2.7 Standards, Methods and Procedures

The fundamental requirement for producing information through a collaborative activity is to share information early, and to trust the information that is being shared as well as the originator of that information. What is needed is a disciplined auditable process that is transparent, controllable and delivers qualified coordinated information, reducing cost, and improving timely delivery.

Within ISO 19650-2, the Standards, Methods, and Procedures (SMP) are identified as two separate resources being named as project information standards, and project information production methods and procedures. The consistent use of these Standards, Methods, and Procedures facilitates effective information management therefore reducing cost and improving productivity. As the CICBIMS is adopted by all, it will provide a common way of working that will help to remove the problem of having to constantly retrain staff on each project when common Appointing Party's / Client's standards are applied. It will also reduce waste by removing the need to reconfigure tools and solutions to these Standards, Methods, and Procedures.

It is important to understand that Standards, Methods, and Procedures will both cascade and develop over the project stages. For a new Appointing Party / Client commissioning their first conceptual project it is unlikely that they will have any defined standards, methods, or procedures. Their project information standards are likely to be reliant on the Delivery Team to agree and to provide these based upon industry best practice. The opposite will be true for an Appointing Party / Client with a large asset portfolio commissioning the construction stage, where Standards, Methods, and Procedures will exist from the existing portfolio and the earlier project stages.

The Appointing Party / Client should identify which project information standards and project information production methods and procedures should be compliant with the CICBIMS. Standards, Methods, and Procedures are initially documented as part of the Appointing Party's / Client's BIM information requirements. These will then be expanded by the Lead Consultant / Lead Contractor within the BIM Implementation Plan (BIM IP) taking on board any additional BIM Use requirements and expanding the project Standards, Methods, and Procedures to facilitate these.

Care should be taken when cascading requirements and other resource and content to ensure that contractual requirements identified by the Appointing Parties / Clients are still being fulfilled.

2.8 Project Information Standards

As part of the Standards, Methods, and Procedures, the project information standards facilitate the delivery of consistent information across a project, an asset or portfolio of assets.

The project information standards shall include but not be limited to:

- Units and Precision;
- Origin and Orientation;
- Classification;
- Nomenclature (Naming Conventions);
- Delivery formats;
- Data requirements and formats; and
- Annotation and Symbology.

The intention of the project information standards is to facilitate the cascading of standards from the Appointing Party / Client to the Lead Consultant / Lead Contractor and their Task Teams whilst adding and developing the detail over the project stages. This process is facilitated by the provision and use of drawing and other templates as shared resources.

2.9 Project Information Production Methods and Procedures

The project information production methods and procedures define how information is to be delivered. The extent of these will be initially dependent upon the Appointing Parties / Clients requirements along with the tools and solutions they use. As with the standards these will also cascade and include of the consultant / Lead Contractor requirements as the project stages develop. Whilst ISO 19650 identifies the product information methods and procedures it is also necessary to produce design and modelling methods and procedures to meet defined uses. It is recommended that this resource is not limited just to production information but should also include other user requirements.

The project information production methods and procedures shall include but not be limited to the following key elements:

- Zonal strategy;
- Delivery formats;
- Methodologies in production of information;
- Procedures for CDE;
- Data delivery milestones and requirements;
- Document delivery milestones and requirements; and
- Quality assurance procedures.

2.10 Information Protocol

The information protocol is intended as an addendum to either an appointment or contract to ensure that all parties work in a collaborative manner. The information protocol should clearly set out the Appointing Party's / Client's contractual needs, which shall be cascaded down to the Delivery Team.

The protocol shall include but not be limited to:

- Specific obligations of all parties relating to the management or production of information;
- Any specific warranty or liabilities associated with the information model;
- Intellectual property rights of information including background and foreground intellectual property;
- The use of existing asset information and shared resources;
- The use of information during the project, including any required licensing terms; and
- The re-use of information after the appointment or in the event of termination.

Refer to CIC Special Conditions of Contract for BIM; and BIM Services Agreement for more information.

2.11 Delivery Team Capability and Capacity Assessment

The need to establish the approach, capability, and capacity of the Delivery Teams is a key requirement. To facilitate this, all parties shall complete a BIM capability assessment as part of the appointment process. The assessment shall include:

- Proposed Approach;
- BIM Capability Assessment;
- IT Capability Assessment;
- Capacity Assessment;
- Security Assessment (as defined by Security Triage); and
- Resumes of proposed staff.

The Lead Consultant / Lead Contractor should also provide a Delivery Team capability summary assessment along with a proposed risk register and mobilisation plan, including training requirements if such a need is identified through the assessments.

Standardised templates for assessment should be provided by the Appointing Party / Client as well as the supply chain summary matrix for completion by the Lead Consultant / Lead Contractor (Refer to CIC BIM Capability Assessments - Appendix D7).

2.12 Business / Project Specific Cyber Security

Depending upon the results of the security triage process and delivery of the SIR provided through the security management plan, each business may be required to demonstrate their approach to both business and project cyber security.

Where specific SIR are identified by the Appointing Party / Client as part of the security triage process then the capability of businesses or solutions used to provide information security management in accordance with ISO/IEC 27001 may need to be defined.

The ability to demonstrate capability for information security management should be in proportion to the level of expected involvement on a project. For a Lead Consultant or Lead Contractor on a project defined as having specific security requirements, the use of companies certified against ISO/IEC 27001 may be considered as a requirement. Other involved parties may need to have identified controls in place in order to demonstrate their secure business response. Such controls should describe how an organisation responds to identified risks by providing a risk treatment plan which consider vulnerabilities, threats, and possible impact.

Security will also impact on the software tools used, the locations of cloud-based hosting, as well as basic system administration, backup, antivirus, malware, and spyware, etc., as well as requirements for passwords. Demonstration of robust business / project specific cyber security principles is likely to increase in future as part of a company's pre-qualification or capability assessment. Authorisation of data access by specific identified users may be considered on a needs basis.

2.13 Shared Resources

To facilitate efficient working practice, the Appointing Party / Client should review with the Lead Consultant / Lead Contractor the requirements for shared resources needed on a project. Many shared resources are likely to come from previous projects or earlier stage project deliverables, asset models or templates.

Typical examples of shared resources may include:

- Existing Asset Information / Previous project stage deliverables;
- Library Objects;
- Library Object Templates;
- Templates;
    - Documents (Including BEPs);
    - Models;
    - Drawings;
    - MIDP / TIDPs;
    - Schedules / Matrix; and
- Product Data Templates.

The advantages of shared resources are reduction in effort, standardised delivery, compliance with Standards, Methods, and Procedures as well as structured data delivery. The Lead Consultant / Lead Contractor should ascertain any shared resource needs from the Task Teams during the appointment and these should be agreed and verified during project mobilisation.

2.14 Project Information Model (PIM)

The Project Information Model (PIM) is the collection of the graphical information, non-graphical information and the documentation required to support the delivery of the project. Consisting of design and construction stage models developed as a response to the LOIN and achieving the BIM Uses as defined by the Appointing Party / Client and Lead Consultant / Lead Contractor. The PIM will develop over the project stages using a model progression strategy which should be based upon the project Standards, Methods, and Procedures. The PIM deliverables of models, drawings, schedules, costings, visuals, etc., are defined within the Master Information Delivery Plan (MIDP) and should be made available within the shared and published functional sections of the Common Data Environment (CDE). Each deliverable will have a defined revision, status, and authorisation code assigned to it.

Figure 12 below consolidates the information management flow in the project cycle from PAS 1192 and ISO 19650:

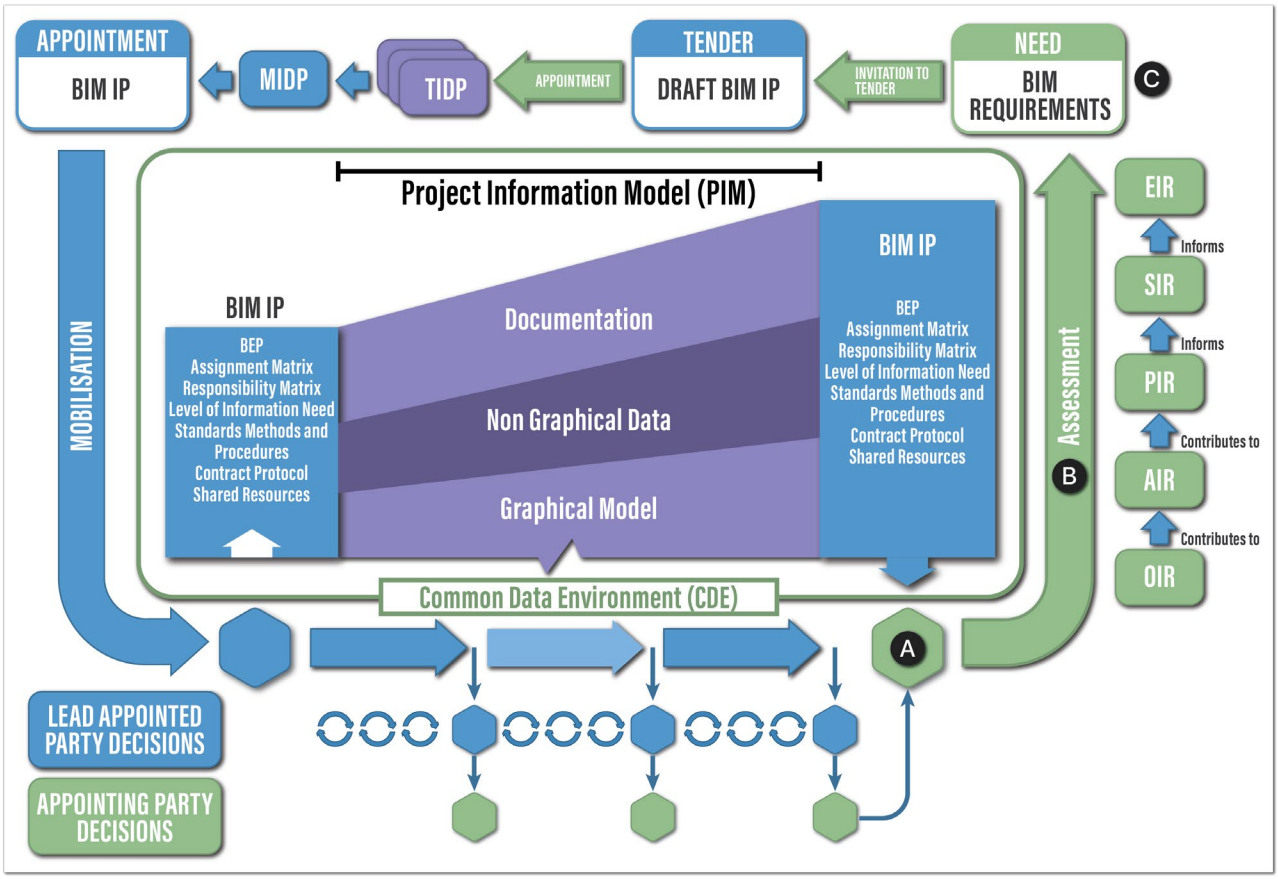

Figure 12 Project Information Cycle

The different colours used in the figure represent the different parties' input, with green elements depicting the Appointing Party / Client, blue the Lead Appointed Party and purple the Appointed Parties (Task Teams).

Figure 12 shows that the Appointing Party may start with input accumulated from a previous stage BIM implementation Plan and project deliverables (point A), or with existing asset data (Point B), or the Assessment process may start without any input from these (Point C).

The BIM Implementation Plans are likely to contribute to the development of the BIM Requirements taking on board the understanding developed through the development of the graphical models, non-graphical information, and documentation.

2.15 Design Information Model (DIM)

The Design Information Model (DIM) is the end-of-design stage model and consists of the PIM identified as suitable to support the strategic and day to day management processes of the design activities. The DIM requirements shall be identified by the Appointing Party / Client and may include design requirements such as room data sheets, drawings generated from DIM and quantities scheduled from DIM.

The Appointing Party / Client shall also establish the information delivery requirements, formats, and versions necessary for acceptance of the DIM.

The Appointing Party / Client decides whether the DIM is to be included as part of the tender document which is contractually binding, or serves only as reference material for the Contractor.

2.16 As-Built Information Model (ABIM)

The As-Built Information Model (ABIM) 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. The AIM requirements shall be identified by the Appointing Party / Client and may include design requirements such as room data sheets and equipment registers, as well as records of installation and maintenance regimes, jobs, ownership and other details as deemed necessary. The Appointing Party / Client shall also establish the information delivery requirements, formats, and versions necessary for acceptance of the ABIM.

The following are examples of information requirements that should be considered for the ABIM through the design and construction phases of an asset:

- Data security requirements;
- Unique asset identifiers;
- Unique type identifier;
- Geospatial referencing of asset locations;
- Spatial identification requirements of levels, areas, spaces, or rooms;
- Asset details including ownership, manufacturer, and supplier;
- Product data sheets, warranties, guarantee information, certificates and periods including start, installation, or commissioning dates;
- Access statements;
- Planned maintenance requirements, schedules, tasks, spares, and jobs;
- Health and safety considerations, including hazardous contents or waste;
- Emergency planning considerations; and
- Demolition, end of life and considerations for disposal.

These elements should be identified within the BIM Requirements as well as identifying data requirements, nomenclature, and delivery formats to support the Appointing Party's / Client's application.

ABIM is to be handed over to Appointing Party's / Client in an agreed media for the operation use.

2.17 Asset Information Model (AIM)

At the point of handling over from the construction phase, the Asset Information Model (AIM) will duplicate the data from the ABIM. Upon acceptance, Appointing Party's / Client's Operation Team will take over the ownership and formally become the AIM, which will then be updated to reflect asset changes

Depending upon the size and complexity of the Appointing Party's / Client's organisation they may already have in place existing enterprise solutions relating to functionality such as:

- Computer aided facilities management (CAFM);
- Electronic document management systems (EDMS);
- Integrated workplace management systems (IWMS);
- Property management systems;
- Enterprise Resource Management (ERP);
- Accounting and financial systems; and
- Purchasing and supplier relationship.

The requirements for integration of information into these systems from the design and construction team's information needs to be clearly identified within the BIM Requirements highlighting the need for "Starting with the end in mind." The experience learned from the Appointing Party's / Client's organisation in utilising the AIM may feedback to the management and affect the OIR for the assets' alteration and addition; or for the organisation's next project for continuous improvement.

ISO 19650-3 explains the procedures for how this then expands into the operational stage of the asset.

3 BIM Implementation Planning (BIM IP)

Party / Client at the beginning of a project life cycle. The Appointing Party / Client may use the CICBIMS to specify the BIM Requirements, understand the purposes (BIM Uses) and define the deliverables required during the project delivery stages and at the final handover of the project.

The Delivery Team should not provide information unless they have agreed and documented what is required.

Figure 13 Producing information with a purpose ("Starting with the end in mind")

The Appointing Party / Client may assign the role of **BIM Manager** to one or more individuals to help develop these requirements. If the Appointing Party / Client does not have experience in specifying or managing the use of BIM, they may develop the **BIM Requirements** with the **Lead Consultant** during the concept stage of a project. The CICBIMS specifies the minimum information to be delivered and the standards and processes to be adopted by the Lead Consultant and Lead Contractor as part of the project delivery process.

The **Appointing Party's / Client's BIM Requirements** may be specified in the scope of services for the **Lead Consultant**[1]. The Appointing Party's / Client's requirements shall specify the deliverables for each of the project stages of inception stage, feasibility & planning stage, conceptual design, preliminary design, detailed design, submission to approving authority, construction and as-built.

The Appointing Party's / Client's requirements may be incorporated into the Lead Consultancy and main contract tender documentation, to enable the Lead Consultant / Lead Contractor to produce a Pre-appointment BIM IP so that their proposed approach, methodology, capability, and capacity can be evaluated.

The Appointing Party's / Client's requirements shall be consistent with other contract documents in use on the project, which in turn should be aligned with the local industry standards.

[1] The term "Lead Consultant" refers to the design consultant who is responsible for leading the design process. For building projects, the architect may fulfil this role and for infrastructure projects, the engineer may fulfil this role.

3.1 Appointing Party's / Client's Requirement Specification

The Appointing Party / Client shall "start with the end in mind" by providing or specifying the BIM Requirements, as identified in Table 1 Schedule of required Resources and Content defined under ISO 19650-1. These are basically the questions for the Lead Consultant / Lead Contractor as the Delivery Team Lead to understand what, when and how the Appointing Party / Client requires information to facilitate their decision-making requirements. The Pre-appointment BIM Implementation Plan (BIM IP) will be the Delivery Team's initial answers to these questions providing a response to the Appointing Party's / Client's BIM Requirements.

The content and resources that form the collection of the Pre-appointment BIM IP are shown in Figure 14 below:

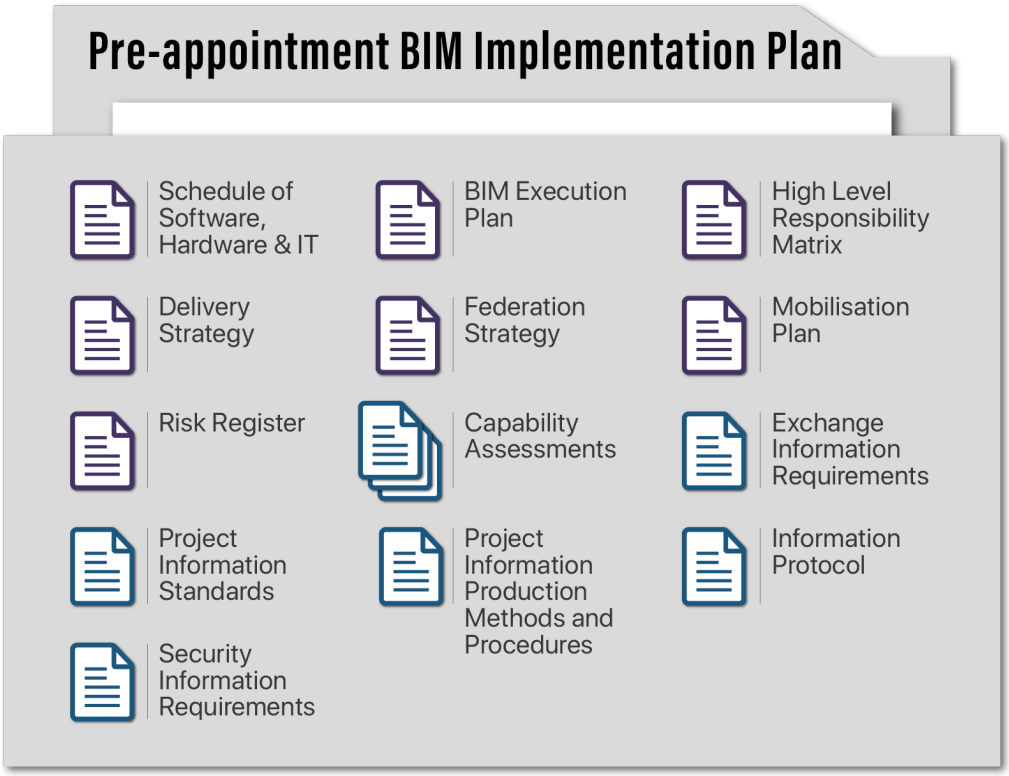

Figure 14 Pre-appointment BIM Implementation Plan (BIM IP) Contents

Therefore, each of the elements of the BIM Requirements provided will need to be taken on board and the contents of the Pre-appointment BIM IP should include responses as shown in Figure 15 below the framework resource and content mapping table between parties:

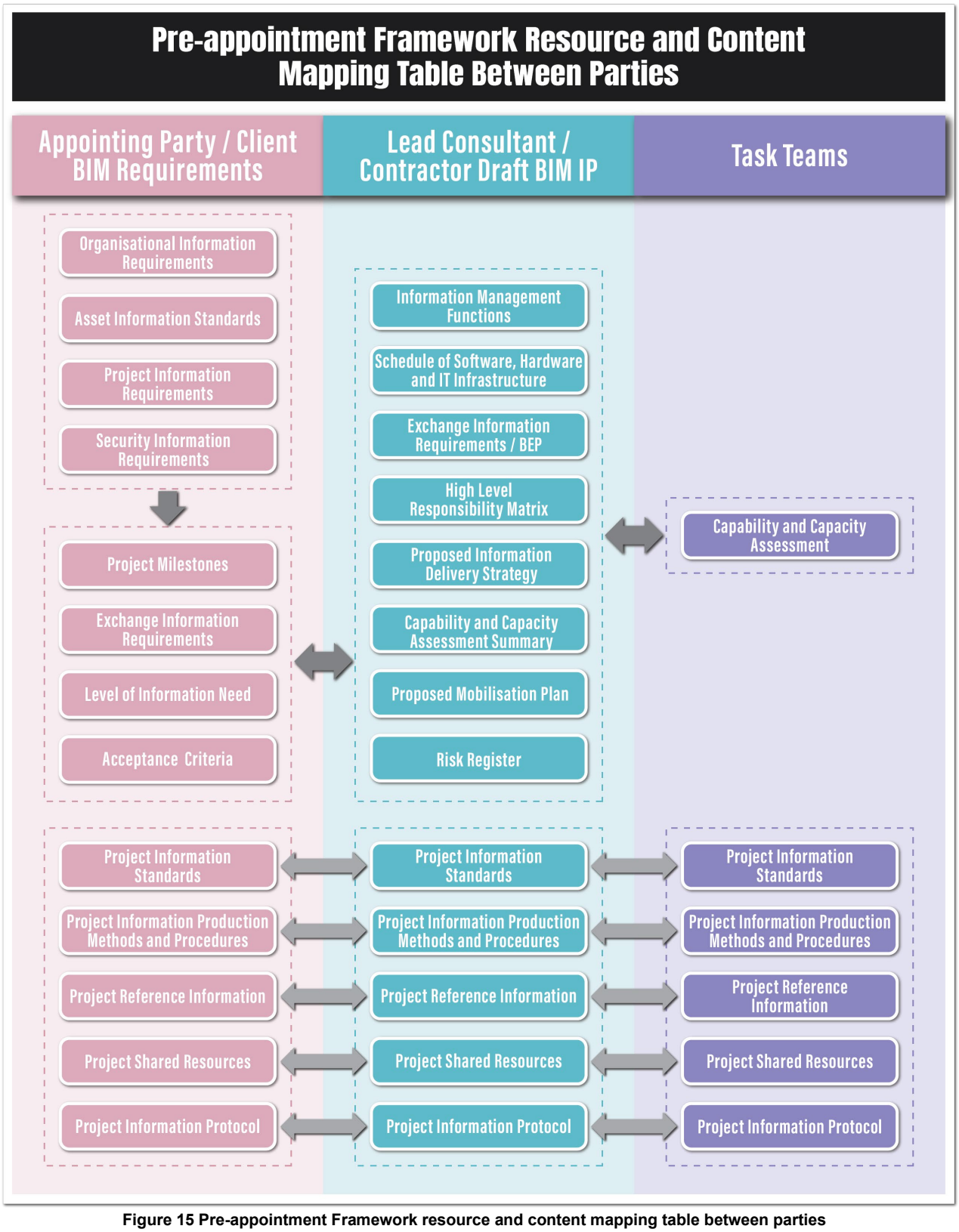

Figure 15 Pre-appointment Framework resource and content mapping table between parties

The BIM Requirements and Pre-appointment BIM IP responses will then form the basis for the appointment or contract between the parties. A contract or appointment could be for design, construction or operation stages of the project life cycle requiring both BIM Requirements and a BIM Implementation Plan.

3.2 Appointment BIM IP

After the appointment, the content and resources of the Pre-appointment BIM IP need to be tested during the mobilisation stages to mitigate any of the risks defined and associated within the risk register. They are then incorporated into the BIM IP for delivery and production of information which will be produced as a container for all the Delivery Team contents and resources as shown in Figure 16 below.

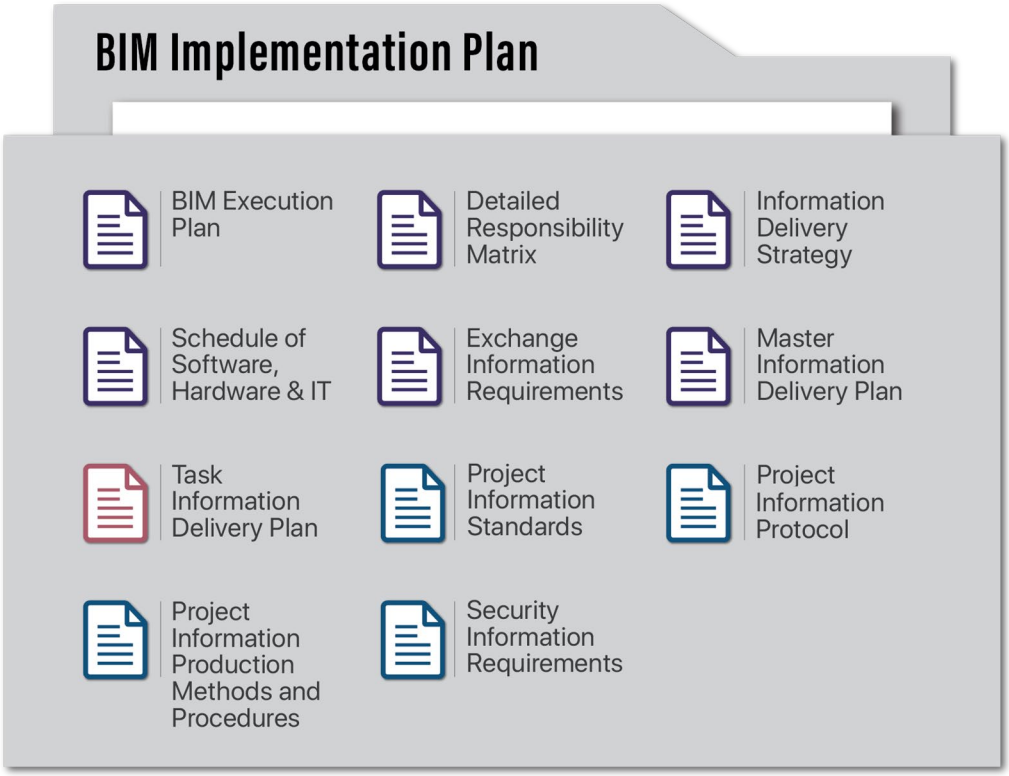

Figure 16 BIM Implementation Plan (BIM IP) Contents

It should be noted that the BIM IP will be continually changed and updated throughout the project delivery stage and traditional change management requirements will need to be incorporated, specifically where elements have been defined as contract documents. It is therefore recommended that the BIM Requirements, Pre-appointment BIM IP and BIM IP are made available to all project team members through the Common Data Environment (CDE).

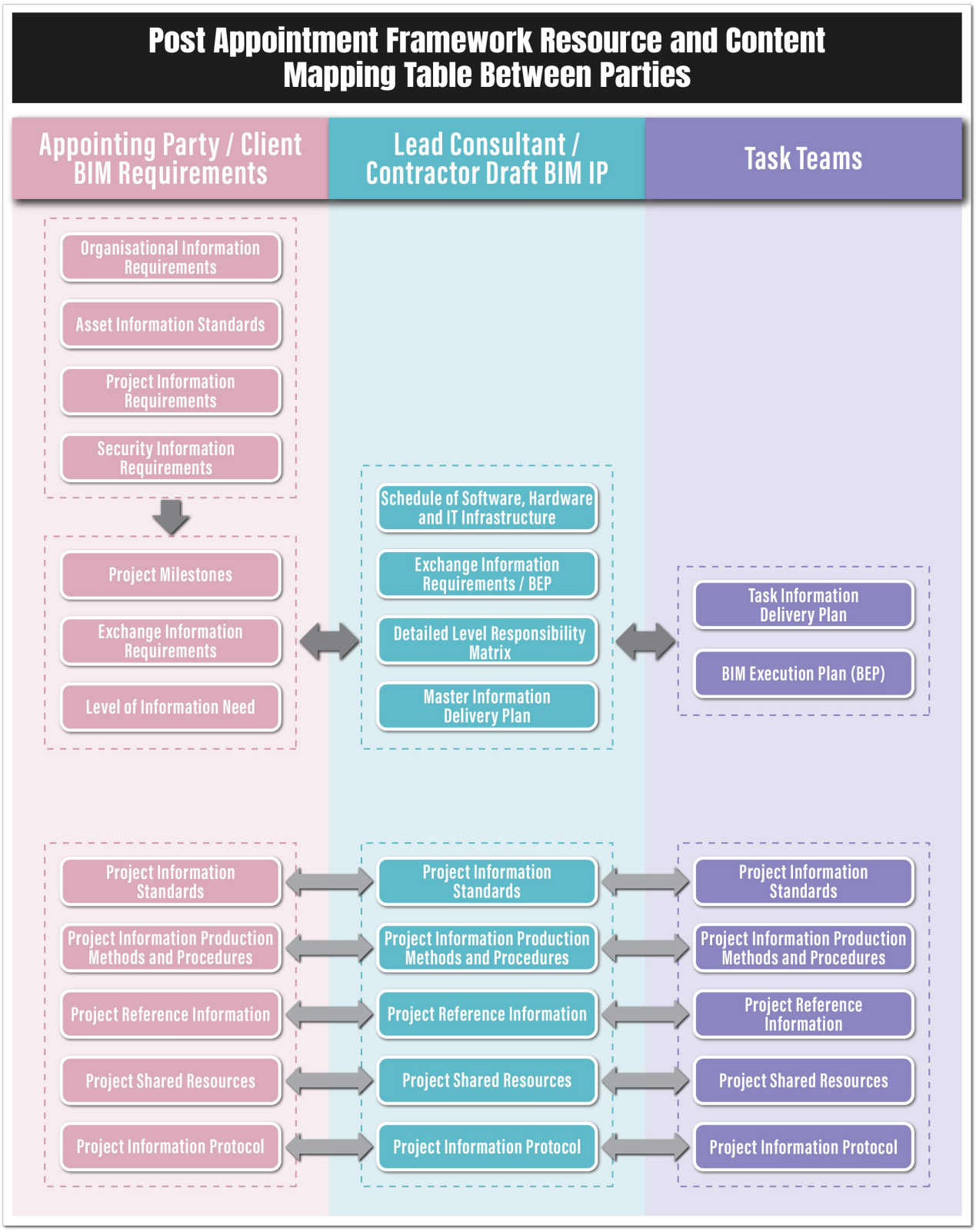

Figure 17 Post appointment Framework resource and content mapping table between parties

During the mobilisation phase, the proposed content and resources will be tried and tested taking any amendments needed on board. This will include, but not limited to, interoperability between software versions and file format requirements, as well as access to IT / CDE solutions, etc.

3.3 Design Stage BIM IP

As part of the Lead Consultant selection process, the Appointing Party / Client shall define the design stage BIM Requirements as a request for the design consultancy services to submit details of their approach via the design stage Pre-appointment BIM IP.

This will provide sufficient information to demonstrate the consultants proposed approach, capability, capacity, and competence. The consultant may provide recommendations for additional resources and services which they consider may also be needed by the Appointing Party / Client.

The Lead Consultant shall confirm that all the Task Teams (architect, structural engineer and building services engineers etc.) have agreed and committed to the Pre-appointment BIM IP.

Upon appointment, the BIM IP will be tested through the mobilisation stage.

The Appointing Party / Client will assess and approve the BIM IP prior to the production of deliverables. The BIM deliverables will also need to be reviewed and accepted by the Appointing Party / Client.

These will also form the basis for BIM Requirements for the next project stage and provided as part of the shared resources included within the BIM Requirements.

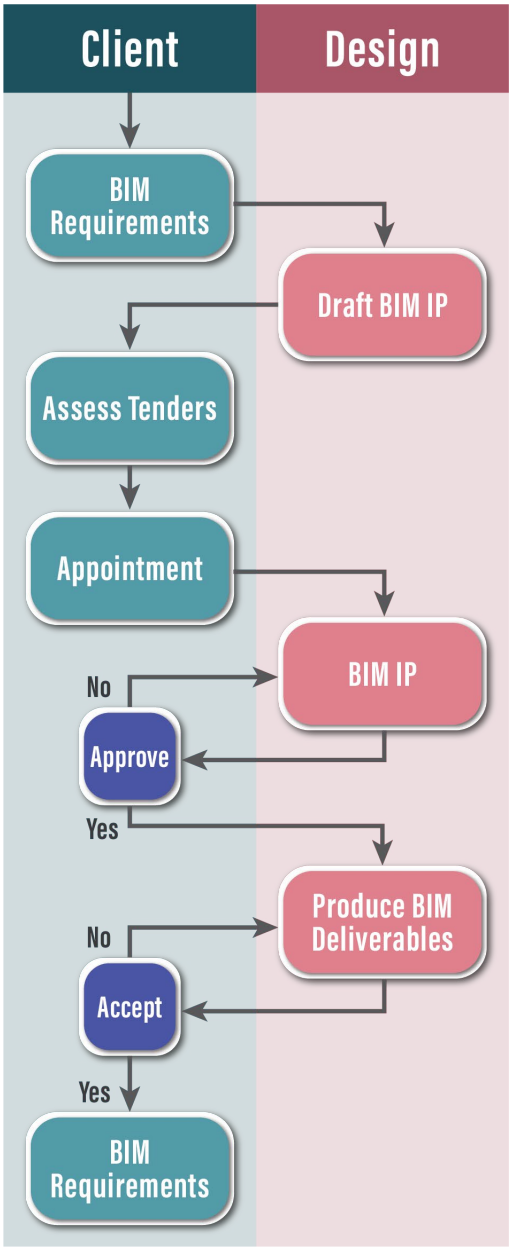

Figure 18 Design Stage Project Process

3.4 Procurement Strategy Impact on BIM IP

Depending upon the procurement strategy to be undertaken there are many different methods of dealing with the EIR between design and construction as well as the needs to address issues such as ownership, liability, risk, etc. Clarity on the **purpose** of the designs and specifically whether these are only identified as **design intent** should be made available.

The Appointing Party's / Client's BIM Requirements should set out the proposed procurement requirements and the project BIM protocol should clearly define appointment and contractual issues relating to the use of the Information Model including elements such as copyright, licensing, information use, ownership, etc. to ensure that there is no ambiguity contractual / legal liability issue.

BIM procurement strategy from design to construction stage still provides three main options to procurement which impact on design, construction and maintenance, which can be identified as follows:

Procurement Strategy A
The design stage Information Models are completed and provided for the construction stage by the Appointing Party / Client as part of the shared resources at the beginning of the construction project. Ownership and liability shall pass to the Contractors' Delivery Team to update and revise the PIM for construction.

Where the Appointing Party / Client requires further design changes, they can then either choose to have the changes managed by the Contractor directly to update the construction model, or alternately go back through the original design team depending upon design liability criteria.

Where the Appointing Party / Client uses the original design team the updated design model will then need to be issued as a contractual change and the normal change mechanism will then be required as change instructions which pass through the Appointing Party / Client to the Contractor.

Procurement Strategy B
The design stage Information Models are partly completed with each phase or area designed, coordinated, and completed prior to handover to the Contractor. A **phased handover of information** is provided by the Appointing Party / Client as part of the shared resources in phases or for specific areas of the project. Ownership and liability would be passed to the Contractor's Delivery Team to update and revise the PIM accordingly.

Where the Appointing Party / Client requires further design changes, they can then either choose to have these managed by the Contractor directly to update the construction model, or alternately go back through the original design team depending upon design liability criteria.

Where the Appointing Party / Client uses the original design team the updated design models will then need to be issued as a contractual change and the normal change mechanism will then be required as change instructions which pass through the Appointing Party / Client to the Contractor.

Procurement Strategy C
Where the design Task Teams become part of the Contractors' Delivery Team, the issue of design liability changes. As the design team already have ownership and are now working

directly for the Contractor, this is less onerous on the BIM protocol to resolve appointments and possible legal / liability issues. Design changes can then be picked up directly in the construction model by the appropriate Task Teams.

3.5 Tender Stage BIM IP

As with the design stage as part of the Contractor selection process, the Appointing Party / Client shall define the construction stage BIM Requirements as a request for the construction works to submit details of their approach via the construction stage Pre-appointment BIM IP with sufficient information to demonstrate the Contractor's and their Delivery Teams' proposed approach, capability, capacity and competence. The Contractor may provide recommendations for additional resources and services which they consider may also be needed by the Appointing Party / Client. They may also have specific requirements for their own BIM Uses which they will define within their BIM Requirements.

The Contractor shall cascade their requirements to each appropriate tier and shall confirm that all the Delivery Team have agreed and committed to the Pre-appointment BIM IP. The Appointing Party / Client will assess and approve the Pre-appointment BIM IP prior to the production of deliverables which will also be required to be accepted by the Appointing Party / Client. These will form the basis for the AIM and any future BIM project requirements for the asset.

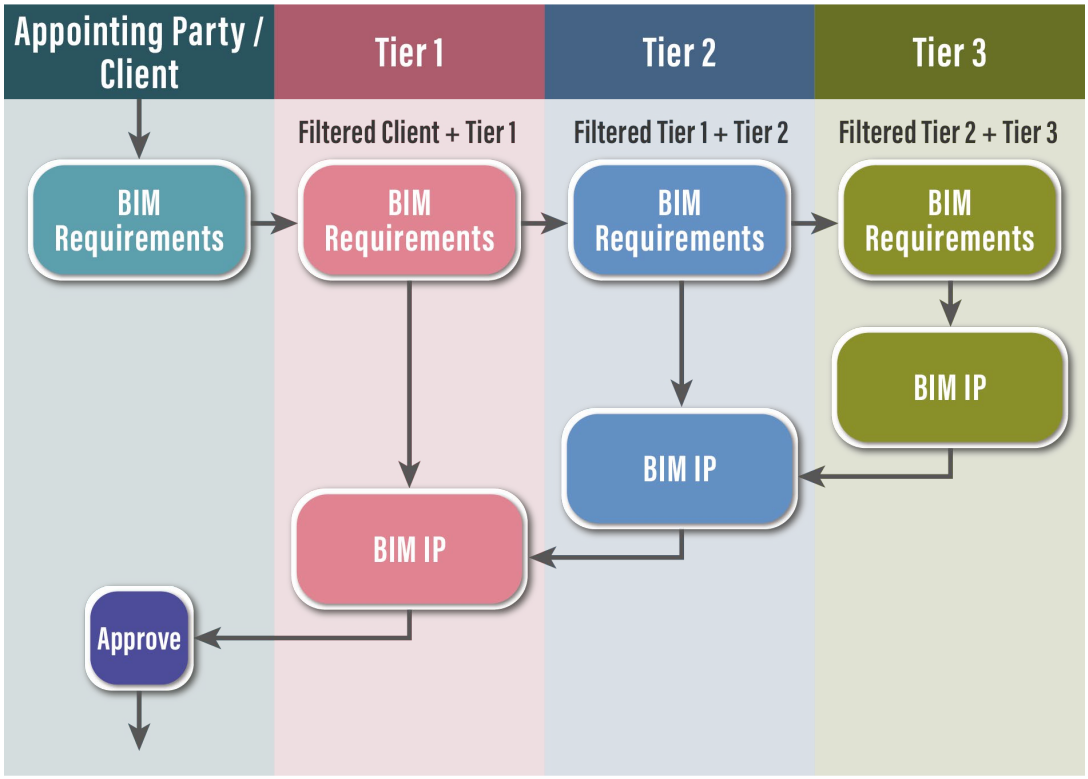

Figure 19 Cascading of BIM Information requirements to construction tiers

3.6 BIM Implementation Plan Components

3.6.1 Project Information (Project Particulars)

Each Appointing Party / Client will have their own specific requirements for project information as part of the AIR. However, the following Project Information section is recommended for all projects and should include:

- Project details including name & address;
- Appointing Party's / Client's details including name & address;
- Project number (Appointing Party's / Client's Project Number or reference);
- Major project milestones (Design Start Date, Tender Out / In Date, Construction Start Date, Completion and Handover Date); and
- Project descriptions.

It is also useful to include additional project information such as:

- Project phase or stage;
- Land registration;
- Project units (format for units of measure);
- Project global positioning;
- Project classification information;
- Topographical data
- Energy data
- Structural Engineering settings
- MEP settings
- Project standards (such as family/object types or styles, templates)
- Project BIM object library;
- Material properties; and
- Shared parameters.

3.6.2 Project Information Functions

(formerly / commonly known as Roles and Contacts)

At the start of a project, it is important to identify the functions along with the roles and responsibilities of the consultant and contractor team members. A Project Information Management Assignment Matrix shall be used to record the names and contact details of the individuals fulfilling the necessary project functions as identified in the Parties section of this guidance. The authorities for the different roles related to the production and management of building information models shall be defined.

The functions should be defined, agreed, and maintained for each stage of a project. On smaller projects, one person may have multiple functions. On larger projects, more than one person may undertake a function.

Project Function	Name	Title	Email	Telephone
Appointing Party / Client Management Functions				
Project Management (Typically Project Manager)				
Information Management (Typically Information Manager/ BIM Auditor)				
Security Management (By Project Manager)				
Asset Management (Typically Facility Manager)				

Table 7 Appointing Party / Client Information Management Functions for Assignment Matrix

Project Function	Name	Title	Email	Telephone
Project Management Functions				
Lead Consultant				
Lead Contractor				
Information Delivery Management (Typically BIM Manager)				
Asset Management (Typically BIM Manager in liaison with Facility Manager)				
Project Management (Typically Project Manager)				

Table 8 Project Information Management Functions for Assignment Matrix

Project Function	Name	Title	Email	Telephone
Task Team Management Functions				
Task Team Manager (e.g. Design Manager)				
Task Information Management (Typically BIM Manager)				
Interface Management (Typically BIM Co-ordinator)				
Information Authors (Typically Designer)				

Table 9 Task Team Information Management Functions for Assignment Matrix

3.6.3 Delivery Team Capability and Capacity Assessment

Key to a successful project is the proposed approach, capability, and capacity of each of the Task Teams that make up the Delivery Team. During the tender stage, each Task Team should prepare:

- Task Team Capability and Capacity Assessment;
- Resume / CVs of key Delivery Team members;
- Company overview;
- Information Delivery Strategy;
- Information and Communication Technologies (ICT) Capability;
- BIM Capability; and
- Information Delivery Capability.

Where Task Teams do not have the appropriate skills, software, or resource available, this should be mitigated through risk assessment, procurement and training preferably through the mobilisation stage.

3.6.4 Information Delivery Strategy

As a response to the BIM Requirements, the Lead Consultant / Lead Contractor should identify each information requirement and consider the following:

- Approach to fulfilling the EIR;
  - Approach to fulfilling the PIR;
  - Approach to input and verify the AIR;
  - Specification of Level of Information Need (LOIN);
  - Establishment of Acceptance criteria;
  - Establishment of Milestones;
- Organisation structures;
- Commercial relationships;
- Procurement; and
- Supply chain and logistic planning / management

3.6.5 BIM Goals, Uses & Deliverables

The Appointing Party / Client shall specify which BIM Uses and deliverables will be implemented on a project and the BEP shall identify which consultant or contractor will be responsible for producing the required Information Models for each stage of the project.

The objectives and uses for BIM shall be defined at the start of the project as it can increase cost and complexity to implement additional functionality in the Information Models later. Care should be taken to understand the differences between the BIM Uses / purposes required for information delivery to the Appointing Party / Client and those BIM Uses / purposes identified by the Delivery Team to facilitate their own project and business needs.

The BIM Manager should consider the adoption of BIM Uses, processes and software tools including the adoption of new solutions that are developed from time to time. The BIM Manager shall develop suitable implementation guidelines for new uses or alternative uses requested by an Appointing Party / Client or proposed by the Delivery Team.

	BIM Use	Plan	Design			Construct		Operate
		Concept Design, Inception Feasibility & Planning	Preliminary & Scheme Design	Detailed Design	Tender Stage	Construction	As-Built	Facilities Management, Operation
1	**Design Authoring**	Y / N	Y / N	Y / N	Y / N	Y / N		
2	**Design Reviews**	Y / N	Y / N	Y / N	Y / N	Y / N		
3	**Drawing Generation (Drawing Production)**	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
a	*Master Layout Plan / Development Plan*	Y / N	Y / N					
b	*Statutory Submission*		Y / N	Y / N	Y / N	Y / N	Y / N	
c	*Tender drawings*			Y / N	Y / N			
d	*Construction and Shop drawings*				Y / N	Y / N	Y / N	
e	*Sale and Lease drawings*						Y / N	
4	**Existing Conditions Modelling**	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
5	**Sustainability Evaluation**	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
6	**Site Analysis**	Y / N	Y / N	Y / N				
7	**Space Programming**	Y / N	Y / N	Y / N				
8	**Cost Estimation**	Y / N	Y / N	Y / N	Y / N	Y / N		
a	*Quantity take-off and cost estimating*	Y / N	Y / N	Y / N	Y / N	Y / N		
b	*5D modelling / cash flow forecasting*				Y / N	Y / N		
9	**Spatial Coordination**			Y / N	Y / N	Y / N		
10	**Engineering Analysis**		Y / N	Y / N	Y / N	Y / N		
a	*Structural Analysis*		Y / N	Y / N	Y / N	Y / N		
b	*Ventilation Analysis*		Y / N	Y / N	Y / N	Y / N		
c	*Lighting Analysis*		Y / N	Y / N	Y / N	Y / N		
d	*Energy Analysis / Thermal Analysis*		Y / N	Y / N	Y / N	Y / N		
e	*Fire Engineering*		Y / N	Y / N	Y / N	Y / N		
f	*Civil Engineering*		Y / N	Y / N	Y / N	Y / N		
g	*Other Engineering Analysis*		Y / N	Y / N	Y / N	Y / N		
11	**Facility Energy Analysis**			Y / N	Y / N	Y / N		
12	**Building Code Checking and Validation**		Y / N	Y / N	Y / N	Y / N	Y / N	
13	**Phase Planning (4D Modelling)**			Y / N	Y / N	Y / N		
14	**Digital Fabrication**			Y / N	Y / N	Y / N		
15	**Site Utilisation Planning**				Y / N	Y / N		
16	**3D Control and Planning**					Y / N		
17	**3D Construction Coordination**					Y / N		
18	**Construction System Design**					Y / N		
19	**Construction Quality Management**					Y / N		
20	**As-Built Modelling and Asset Information Modelling**					Y / N	Y / N	Y / N
21	**Maintenance Scheduling**					Y / N	Y / N	Y / N
22	**Project Systems Analysis**						Y / N	Y / N
23	**Space Management and Tracking**						Y / N	Y / N
24	**Asset Management**						Y / N	Y / N
25	**Sales and Marketing**			Y / N	Y / N	Y / N	Y / N	Y / N
26	**Heritage Information Modelling**						Y / N	Y / N
-	**Other BIM Uses**							

Table 10 Table of BIM Uses by Project Phases

Each of the BIM Uses in the Table above are defined below:

BIM Use 1: Design Authoring

Design Authoring is a process of using BIM authoring software and tools to create and develop an Information Model of the project progressively to support selected BIM Uses before project milestones which includes a database of properties, quantities, means and methods, costs and schedules. The architect, engineer, surveyor, consultant, contractor, sub-consultant and sub-contractor shall use the BIM authoring software and tools to develop their designs and produce views and drawings including but not limited to 3D perspective, layout plan, elevation, section, detail, fabrication and shop drawings. The software and tools are also used to produce schedules (room, door, window, finishes, and panel for distribution board, etc.). The same principle applies to all types of projects and disciplines.

BIM Use 2: Design Reviews

Design Reviews is a process for stakeholders to view a model, images and drawings from the models or animated walk-throughs of the project, provide feedback and validate numerous design aspects such as meeting the Appointing Party's / Client's requirements and previewing spaces and layouts in digital deliverables. The reviewers shall check layout, sightlines, lighting, security, disabled access and egress, wayfinding, ergonomics, acoustics, textures and colours, etc. The review can be done by using computer software only or with special virtual mock-up facilities, such as immersive lab, etc. Virtual mock-ups can be performed at various levels of detail depending on project needs.

BIM authoring software and tools with functions such as real-time high definition rendering (photo realistic), user interactions and simulations can be used to facilitate the effectiveness and efficiency of the design review / presentation process and meetings. Fully rendered still shots, animated BIM renditions, fly through and walk through visualisation can be produced for design review to facilitate the coordination meeting and stakeholder engagement.

Design Reviews shall also be used as part of the identified shared review and approval process as documented in this Standards.

BIM Use 3: Drawing Generation (Drawing Production)

Drawing Generation is a process of using BIM to produce 2D drawings, which shall be adopted in both design stage and construction stage.

As far as practicable, all 2D drawings shall be generated from the BIM authoring software and tools directly. Approval shall be sought from the Appointing Party / Client for the exemption of producing any drawings from BIM.

A registration list showing the relationship between the Information Models and 2D drawings shall be created to indicate whether each 2D drawing is generated from the BIM or not. Any 2D drawings which are produced from non-BIM authoring software or tools shall be prepared in accordance with the standards for 2D drawings as specified in the contract documents. In case any drawing is not created natively in the BIM authoring software it should be linked to the Information Models.

(a) *Master Layout Plan / Development Plan*

In planning / conceptual and preliminary design stage, master layout plan or development plan can be generated from a preliminary BIM to facilitate checking of compliances to basic development constraints.

(b) *Statutory Submission*
In the design stage, BIM shall be used for design development with statutory plan development and submission to the approving authorities of the HKSARG. Fundamental checking equivalent to the standards as per current Practice Notes and development / planning restrictions shall be determined with the aid of BIM.

See Sections 5.2 and 5.8.6 for further elaboration.

Drawing production for statutory submission shall also be correlated to *BIM Use – Building Code Checking and Validation*.

(c) *Tender drawings*
In the tender stage, the tender information for the works contracts shall include tender drawings generated from the Information Models including but not be limited to the general layout plans, elevations, schedules of works, sections, details and schedule of structural and MEP drawings and Combined Builder's Works Drawings (CBWD), etc.

See Sections 5.3 and 5.8.6 for further elaboration.

(d) *Construction and Shop drawings*
In the construction stage, drawings in the required file format shall be generated from the Information Models to facilitate the coordination and operation for the construction works during the contract period. Shop drawings shall also be generated from the Information Models to facilitate procurement.

See Sections 5.4 and 5.8.6 for further elaboration.

(e) *Sales and Lease plans*
In preparation of the Sales Brochure of residential or commercial development, the Architect shall generate the plans required from the Information Models as far as practicable, including but not be limited to floor plans of the residential / commercial properties and parking spaces, cross-section plans and elevation plans, etc.

Information Models shall also be used to generate schedules of the saleable areas, areas of other specified items not included in the saleable area, as well as generate or facilitate verification of fittings, finishes and appliances schedules.

BIM Use 4: Existing Conditions Modelling

Existing Conditions Modelling is a process of creating a 3D model of the existing site conditions, such as 3D point cloud model, 3D mesh model and 3D individual photo-realistic models. The existing conditions model should be developed by land surveyor from laser scanning, photogrammetry, conventional survey method, record drawings and digital map products available from Lands Department. For historic graded buildings, the author shall include heritage documentation and assessment prepared by the architect and structural engineer. The existing condition models are used for design visualisation and planning, as well as field verification and facility management. They shall be supplemented by photographic records

In the planning / design stage, the existing site condition, and existing building condition for alterations and additions (A&A), shall be surveyed by the above-mentioned technologies to produce 3D point cloud and / or mesh model to facilitate project planning and design development. If necessary, 3D individual photo-realistic models or Information Models of existing structure / building can also be generated.

In the construction stage, 3D digital survey technology such as laser scanning shall be employed to provide verification of the as-built condition for the construction works. It also provides documentation of the environment for future modelling, design coordination and facility management.

BIM Use 5: Sustainability Evaluation

Sustainability Evaluation is a process in which a project model is evaluated based on BEAM Plus, LEED, or other sustainable / green building criteria. This process should occur during all stages of the facilities' life including planning, design, construction, and operation.

This comprehensive process requires all disciplines to interact earlier by providing valuable insights. Energy analysis and simulations, calculations, and documentation should be performed within an integrative environment when responsibilities are well defined and clearly shared.

Information Models can also be utilised to facilitate various evaluations such as integrated design and construction management, sustainable sites, energy use and water use, air quality, embodied carbon of building structures and material usage of different parts of the building structure.

BIM Use 6: Site Analysis

Site Analysis is a process of making use of BIM and/or Geographic Information System (GIS) tools to evaluate the site to determine the most optimal location, position, orientation and site boundary, road alignment, etc. for the project. The analysis shall include but not be limited to master planning, visual analysis, vantage point / ridgeline / sightline analysis, site context analysis, terrain analysis, environmental impact, air ventilation assessment, heritage impact, traffic impact (both pedestrian and vehicular), tree preservation analysis, sun and shadow studies, daylight analysis and solar envelope analysis etc.

BIM Use 7: Space Programming

Space Programming is a process of using BIM for checking Appointing Party's / Client's spatial requirements such as compliance with the approved schedule of accommodations, reference plot ratio for the project and site coverage of greenery for the project, height restriction and other spatial requirements relevant to the project as considered appropriate.

Space programming shall be conducted by using the developed Information Model to analyse space and understand the complexity of space standards and regulations. Efficient and accurate assessment of design performance in regard to spatial requirements by the owner and statutory requirements (such as school design, provision of barrier free access facilities, etc.) should be conducted.

Examples on extended space programming process may include authoring of spatial and material design model, design visualisation for functional analysis.

BIM Use 8: Cost Estimation

Cost Estimation / 5D modelling is a process in which BIM can be used for cost estimates throughout the life cycle of a project.

(a) *Quantity take-off and cost estimating*

In the design stage, the Information Models can generate more accurate quantities for project cost budgeting, project cost control and cost evaluation on design options, etc. as far as practicable.

In the tender stage, the Information Models can be used for extracting quantities in the preparation of pricing documents [and the Information Models shall form part of tender information to indicate the design intent layout and the material quantities for the tenderers' information].

(b) *5D modelling / cash flow forecasting*

In the construction stage, the Information Models can be used for extracting quantities for project cost control, cost evaluation on the variation of works, cash flow forecast, spending analysis, interim payment, etc. as far as practicable. The 5D Model shall be adopted in the regular project progress meeting to indicate and compare the current cash flow status with the baseline forecast to facilitate project management.

See Section 5.8.3 for further elaboration.

BIM Use 9: Spatial Coordination (formerly 3D Coordination)

Spatial Coordination is the whole process of design error avoidance using federated Information Models and a collaborative shared design environment. The goal of the coordination process is to eliminate design errors before construction of the project. The BIM coordination process shall also include but not be limited to the checks for spatial and headroom requirements, working spaces for building operations and maintenance activities, installation and replacement of equipment and machines.

Modelling teams are required to deliver coordinated information and must undertake their own check, review, and approve process prior to the sharing of information. The procedure for undertaking the model check includes:

1. To compare Information Models built up from designs of different disciplines;
2. To ensure models are coordinated with the current shared information;
3. To ensure models include all reference file names, revision, version, status code and authorisation codes;
4. To identify spatial clashes, mark-ups, comments and priority for actions;
5. To report spatial coordination conflicts to the responsible parties and if necessary, the Appointing Party / Client or its representatives for decision making;
6. To ensure information is spatially coordinated and revise design information upon instruction;
7. To rebuild / update Information Models;
8. To identify coordinated models for sharing as suitable for coordination, submission and approval; and
9. To document changes, revision history and approved copies.

As part of the review and approval or the review and authorisation process, a clash analysis process as documented in the BIM Project Execution Plan shall be undertaken to verify that modelling teams have undertaken the appropriate checks. Information not coordinated or suitably marked and commented shall be rejected.

BIM Use 10: Engineering Analysis

Engineering Analysis is a process that uses the Information Model to assist, analyse and optimise different design options to determine the most effective engineering solution to meet design codes and Appointing Party's / Client's requirements.

(a) Structural Analysis

For structural analysis, the analytical modelling software utilises the BIM design authoring model to determine the behaviour of a given structural system including demolition, ground investigation, site formation, foundation and superstructure systems. Based on this analysis, further development and refinement of the structural design takes place to create effective, efficient, and constructible structural systems. The development of this information is the basis for what will be passed onto the digital fabrication and construction system in design stages.

(b) Ventilation Analysis

For ventilation analysis, analytical modelling software can utilise the BIM design authoring model and incorporate the model into a site model so as to predict the performance for Computational Fluid Dynamic (CFD), Air Ventilation Assessment (AVA), micro-climate analysis, etc.

(c) Lighting Analysis

For lighting analysis, analytical modelling software can utilise the BIM design authoring model to determine the behaviour of a given lighting system. This can also include artificial (indoor and outdoor) and natural (daylighting and solar shading) lighting. Based on this analysis further development and refinement of the lighting design take place to create effective, efficient, and constructible lighting systems. The application of this analysis tool allows performance simulations that can significantly improve the design and performance of the facility's lighting over its life cycle and comfort requirements.

(d) Energy Analysis / Thermal Analysis

For energy analysis in the design stages, one or more building energy simulation programs use a properly adjusted Information Model to conduct energy assessments for the current building design. The core goal of this BIM Use is to inspect building energy standard compatibility and seek opportunities to optimise the proposed design to reduce the structure's operation costs.

(e) Fire Engineering

Where fire engineering is adopted, the BIM design authoring model can be utilised to assist the evaluation between the Deemed-to-Comply provisions and the performance requirements, assist in identifying additional fire safety provisions to compensate for the deviation or shortfall, facilitate quantitative analysis to assess an alternative solution, etc.

(f) Civil Engineering

For civil engineering works, the models can be analysed for site formation (cut & fill) hydraulic design of water supply, waste treatment, sewerage and storm water drainage systems.

(g) Other Engineering Analysis

Other engineering analysis may include mechanical, acoustic, environmental noise, plumbing, drainage, people movement analysis, risk analysis, etc. The model can be used to predict the performance of a system which should then be compared to actual performance data such as commissioning results.

BIM Use 11: Facility Energy Analysis

Facility Energy Analysis is a process of using a building energy simulation programme with a model to conduct energy assessments of a project design to optimise the design to reduce energy cost hence life cycle costs.

By checking the building energy standard compatibility and conducting energy assessment using Building Energy Simulation and Analysis Software, the energy model shall be delivered and the predicted energy uses can be specified. The results of facility energy analysis can facilitate the energy benchmarking.

BIM Use 12: Building Code Checking and Validation

Building Code Checking and Validation is a process of reviewing compliance with building codes and regulations that apply to the project through one or more Information Models. Code validation software may be utilised to check the model parameters against project specific codes.

Currently BIM is submitted as supplementary information for reference only; the Buildings Department processes approval of plans under the Building Ordinance based on the information contained in the plans. In case of any discrepancy between the plans and BIM submitted, the plans shall prevail. Examples of BIM supplement plan submissions are given in Appendix A of PNAP ADV-34.

Reference shall also be made to Statutory Submission under Drawing Generation (Drawing Production).

Although code validation is currently in its infant stage of development in Hong Kong, it would become more prevalent as rule-based model checking tools continue to develop.

BIM Use 13: Phase Planning (4D Modelling)

Phase Planning (4D Modelling) is a process in which an interactive 4D model (3D models with the added dimension of time) is utilised to effectively plan the construction sequence and space requirements on a building site.

In the design stage, Phase Planning (4D Modelling) shall include construction sequence simulation for visually demonstrating and communicating project construction sequence based on proposed design and requirements on the project. Construction activities with very high to extreme risk level or other activities as the Appointing Party / Project Manager considered appropriate shall be included. The BIM shall include all major systems and shall contain sufficient data to show planned sequential construction in animation. Any assumptions (e.g.: construction programme, phasing, temporary structures, if any) shall be communicated, commented and agreed by the Appointing Party / Client. A comparison of the planned activities verses the actual activity is required. Meetings to review and forecast of the time activities shall be carried at regular intervals to

The 4D simulations can also include the demonstration of the sequence of construction of the prefabricated, MiC* and DfMA* elements / units from fabrication, transportation to installation on site. The swept path analysis from the port (marine transport) or factory (land transport) to the site of the above elements / units is also required.

See Section 5.4 for further elaboration on Phase Planning (4D Modelling) During Construction Stage.

BIM Use 14: Digital Fabrication

Digital Fabrication is a process for digitalising the construction details in the Information Model for mass customised components such as metal cladding, acoustic panels, building façade panels, ceiling panels, acoustic barriers, metal structural members, etc. which are of large quantities and variety in dimensions, shapes, geometries, etc. Digital Fabrication shall be adopted for prefabrication process in factories.

As far as practicable, the Information Models may be able to transfer directly to the Computer Numerical Control (CNC) machines for fabrication and manufacturing. The Information Models can also be used for prototyping with 3D printers as part of a design intent review process.

BIM Use 15: Site Utilisation Planning

Site Utilisation Planning is a process of using models to graphically represent both permanent and temporary facilities on site for all of the phases of the construction process. The models should be linked to the construction schedule (4D) to review space planning, site logistics, sequencing requirements, temporary works and safety.

Site Utilisation Planning shall be adopted in construction stage for the construction activities with very high to extreme risk level or other activities as the Appointing Party / Client / Project Manager considered appropriate. As far as practicable, the plant / equipment / vehicle / machinery operation, etc. associated with the works activities should be included in the site utilisation planning.

BIM Use 16: 3D Control and Planning

3D Control and Planning is a process that utilises a model to layout project elements such as the position of walls using a total station with survey points preassigned in the model, the process of automating the control of equipment's movement and location such as using Global Positioning System (GPS) coordinates, to determine if proper excavation depth is reached or assembling components on site.

3D Control and Planning can be adopted in construction stage to link the Information Models with HK1980 Grid System to increase efficiency and productivity by decreasing time spent surveying in the field. Control points shall be directly generated from the Information Models with the adoption of machinery with GPS capabilities and digital layout equipment together with Information Model transition software.

BIM Use 17: 3D Construction Coordination

3D Construction Coordination is a process of further coordinating the federated Information Models from design stage to construction stage. Designers, consultants, main contractors, sub-contractors and suppliers shall be involved in this coordination. The goal of the coordination process is to eliminate design errors before construction of the project and enhance the efficiency and constructability of the Information Models. Practical system layout arrangement due to site condition, limitation / details of the component purchased from suppliers and coordination between discipline sub-contractors shall be taken into considerations.

BIM Use 18: Construction System Design

Construction System Design is a process of design and analysis of the supplementary construction systems e.g.: safety plan, temporary support, formworks, excavation support, method statement, etc., to optimise their planning and construction through Information Models.

BIM Use 19: Construction Quality Management

Construction Quality Management is a process of utilising a Construction Quality Management system (CQMS) during construction stage to record all site defects spotted by site quality team, dispatch such records to relevant parties to follow up and keep tracked with the status until the defect is fixed. CQMS shall support viewing and navigating of Information Models, so that quality team can compare the Information Model against actual site installations.

The BIM shall also be made compatible and be interfacing with the Digital Works Supervision System (DWSS) if adopted in the project. The DWSS shall provide API for the Common Data Environment or BIM software applications to retrieve the forms or records in the DWSS through unique Object / BIM / Location ID.

BIM Use 20: As-Built Modelling

for As-Built Model (ABIM)
and Asset Information Model (AIM)

As-Built Modelling for asset management and facilities upkeep is a process used to depict an accurate representation of the physical conditions, environment, and assets of a facility, which shall be adopted in construction stage.

The As-Built Information Model (ABIM) shall be updated based on the final approved construction information that has been built, checked and shall be accurate as shown on the as-built drawings / models. Information on location such as room number, room name and building name, staircase number, washroom number, lift lobby number is required to be incorporated into the ABIM. The operation data, product catalogues, manuals, warranties, certificates and maintenance history of equipment, etc. shall also be linked to the ABIM.

When verified ABIM is handed over to Appointing Party / Client, it becomes the Asset Information Model (AIM) for operation use.

BIM Use 21: Maintenance Scheduling

Maintenance Scheduling is a process in which the functionality of the building structure (walls, floors, roof etc) and equipment serving the building (mechanical, electrical, plumbing etc) are maintained over the operational life of a facility. A successful maintenance program will improve building performance, reduce repairs, and reduce overall maintenance costs.

It shall be adopted in construction stage in collecting and providing maintenance attributes, such as maintenance cost, expected lifetime, mean time between failure, warranty start/end day, maintenance parties, etc., for facility structures, fabrics and equipment in the ABIM as considered appropriate. Record model shall be provided for tracking maintenance history.

BIM Use 22: Project Systems Analysis

Project systems analysis is a process of measuring how a project performs compared to the design specifications, to ensure the project is operating to specified design and sustainable standards.

Before handing back the built assets, contractor together with sub-contractors, suppliers and other specialists are required to use sensors, other building control systems and building systems analysis software (energy, lighting, mechanical and others) to perform the Project Systems Analysis to prove the product specifications and standard compliance.

This may include assessing how a mechanical system operates, how much energy a project uses, conducting lighting analysis, solar gain analysis and airflow analysis using Computational Fluid Dynamics (CFD). "What if" scenarios can be created, for example by changing different materials, throughout the project to show better or worse performance conditions.

BIM Use 23: Space Management and Tracking

Space Management and Tracking is a process in which BIM is utilised to effectively distribute, manage, and track appropriate spaces and related resources within a facility. The ABIM containing the facility information shall allow the facility management team to analyse the existing use of the space and effectively apply transition scheduling activities / planning management towards any applicable changes.

The ABIM can be used to assess, manage and track spaces and associated resources within a project. A BIM can be integrated with spatial tracking software to analyse the existing use of space, apply transition planning for renovations and refurbishment projects.

BIM Use 24: Asset Management

Asset Management is a process of linking an Asset Information Model (AIM), which shall be developed from the ABIM, and database to an organised building management system which should be used to maintain and operate a facility and its assets. The assets in the AIM for asset management shall include buildings, infrastructure, system and equipment which should be operated, maintained and upgraded.

The process utilises the data contained in an ABIM to populate an asset management system. The link allows users to visualise an asset in the model before servicing it. The facility manager / maintenance parties shall specify the data required for each element in the AIR.

BIM Use 25: Sales and Marketing

Design and Construction Professionals

When a project offer includes 3D walkthrough and an accurate budget, the designers and contractors demonstrate engineering know-how and a technological edge. By taking advantage of BIM as a marketing tool, designers and contractors can beat larger competitors with more resources at their disposal.

Sales and Marketing Professionals

Other than engineering BIM Uses, there are applications in the sales and marketing areas:

- develop stunning and accurate marketing collateral such as static high-quality images and high-quality video;
- create stronger marketing proposals;
- prepare graphics for presentations;

- develop and maintain marketing plans;
- develop and maintain trade show experiences;
- visualise designs in immersive environments such as Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR);
- customise spaces and building elements;
- create Point of Sales configurators for building elements for indoor navigation;
- embed building products in context of building spaces;
- embed project in accurate geolocation positioning for visualisation and analysis; and
- as marketing gadget by offering the buyer the BIM unit with relevant provisions they purchased or rented, subsequent modification can be clearly managed e.g.: would not nail a picture at the position where a concealed conduit or water pipe is embedded in the wall.

BIM Use 26: Heritage Information Modelling (HIM)

Heritage Information Modelling (HIM) is an extent of the swift-developed Building Information Modelling (BIM). It is not just a digitalised building with physical, architectural, functional social and cultural characteristics, but can also with the implementation of new technologies, HIM provides a new way for working in collaboration.

The asset data and three-dimensional model can be used for effective management and create more effective methods of maintaining and conserving the heritage buildings. New technologies such as laser scanning, unmanned aerial vehicle (UAV) based photogrammetry are used for the BIM process. Radio Frequency Identification (RFID), near field communication (NFC) tags, quick response (QR) code, augmented reality (AR) are being used for the user-friendly detection of heritage tourism and maintenance workflow at the heritage site.

With the 4th dimension, time, introduced into the 3D models, different phases or era of the asset can be modelled to indicate the progress or evolution of changes throughout the asset history, different historical or cultural non-graphical information can be attached to its appropriate phases. Model viewer with sliding historical display can reveal the asset outlook and its corresponding historical information for visualisation, education, maintenance, preservation, guided tour / virtual tour and tourism uses.

3.6.6 Information Management Assignment Matrix

Each party (Appointing Party / Client, Lead Consultant / Lead Contractor or Task Team) should identify the information management roles identified to carry out the information management functions assigned to them and identify these within an Information Management Assignment Matrix. An explanation of the ISO 19650 assignment matrix is provided in Section 1.2. Against each task, the matrix shall identify at least a simplified approach of which of the roles is responsible for each Task, by indicating a tick or cross against the matrix. Ideally, the tasks should be allocated using a full RACI responsibility assignment approach indicating either:

R = Responsible for undertaking activity;
A = Accountable for activity completion;
C = Consulted during activity; and
I = Informed following activity completion.

An example of an Appointing Party / Client information management responsibility matrix using a RACI approach is shown in Table below and identifies ownership and responsibility for each task:

I.D.	**Task** **R = Responsible for undertaking activity** **A = Accountable for activity completion** **C = Consulted during activity** **I = Informed following activity completion**	**Appointing Party's** / **Client's** Delivery Manager	**Appointing Party's / Client's BIM Manager**	**Asset / Security Officer**
1	Appoint individuals to undertake the Appointing Party / Client information management function	***R***	***A***	***C***
2	Establish the project's information requirements	***A***	***R***	***C***
3	Establish the project milestones	***R***	***A***	***C***
4	Establish the Project Information Standards	***A***	***R***	***C***
5	Consider the exchange of Information	***A***	***R***	***C***
6	Consider the means of structuring and classifying information	***A***	***R***	***C***
7	Consider the use of information during the operational phase of the asset	***A***	***C***	***R***
8	Establish the project's information production methods and procedures	***A***	***R***	***C***
9	Consider the capture of existing asset information	***A***	***C***	***R***
10	Consider the security or distribution of information	***A***	***C***	***R***

Table 11 Indicative Appointing Party / Client Information Management Assignment Matrix using RACI

For the Lead Consultant / Lead Contractor defining project delivery and information management roles an example of a Project Information Management Responsibility Matrix using a simplified approach for each task could be as follows in Table below:

I.D.	Task	Project Manager	BIM Manager
1	Confirm the Delivery Team's BIM execution plan		✓
2	Confirm the names of the information management function	✓	
3	Update the information delivery strategy	✓	
4	Update the high-level responsibility matrix		✓
5	Confirm and document the proposed information production methods and procedures		✓
6	Agree with the Appointing Party / Client any additions or amendments to the project's information standard	✓	
7	Confirm the schedule of software, hardware, and IT infrastructure		✓
8	Establish the Delivery Team's detailed responsibility matrix	✓	
9	Establish the Lead Appointed Party's EIR		✓

Table 12 Indicative Project Information Management Assignment Matrix

For each Task Team a matrix defining team roles shall be provided. An example of a Task Team Information Management Responsibility Matrix using a RACI approach for each task could be as follows in Table below:

I.D.	**Task** **R = Responsible for undertaking activity** **A = Accountable for activity completion** **C = Consulted during activity** **I = Informed following activity completion**	Task Team Leader	BIM Coordinator	Modellers
Production				
1	Check availability of reference information and shared resources	***A***	***R***	***C***
2	Generate information in accordance with the TIDP	***A***	***C***	***R***
3	Generate information in accordance with SMPs	***A***	***C***	***R***
4	Generate information in accordance with Level of Information Need	***A***	***C***	***R***
5	Generate information coordinated and cross referenced with Shared Information	***A***	***C***	***R***
6	Generate information that is spatially coordinated	***A***	***C***	***R***
7	Generate information with appropriate suitability (Status Code)	***A***	***R***	***C***
8	Check Information for sharing	***A***	***C***	***R***
9	Review information	***A***	***R***	***I***
10	Approve for sharing	***R***	***C***	***I***

Table 13 Indicative Task Team Information Management Assignment Matrix

3.6.7 Project Information Standards

(formerly / commonly known as standards on BIM Procedures)

The Appointing Party / Client will provide the initial Project Information Standards and the Lead Consultant / Lead Contractor will expand this with any additions or amendments identified by the Delivery Team for approval by the Appointing Party / Client. Project Information Standards should include the following:

- File data requirements (including images and animations);
- Nomenclature;
  - File Identifiers (File naming convention);
  - BIM objects;
  - Levels;
  - Rooms / Areas;
  - Object Identifier;
  - Views (Plans, Sections, Schedules, etc.)
- BIM object standard;
- Annotation and symbology;
- Classification;
- Properties (Attribute / Parameter);
- Layer / Workset standards / Conventions;
- Units and precision; and
- PIM origin and orientation.

Project information standards are the main ingredient in delivering consistent project information and reducing waste. As much as possible, Project information standards should be based upon documented industry best practice as this will reduce the effort in writing, education and complying with the standards.

The project mobilisation phase should be used to test and verify delivery against the standards. Project inductions, training and education programmes should all address the requirements of the standards along with the Project Information Production Methods and Procedures.

3.6.8 Project Information Production Methods and Procedures

(formerly / commonly known as BIM Procedures)

The Appointing Party / Client will provide the initial Project Information Production Methods and Procedures which the Lead Consultant / Lead Contractor will expand with any additions or amendments identified by the Delivery Team for approval by the Appointing Party / Client. The Project Information Production Methods and Procedures should include the following:

- Project Stages / Plan of works;
- Zonal / Federation strategy;
- Phasing strategy;
- Spatial coordination;
- Security strategy;
- Modelling methodology;
- Model Delivery formats and requirements;
- Document Delivery formats and requirements;
- Data Delivery requirements;

- Shared resources
  - Templates;
  - Common object libraries; and
  - Title blocks.
- Procedures for CDE;
  - Status codes;
  - Revision codes;
  - Authorisation codes;
  - Export / exchange formats; and
  - Access / security requirements;
- Quality assurance procedures / workflows;
  - Check, review, approve;
  - Review and approval (Design review);
  - Review and authorisation;
  - Review and accept; and
- Print requirements / plot styles.

The aim of the Project Information Production Methods and Procedures is to provide consistent information delivery. Often there are multiple ways of achieving the same end, but each will produce a slightly different result.

Example: Construction Operations Building Information Exchange (COBie) deliverables is a project requirement.

COBie can be delivered by multiple methods which can generally be identified as:

- Exporting directly from the Authoring tool;
- Exporting from a Third-Party tool; and
- Exporting to IFC and using an IFC / Cobie exporter.

Each option will provide a different result regarding the final information that is provided depending on the settings of each export. Using a third-party tool or via the IFC route also has the added complication that there are two exports to be undertaken and therefore more opportunity with errors in settings, methods and procedures to be managed for each option.

To resolve these types of issues, the Project Information Production Methods and Procedures should document these methods and procedures against which information delivery will be verified and this should be tried and tested during the mobilisation / operation phase.

3.6.9 Model Federation Strategy

(formerly / commonly known as Model Division)

To effectively manage the Information Model, it needs to be divided into its component parts. This is defined as an information breakdown structure which is a pre-determined method to identify manageable units of information to be used across a project or asset life cycle. The information breakdown structure documents the proposed federation strategy.

The high-level breakdown starts at the three identified components of an Information Model which are:

- Graphical model;
- Non-Graphical Information; and
- Documentation.

The misconception about BIM is that all three components should reside in a single file. In fact, a federated approach makes collaborative working easier using a linked data approach. It is common practice depending upon the software used to include documentation (views and sheets) within the graphical model files. This adds waste as many elements need to be purged from the models prior to sharing for collaboration. The separation of the documentation and graphical at the component level should be a requirement on all but the smallest projects and each of the three components can also be subdivided into different units.

One advantage of further breakdown is to allow an efficient simultaneously working approach by multiple members of a Task Team. Depending upon the tools used the breakdown may need to be at the file or other levels such as layer or workset. Some of the elements that need to be taken on board when undertaking this breakdown will include:

- Disciplines;
- Zones / Volumes;[2]
- Systems / Sub systems;[3]
- File Size;
- Work packages;
- Resource access;
- Software solutions;
- Security;
- Information Exchange;
- Quality Assurance procedures;
- Data Audit; and
- Standard Approach of Modelling (SAM).

Simultaneous working is a key consideration when assessing the federation strategy. The federation strategy will include multiple requirements and may reflect usage, ownership, design responsibility, construction phasing, structural integrity etc. There are many different options for a project and each option will have advantages and disadvantages at different project stages. Experience will aid in understanding the trade-off between federating too much, which can create model management issues and too few which can impact on performance and delivery.

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[2] the required space that a system needs within the building allowing for installation, maintenance and replacement.

[3] system is usually defined as a number or alpha numeric code that is unique for each system, e.g.: multiple HVAC systems on each floor.

3.6.10 Security Strategy

Within the BIM Requirements, the Appointing Party / Client shall provide the SIR as the result of the security triage process (see Section 2.4 Security Information Requirements (SIR) (Appendix D4) and should provide a security approach, strategy, and plan documented in the security management plan.

The BIM Execution Plan will then need to take on board these requirements. Security can have an enormous impact on the delivery requirements and in extreme cases can require a co-located workforce working behind isolated local area networks with extreme controls for information input and outputs to that network.

Security can impact the proposed approach to BIM delivery with specific areas or particular projects that should be considered including:

- Delivery Team Approach, Capability and Capacity Assessment;
- Project Information Production Methods and Procedures;
- Project Information Standards;
- Zonal / Federation Strategy;
- Spatial Coordination;
- Modelling Methodologies;
- Procedures and setup of CDE;
- Quality Assurance procedures; and
- Software and hardware (IT systems).

For example, under Delivery Team Approach, Capability and Capacity assessment this may require specific security clearance or at least background checks on individual staff members working on projects. Companies being considered may need to demonstrate that they have appropriate processes in place to undertake these staff checks and that their buildings and IT Infrastructure provide a secure environment.

For Information Technology this may require compliance with recognised international certification schemes such as ISO 27000 Information technology - Security techniques - Information security management systems. One of the areas in research is the application of encrypting technology such as Block Chain to add a trackable layer of security to the information transmitted, so that the audit trail can also be added. Software solutions, hardware and CDE solutions chosen may also be impacted by the security approach but may be alleviated by simple elements such as restricting administration rights. Data storage security concerns should also be taken into consideration including aspects like cloud / data centre locations.

The design and construction Information Models may also be federated to alleviate security risks with disciplines only having access to the minimal information necessary to undertake their deliverable and information may be delivered with minimal detail and information obfuscated so that room names, secure assets labels, object properties, etc., are not available except to those that have the information keys. The proposed approaches to security are often in conflict with the openBIM approach and therefore the security strategy must be a response to the identified risk from the Appointing Parties security management plan.

Where security is identified as a specific issue early liaison with those undertaking the Appointing Party / Client Security Management function will assist in defining an appropriate response.

3.6.11 High Level Responsibility Matrix

(formerly / commonly known as BIM Organisation Chart)

The relationship of the BIM roles and responsibilities are documented for two contract types: traditional Design-Bid-Build and Design & Build Contracts at a high level.

Design-Bid-Build – there are essentially 4 parties involved in the in the BIM Organisation Chart BIM Process:

a) Appointing Party/ Client/ PM. **BIM Auditor** is the responsible party from the client side.

b) Design Team (may be one team for smaller project, and more teams for larger projects). **Design Team BIM Manager** is the responsible party at design phase, but shall continue to supervise through construction phase.

c) Construction Team (may be one team for smaller project, and more teams for larger projects). **Construction Team BIM Manager** is the responsible party at construction stage.

d) Facility Management Team. Being advised by the **BIM Auditor** or have a BIM Manager on BIM matters.

Corresponding BIM Roles, Responsibilities and Authority are defined in the next session.

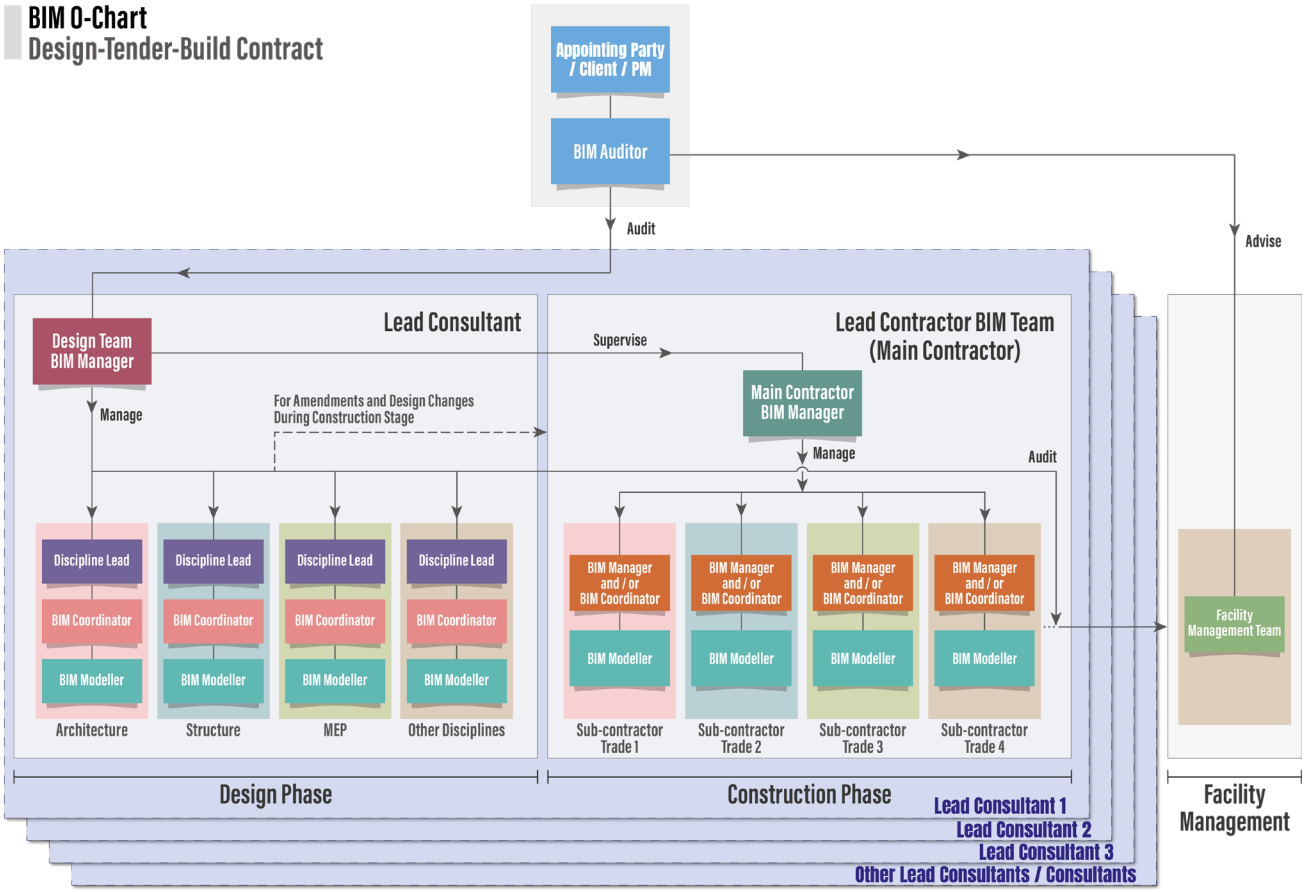


Figure 20 BIM Organisation Chart for Design-Tender-Build Contract

Design & Build Contract – there are essentially 3 parties involved in the in the BIM Organisation Chart BIM Process

a) Appointing Party/ Client/ PM. **BIM Auditor** is the responsible party from the client side.
b) Construction Team (may be one team for smaller project, and more teams for larger projects, Design team is included into this construction team **Construction Team BIM Manager** is the responsible party right from the project start. **Design Team BIM Manager** to report to construction team.
c) Facility Management Team. Being advised by the **BIM Auditor** or have a BIM Manager on BIM matters.

Corresponding BIM Roles, Responsibilities and Authority are defined in the next session.

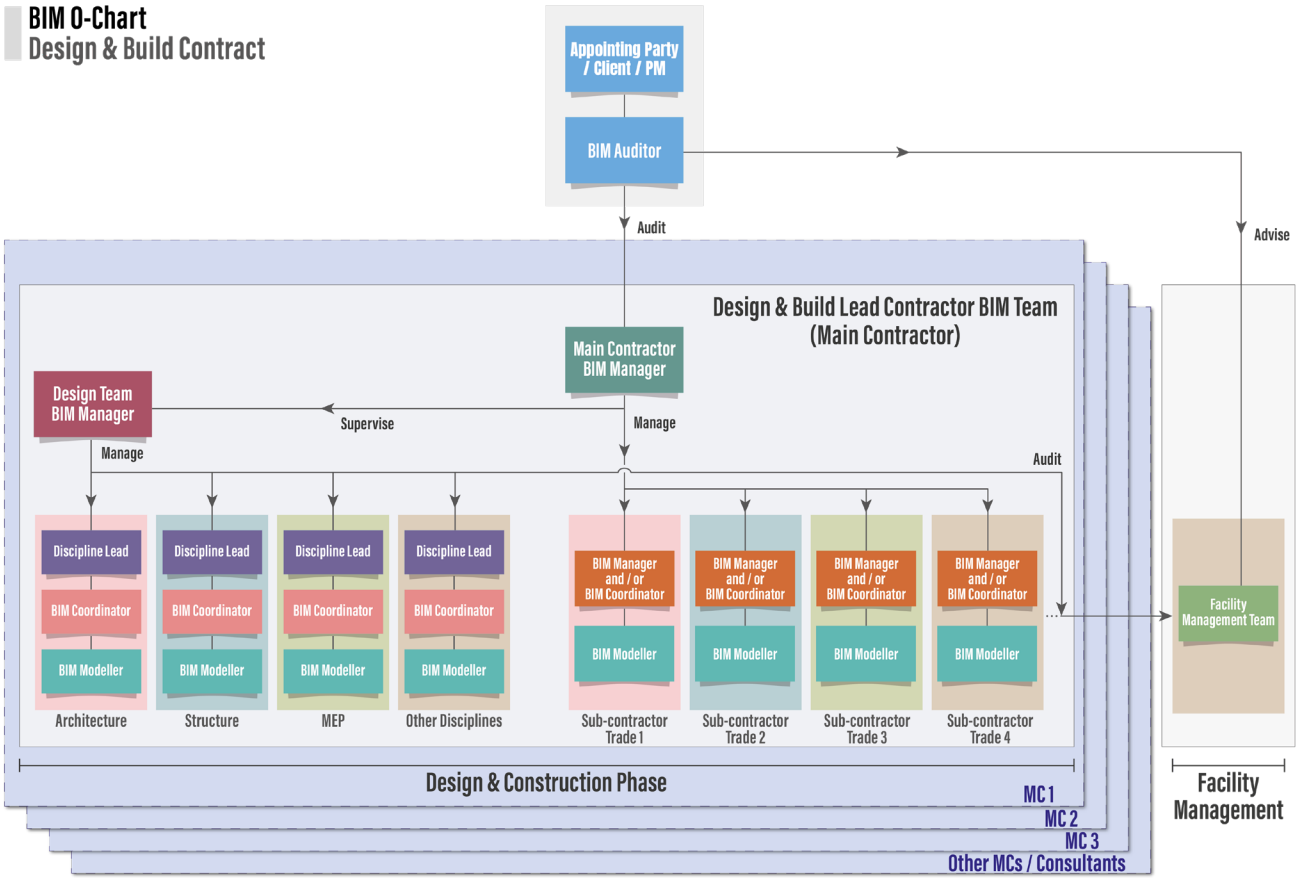


Figure 21 BIM Organisation Chart for Design-and-Build Contract

3.6.12 Roles, Responsibilities and Authority

At the start of a project it is important to identify the roles and responsibilities of the consultant and contractor team members. A table shall be included in the BIM Execution Plan to record the names and contact details of the individuals fulfilling the necessary project and task roles. The authorities for the different roles related to the production and management of Information Models shall be defined in the responsibility matrix.

The following roles should be defined, agreed and maintained for each stage of a project. On smaller projects, one person may have multiple roles and responsibilities.

Role	Responsibility & Authority
Appointing Party / Client / PM	Planning of overall project objectives, managing cost, time, scope and quality of all project deliverables.
BIM Auditor	The BIM Auditor shall supervise the BIM execution and oversee the BIM process of the Project under his/her Contract. Key role and responsibilities of the BIM Auditor shall include but not be limited to: • Supervise the development, implementation and management of the BIM Execution Plan (BEP), standards, processes, procedures; • Responsible for auditing all BIM deliverables, delivery schedules, progress monitoring and quality assurance; See Section 5.8.4 BIM Audit for detail responsibility and tasks.
Design Team BIM Manager	The BIM Manager shall take lead on the BIM execution and oversee the BIM process of the Project under his/her Contract. It should be ensured that the BIM Manager shall work independently from the role of its respective Discipline Lead. Key role and responsibilities of the BIM Manager shall include but not be limited to: • Facilitate the development of the BIM team and management of BIM Execution Plan (BEP) to ensure that the deliverable of Appointing Party / Client are issued on time; • Responsible for the delegation of BIM tasks within the BIM Coordinator(s) and BIM Modellers and monitoring the collaboration of information exchange to make sure it all recorded in a model; • Responsible for coordinating and collaborating with the appointed parties under the contract and the Appointing Party / Client including its representatives; • Audit and manage the federated Information Model by the individual disciplines; • Carry out clash detection analysis, issue management and oversee the change of management within the BIM process; and • Liaise with FM / AM team for identifying AIR. For **Design-Bid-Build Contract**: • Manage the BIM project standards, develop implementation strategy and consolidate the submission of Information Models from individuals' disciplines; • Provide quality assurance on the checking procedure to the BIM deliverables and submit to the BIM Auditor and Appointing Party / Client / PM; • Supervise on Main Contractor BIM Manager during construction and as-built stage; • Verify as-built information submitted by the Main Contractor; and • Manage project-wide Common Data Environment (CDE). For **Design & Build Contract**: • Manage the BIM project standards, develop implementation strategy and consolidate the submission of Information Models from individuals' disciplines; and • Provide quality assurance on the checking procedure to the BIM

Role	Responsibility & Authority
	deliverables and submit to the Main Contractor BIM Manager.
Main Contractor BIM Manager	The BIM Manager shall take lead on the BIM execution and oversee the BIM process of the Project under his/her Contract. It should be ensured that the BIM Manager shall work independently from the role of its respective discipline BIM Manager. Key role and responsibilities of the BIM Manager shall include but not be limited to: • Facilitate the development, implementation and management of the BIM Execution Plan (BEP), standards, processes, procedures; • Ensure delivery of the Appointing Party's / Client's BIM Requirements, goals and uses; • Responsible for the BIM deliverables, delivery schedules, progress monitoring, quality assurance and BIM coordination; • Collaborate among various Sub-contractors under the Contract; • Federation of all Information Models prepared by the individual disciplines / Sub-contractors; • Carry out clash analysis and management, Issue management and change management of the BIM process; • Manage Project-wide Common Data Environment (CDE); and • Verify as-built information submitted by the Main Contractor. For **Design-Bid-Build Contract**: • Consolidate BIM submissions from individual disciplines, manage model compliance and quality assurance and submit to the Design Team BIM Manager. For **Design & Build Contract**: • Supervise on Design Team BIM Manager during Design Stage; and • Consolidate BIM submissions from individual disciplines, manage model compliance and quality assurance and submit to the BIM Auditor and Appointing Party / Client / PM.
Discipline Lead	The Discipline Lead shall be mainly responsible for leading design authoring and production (drawings, visualisation, analysis, etc.) of its individual discipline. The Discipline Lead takes up the Task Team Management function. Key role and responsibilities of the Discipline Lead shall include but not be limited to: • Lead the execution of the BIM Execution Plan (BEP) within own discipline; • Manage and lead the Design Authoring Process within own discipline; • Lead the production of BIM deliverables as per requirements; • Coordinate with the BIM Manager, feedback to its corresponding discipline design team / trade to resolve clashes and issues identified through the BIM process; • Coordinate with BIM Teams from other disciplines; • Resolve design issues within its corresponding discipline; • Carry out quality assurance checks before sharing the models with other disciplines, BIM Manager and BIM Auditor; • Share information by the Project-wide Common Data Environment (CDE); and • Liaise with FM / AM team for identifying AIR.

Role	Responsibility & Authority
BIM Coordinator	The BIM Coordinator shall be mainly responsible for the daily coordination of the overall BIM process internally (within own discipline) and cross-disciplines / trades, in support to all BIM implementation activities led by the Discipline Lead or the Main Contractor. Key role and responsibilities of the BIM Coordinator shall include but not be limited to: • Coordinate and manage specific discipline model and consolidate the information from the modellers to ensure all the models, drawings, schedules and documents compliance to the BEP; • Coordinate between BIM Manager, Discipline Lead, designers, consultants, other coordinators, modellers, quantity surveyors, Main Contractor, sub-contractors and other project participants; • Build and develop the Information Models and all deliverables based on the information and data collected, to manage the BIM databases, to report any clash/conflict or difficulties in Information Models production and to resolve such difficulties with relevant parties; • Carry out the quality assurance checks; make sure the latest input is updated from time to time and make sure all deliverables are coordinated on time before sharing the models with other disciplines / trades, BIM Manager and BIM Auditor; • Manage and keeping track the revisions, inclusions or amendments to ensure consistency among all deliverables within the parties; • Maintain a library of objects and elements for use on the project which is compatible with the selected software platforms; and • To fully utilise BIM for minimisation of design changes and risks, clarification of project costs and programmes, and enhancement of safe design for construction and operation. For Design Team BIM Coordinator during construction stage: • Oversee and administer the BIM deliverables to be developed and submitted by the Contractor, to instruct the Contractor for necessary update or rectification to the BIM deliverables whenever required; and • Perform or carry out such other duties, works or services as reasonably required or instructed by the Appointing Party / Client from the beginning of design stage to the completion of the consultancy services.
BIM Modeller	The BIM Modeller shall be discipline-specific and mainly responsible for BIM authoring and production of its individual discipline or trade. Key roles and responsibilities of the BIM Modeller shall include but not be limited to: • Create, maintain or amend models, drawings, schedules, images, animations and documents to the LOIN prescribed in the BIM Execution Plan (BEP) • List and track change of the models

Table 14 Role & Responsibility

The BIM Manager and BIM Coordinator roles can be undertaken by existing members in the project team, such as project managers, architects, engineers, surveyors, contractors, etc.

Figure 22 Collaboration

Besides ensuring that the Appointing Party's / Client's BIM objectives are achieved, the BIM Manager should also ensure that all parties work collaboratively to resolve conflicts in the most efficient way. The role of the BIM Manager does not include making decisions about design, engineering and construction solutions for the project, nor organisational processes for each discipline.

3.6.13 BIM Team Resources, Competency and Training

The staffing resources, skills, qualifications and training requirements should be planned and managed by the BIM Manager in collaboration with each of the discipline BIM coordinators, Lead Consultant and heads of department.

The requirements of the team members for carrying out their duties and responsibilities effectively should be recommended by the BIM Manager at the project commencement. This will depend on the size and complexity of each project.

3.6.14 Delivery Team Risk Register

The Delivery Team shall keep a BIM risk register regarding identified information management risks. It is acceptable to include these within the existing risk quality management documents or systems. The Appointing Party / Client should identify specific risks within the BIM Requirements that need to be addressed. It is important to identify risks early and, if possible, mitigate those risks by education, trial, testing etc. through the mobilisation stage. Risks assessments should be cascaded down to the Task Teams and should also be escalated up, where appropriate.

Typical risks that should be reviewed may include:

- Resource capability and capacity;
- Access, use, and functionality of CDE solution;
- Proposed software updates or new versions;
- Delivery of information in new file formats;
- Interoperability between file formats new to the Delivery Team; and
- Implementation of quality procedures.

Over modelling or under modelling are also considered risks as neither support efficient information generation nor reducing waste from the process. Precise BIM Requirements including proposed uses, Level of Information Need, and delivery plans can aid in mitigating this risk.

The advantage of using consistent Standards, Methods, and Procedures is that most risks have already been identified, tested, and mitigated with measures proposed and walkthrough, reducing effort in information production.

3.6.15 Mobilisation Plan

(formerly / commonly known as resources planning / work planning)

The mobilisation plan identifies how identified risks can be mitigated prior to the delivery of information activity commencing. This is the opportunity to test the proposed methods of working in a non-critical environment before the project starts.

The mobilisation activity is likely to include but is not limited to:

- Education / training;
- Software procurement, implementation, configuration, and testing;
- Interoperability testing;
- Template creation and testing including location, orientation, datums, units, grids;
- CDE Solution, Control / Monitor, Access, and workflows (Approval, Authorisation and Acceptance);
- Approach and Method Statement; and
- Quality procedure.

The mobilisation plan should set out how these and any other identified risk elements can be mitigated and where resolved identified within the risk register.

3.6.16 Master Information Delivery Plan (MIDP)

The MIDP is the primary delivery programme best developed and documented using critical path analysis software, such as MS Project or equivalent. The purpose is to manage the delivery of information in a changing design or production information environment where the impact from the lack of one delivery can escalate into significant project delays.

The MIDP will be developed by the Lead Consultant / Lead Contractor and is a collation of each Task Team's TIDP taking onboard project milestones, information dependencies and quality procedures identified. The provision of standard TIDP templates can facilitate the population of the MIDP fields relating to each deliverable.

The purpose of the MIDP is to manage information delivery change as and when it happens and therefore needs input from all parties. Information deliverables which may be listed in the MIDP include (but are not limited to):

- Models;
- Drawings or renditions;
- Specifications;
- Schedules;
- Room data sheets;
- Reports; and
- Prototyping / Samples.

The MIDP should identify:

- Milestones against which information must be delivered;
- Each delivery should be identified as a task, delivery date and resource;
- Predecessor or dependencies;
- Design / Construction Authorisation Requirements; and
- Appointing Party's / Client's Acceptance Requirements.

Any changes in the MIDP should be replicated in each Task Team's TIDP. Each TIDP may become a model view definition (MVD) of the MIDP relevant to each Task Team. The Lead Consultant / Lead Contractor should establish the baseline deliverables and dates to meet the milestones within the MIDP and inform all parties of any changes required. Risks or issues associated with resourcing should be managed using the MIDP after consultation with the project team.

Parties often and consistently change on projects and the MIDP should be reviewed regularly in design / review or construction team meetings to resolve delivery and resourcing issues with Task Team representatives.

3.6.17 Task Information Delivery Plans (TIDP)

Each Task Team should develop and maintain through the project a task information delivery plan which identifies the deliverables and associated content and resources to be produced.

The TIDP should document for each deliverable at least the following information:

- A unique Identifier;
- Title / Name;
- Description;
- Time estimates for production;
- Proposed resource to be allocated;
- Any predecessors or dependencies;
- Delivery milestones; and
- Level of Information Need (LOIN).

It can also be useful to identify

- Document size;
- File format;
- Delivery scale;
- Paper size; and
- Template to be used.

The Task Team should also consider

- Project delivery milestones;
- Detailed responsibility Matrix;
- EIRs;
- Availability of shared resources; and
- Authorisation and Acceptance process and criteria.

ID	FileIdentifier								Model / Document Title	Details		Resource		Dependents		Milestone 1		
Reference	Project No.	Originator	Volume/System	Level \ Location	Discipline	Sub-Discipline	Type	Number	Description	Scale	Format	Author	Duration	Lead \ Lag	Prerequisites	LOD-G	LOD-I	Required Date
A1	STP171_C	OCS	XX	XX	A	GA	M3	001	Site Model	1:1	.RVT	PAO	5	0		200	200	01/01/2014
A2	STP171_C	OCS	XX	XX	A	SP	DR	001	Site Plan	1:500	.RVT	HEO	1		A1	200	200	01/01/2014
A3	STP171_C	OCS	XX	XX	A	GE	DR	002	Site Elevations	1:500	.RVT	HEO	1		A1,A5,A9,A14,A18	200	200	01/01/2014
A4	STP171_C	OCS	XX	XX	A	GS	DR	003	Site Sections	1:500	.RVT	HEO	1		A1,A5,A9,A14,A18	200	200	01/01/2014
A5	STP171_C	OCS	NS	XX	A	GA	M3	001	North Stand GA Model	1:1	.RVT	SJO	10			200	200	01/01/2014
A6	STP171_C	OCS	NS	00	A	GA	DR	001	North Stand Ground Floor Plan	1:100	.RVT	SJO	1	1	A5	200	200	01/01/2014
A7	STP171_C	OCS	NS	01	A	GA	DR	002	North Stand First Floor Plan	1:100	.RVT	SJO	1	2	A5	200	200	01/01/2014
A8	STP171_C	OCS	NS	0R	A	GA	DR	003	North Stand Roof Plan	1:1	.RVT	SJO	15	3	A5	200	200	01/01/2014
A9	STP171_C	OCS	ES	XX	A	GA	M3	001	East Stand GA Model	1:1	.RVT	PAO	15			200	200	01/01/2014
A10	STP171_C	OCS	ES	00	A	GA	DR	001	East Stand Ground Floor Plan	1:100	.RVT	PAO	1		A9	200	200	01/01/2014
A11	STP171_C	OCS	ES	01	A	GA	DR	002	East Stand First Floor Plan	1:100	.RVT	PAO	1	1	A9	200	200	01/01/2014
A12	STP171_C	OCS	ES	02	A	GA	DR	003	East Stand Second Floor Plan	1:100	.RVT	PAO	1	2	A9	200	200	01/01/2014
A13	STP171_C	OCS	ES	0R	A	GA	DR	004	East Stand Roof Plan	1:100	.RVT	PAO	1	3	A9	200	200	01/01/2014
A14	STP171_C	OCS	SS	XX	A	GA	M3	001	South Stand GA Model	1:1	.RVT	FAO	10			200	200	01/01/2014
A15	STP171_C	OCS	SS	00	A	GA	DR	001	South Stand Ground Floor Plan	1:100	.RVT	FAO	1	1	A14	200	200	01/01/2014
A16	STP171_C	OCS	SS	01	A	GA	DR	002	South Stand First Floor Plan	1:100	.RVT	FAO	1	2	A14	200	200	01/01/2014
A17	STP171_C	OCS	SS	02	A	GA	DR	003	South Stand Roof Plan	1:100	.RVT	FAO	1	3	A14	200	200	01/01/2014
A18	STP171_C	OCS	WS	XX	A	GA	M3	001	West Stand GA Model	1:1	.RVT	MMO	15			200	200	01/01/2014
A19	STP171_C	OCS	WS	00	A	GA	DR	001	West Stand Ground Floor Plan	1:100	.RVT	MMO	1		A18	200	200	01/01/2014
A20	STP171_C	OCS	WS	01	A	GA	DR	002	West Stand First Floor Plan	1:100	.RVT	MMO	1	1	A18	200	200	01/01/2014
A21	STP171_C	OCS	WS	02	A	GA	DR	003	West Stand Second Floor Plan	1:100	.RVT	MMO	1	2	A18	200	200	01/01/2014
A22	STP171_C	OCS	WS	0R	A	GA	DR	004	West Stand Roof Plan	1:100	.RVT	MMO	1	3	A18	200	200	01/01/2014

Table 15 Example Task Information Delivery Plan

3.6.18 BIM Deliverable Schedule (Programme)

For each project stage, the goals, objectives, and deliverables for the BIM implementation shall be considered. The dates and duration for each stage should be defined with the milestones provided by the Appointing Party / Client. Initially a high-level responsibility matrix will be identified prior to further development into the detailed responsibility matrix. Finally, a full design delivery schedule in the form of a Master Information Delivery Plan (MIDP) will be developed after input via the Task Information Delivery Plans (TIDP). The deliverables shall be based on the BIM Uses required by the Appointing Party / Client and meet the requirement of Level of Information Need for each stage.

Concept Design, Inception Feasibility & Planning	Preliminary & Scheme Design	Detailed Design	Submission to Approving Authority	Tender Stage*	Construction	As-Built, Facilities Management

Table 16 High Level responsibility matrix

*The tender stage specified in the LOD Responsibility Matrix is assumed to be that from a traditional “Design-Bid-Build” contract type / procurement method. The project team may agree and decide if another contract type should be adopted in the project.

Approval process of BIM Deliverables

To ensure that models, drawings and data schedules can be Accepted by the Appointing Party / Client, the various approvals processes set out within the CDE processes section shall be followed. This sets out the Task Team check, review and approve process, the Lead Consultant review and approval process, the Lead Consultant / Lead Contractor review and authorisation process and the Appointing Party / Client review and accept process.

The Contractor’s construction stage BIM IP, BIM deliverables and as-built BIM deliverable submission should be authorised by the Lead Consultant before submission to the Appointing Party / Client.

3.6.19 Spatial Coordination Process

(formerly / commonly known as BIM Coordination and Clash Detection)

Spatial Coordination is a by-product of the CDE process. Each Task Team should be developing information that has been through a check, review and approve process with the linked information identified on it, providing confidence that it is appropriate for use.

Each Task Team should have a function appointed to deal with interface issues and each author should raise any issues found with that person undertaking the interface function. Their responsibility is to raise any issues with other Task Teams and if a resolution cannot be found escalate these to the Lead Consultant / Lead Contractor for a decision. Where the issues raised either conflict with the requirements or significant cost instruction may be required, then these should escalate to the Appointing Party / Client for resolution.

Open data standards such as BIM Collaboration Format (BCF) used to exchange snippets of models with comment and mark-up can aid in this process whilst providing an audit trail

of issues and resolutions.

Design reviews on a regular basis by the Lead Consultant / Lead Contractor as well as Appointing Party / Client reviews using clash detection solutions along with appropriate approval will also aid with the spatial coordination process and aid in decision making.
Standardised approaches using the identified solutions should be documented with the project information production methods and procedures for design review, review and authorisation, and review and accept. Task Teams can then adopt the same methods and procedures for their internal reviews.

3.6.20 Software, Hardware, CDE and IT Infrastructure

The key to any successful project delivery is choosing and using the right tools for the job. The Appointing Party / Client should identify their BIM Uses within the BIM Requirements, along with their software tools and delivery formats. The Lead Consultant / Lead Contractor should do likewise. Each Task Team should deliver an approach, capability and capacity assessment including their approach, software, collaboration platform and IT infrastructure.

From the above information the requirements for the software, hardware and network bandwidth for modelling, coordination and visualisation on workstation / desktop / notebook computers and mobile devices should be determined. The minimum requirement varies for different applications, project sizes and operating systems. The actual needs of a project must be determined on a case-by-case basis.

The proposed Schedule of software (including version), hardware and IT infrastructure should then be shared for feedback before approval. Any identified risks would be carried through to the Risk register and where possible, mitigated through the mobilisation activity.

Software Versions
Versions of licensed operating systems as well as other IT limitations should all be identified as these can all impact the authoring software versions to be used. I.e., Specific versions of authoring software may only run on the latest operating system which may be unavailable to some team members.

It should also be recognised that specific authoring tools are not backward compatible and that the BIM and CAD software, along with versions, that will be used by the design team and contractor shall be agreed before starting the project. The models should be created using suitable BIM authoring software applications that allow the assembly of data-rich models and the production and checking of co-ordinated drawings and documentation. To allow for interoperability, the BIM authoring tools should be compliant with Open data exchanges such as IFC.

Exchange Formats
The required delivery formats for file exchange models, drawings, and schedules shall be identified by the Appointing Party / Client in the BIM Requirements. The Delivery Team should identify and document their proprietary formats and open formats within the BEP.

Hardware Specifications
The BIM Manager should provide specifications for the consultants and contractors for the provision of BIM data servers, workstations and viewing platforms. The specifications should include recommendations for the operating system, CPU, memory, video cards, hard disk space and network speeds.

IT Upgrades
The BIM Manager should plan, manage and supervise the processes for the upgrading of software and hardware changes throughout the project.

Data Security & Back-up
A data security protocol should be established to prevent any possible data corruption, virus "infections," and data misuse or deliberate damage by project team members, other employees, or outside sources. Adequate user access rights should be established to prevent data loss or damage during file exchange, maintenance, and archiving. BIM project data residing on network servers should be subjected to regular back-ups.

CDE Specification
The BIM Manager shall confirm the CDE arrangement for the project. CDE shall consist of:

1. CDE Function Requirements;
2. CDE Process Requirements; and
3. CDE Handover Procedures

Please refer to Section 4 for elaboration on CDE.

3.6.21 Quality Assurance – BIM Auditing

(formerly / commonly known as Quality Control)
For quality assurance please refer to Section 5.8.4 for BIM Auditing procedures.

3.7 BIM Execution Plan (BEP) Contents

The BIM Execution Plan (BEP) is a crucial part of the BIM IP content requirements for design, construction, and operation stages of a project which not only sets out to the Appointing Party / Client how the Delivery Team can meet their requirements, but also is the working document used by the Delivery Team throughout the project. All parties must commit to the BEP and ensure that their deliverables comply with its requirements. The onus is on each Task Team to confirm their deliverables comply with this as part of the check, review, and approval process as outlined in the CDE section.

3.7.1 Pre-appointment BEP Content

As identified previously, the initial Pre-appointment BEP is part of the Pre-appointment BIM IP and provided to the Appointing Party / Client to assess the approach and capability of the Delivery Team. The Pre-appointment BEP contents shall include:

1. Project Information (Project particulars);
2. Proposed Information Management Functions (commonly known as Roles);
3. BIM Goals, Uses & Deliverables;
4. Proposed organisation structure and Delivery Team composition;
5. Proposed names and resumes of individuals to undertake information management functions;
6. Delivery Team Capability and Capacity Assessment;
7. Proposed Information Delivery Strategy;
8. Proposed EIR Strategy;
9. Proposed Project Information Standards (formerly / commonly known as standards on BIM Procedures);
10. LOID Framework (LOD-G, LOD-I and DOC);
11. Proposed Model Federation Strategy;
12. Proposed Project information production methods and procedures;
13. Goals for collaborative production;
14. Proposed Delivery Team Risk Register;
15. Proposed Mobilisation Plan; and
16. Proposed Schedule of software (including versions), Hardware, CDE and IT infrastructure.

Refer to Pre-appointment Templates (Appendix D5 & D6).

3.7.2 Post-appointment BEP Content

Once an appointment is confirmed, the main BEP shall be documented, assessed through discussions with the Delivery Team and Appointing Party / Client and tested through the mobilisation phase. The contents of the BEP shall then be expanded to include:

1. Project Information (Project particulars);
2. Project information functions (formerly / commonly known as Roles and Contacts);
3. Information Delivery Strategy;
4. BIM Goals, Uses & Deliverables;
5. Information Management Assignment Matrix;
6. Project Information Standards (formerly / commonly known as standards on BIM Procedures);

7. Project Information Production Methods and Procedures (formerly / commonly known as BIM Procedures);
8. Federation Strategy (formerly / commonly known as Model Division);
9. Security Strategy to fulfilling the SIR
10. High and Detail Level Responsibility Matrix (formerly / commonly known as BIM Organisation Chart); with defined roles, responsibilities and authority;
11. BIM Team Resources, Competency and Training;
12. Delivery Team Risk Register;
13. Mobilisation Plan (formerly / commonly known as standards on resources planning / work planning);
14. Master Information Delivery Plan (MIDP);
15. Task Information Delivery Plans (TIDP);
16. BIM Deliverable Schedule (Programme);
17. Spatial Coordination Process (formerly / commonly known as BIM Coordination and Clash Detection);
18. Software, Hardware, CDE and IT infrastructure;
19. Quality assurance – BIM auditing; and
20. Handover Procedure.

BEP is a live document which is subject to regular review and change during the course of the design or construction process.

It should be noted that content requirements can be managed using different approaches and the identified BEP content may exist as either separate documents within the Implementation Plan, annexes to the BEP, or content placed within the main text of the BEP document. Provision of content from Appointing Party / Client, scale and complexity or projects, along with appointed roles and responsibilities will dictate the appropriate approach to use which may be on a project-by-project basis.

4 Common Data Environment (CDE) [aligned with ISO 19650]

4.1 Project Information Requirements

In order to establish the principles of the Common Data Environment (CDE), which manages the single source of the truth, it has been recognised that digital transmission processes must follow well-defined procedures in a secured and shared environment, with the advantage that technology can bring to assist in ensuring compliance. The key ingredients are:

- File identification (file properties, naming, title blocks, etc.);
- Suitability of use defined by the author (status code applied);
- Ownership and defined responsibilities (check, review and approve);
- Documentation of all transactions (drawing / model Issue sheets);
- Document versioning (revision and version);
- Purpose of issue;
- Authorisation and acceptance process applied (authorisation code); and
- Record copy of what has been issued (history).

What also needs to be established is who is the intended target for the information delivery. A great deal of information produced on a project is not intended for the Appointing Party / Client and the requirement for information to be always reviewed and accepted by the Appointing Party / Client could impact the Appointing Party's / Client's capability to review and accept the information that is relevant to them. This is the purpose of the separation of the Appointing Party's / Client's Shared environment.

4.1.1 Sharing and Publishing Information

What is also identified with the move to a digital approach is that now there are two forms of information release and these are:

- Sharing of information for collaborative working (non-contractual); and
- Publishing of information to meet statutory and contractual delivery.

What is also recognised is that the delivery format requirements are also different between sharing and publishing Information. Shared information is generally required for referencing by other Task Teams and is often required in proprietary file formats for CAD and BIM software. Published information is predominantly contractual deliverables where the equivalent of electronic paper is required, such as PDF or DWF/ DWFx (immutable) formats. This often has an impact on the software solutions chosen for the CDE provider depending on the technology requirements as the capability for reviewing CAD and BIM files is often limited.

4.1.2 Finding Current Information

As the single source of the truth, the Common Data Environment shall provide access to the current information. But what should also be recognised is that it is possible to have

multiple revisions or versions of a file at differing states within the CDE. The Published and Shared environments may include different revisions of the same information file which could both be current and available in both environments released to meet different needs. What is important is the ability to use the revision, status code and authorisation code along with timestamps to establish which of the current versions is appropriate for the task to be undertaken.

4.1.3 Data Environments and Common Data Environments

A data environment is a concept which considers the repositories, processes, and technology requirements of a project to facilitate an Information Model. The purpose of a data environment is to ensure efficient information management, ensure information can be trusted and that the information meets the intended use criteria. The predominant use of a data environment is to manage the current PIM, ensure that sufficient archiving is undertaken and facilitate the application of the information methods and procedures.

A Common Data Environment (CDE) is a process supported by a properly configured solution that extends the data environment principles. It should facilitate the use of common file formats and interoperable exchanges, common standards, common methods, and common procedures in standardised environments, providing a way of working that reduces waste, avoids ambiguous information and ensures robust information management.

The Common Data Environment (CDE) was developed as a project specific solution to meet the common criteria for delivering the PIM. Where the operations stage either takes on board that common criteria or has contributed to the creation of that common criteria, then the Common Data Environment can continue into the Asset management phase. This can then be termed as an Asset Information Model Common Data Environment (AIM CDE).

The AIM CDE takes on board a different use and process than a PIM CDE as its primary role is only to manage the built asset information. Multiple PIM Data Environments over time may contribute to the content of an AIM Data Environment which is intended to support a life cycle data approach.

The purpose of this document is to support the use of the Common Data Environment to deliver the PIM and the AIM is considered out of scope for publishing this Standards.

4.1.4 Why do we need a Common Data Environment (CDE)?

The fundamental requirement for producing information through a collaborative activity is to share information early, and to trust the information that is being shared as well as the originator of that information. What is needed is a disciplined auditable process that is transparent and controllable delivering qualified coordinated information, reducing cost, and improving timely delivery.

The method for managing a project through a Common Data Environment (CDE) is applicable to all sizes of projects, and it prepares teams to be able to work collaboratively. As a standard that is adopted by all, it provides a common way of working that will help to remove the problem of having to constantly retrain on each project, reconfigure resources and tools, plus configuring templates and documentation. If the Appointing Party / Client accepts the industry agreed procedures for the CDE and make them contractual, then the problems identified disappear.

The CDE is a means of allowing information to be shared efficiently and accurately between all members of the project team –including information that is 2D or 3D graphical

models, non-graphical information, or documentation. The CDE enables multi-disciplinary design teams to collaborate in a managed environment, where the build-up and development of information follow the design, tendering, prefabrication and construction sequence.

The CDE process also ensures that information is only generated once and is then reused as necessary by all members of the supply chain. It also ensures that the information is updated continuously and enriched for final delivery as part of the project development life cycle.

CDE can be implemented in many ways and the different approaches for the use of a CDE are dependent on the Appointing Party / Client, procurement, and other external factors. The main approach types can be defined as, but are not limited to:

- A single project at a specific stage;
- A single project at multiple stages;
- A single project full asset life cycle;
- A programme of projects (design or construction or asset); and
- An enterprise solution.

Each of these approaches impacts on the common file formats and interoperable exchanges, common standards, common methods, and common procedures in standardised functional sections that need to be adopted. The expansion of the CDE to take on board, design requirements, construction requirements and asset management requirements increases the need for functionality from each aspect which is likely to impact delivery formats, project information standards, and methods and procedures. A proposed schedule of operating systems and software, including builds and versions, hardware, IT infrastructure to be adopted by the approach should be considered when choosing the CDE solution and documented within the requirements. These will all contribute to the specification of the CDE Solution.

The CDE is there to improve collaboration and the recognised advantages of adopting such a CDE include:

- Ownership of information remains with the originator, although it is shared and reused.
- Shared information using reference files reduces the time and cost of producing coordinated information;
- If the procedures for sharing information are consistently used by the design teams, spatial co-ordination is a by-product of using the CDE processes and will deliver production information that is right first time;
- Any number of documents can be generated from different combinations of model files;
- Information can subsequently be used once, authorised for multiple purposes, including design and planning, construction planning, estimating, cost planning, facilities management, and other downstream activities;
- Spatial coordination should be achieved because of the detailed design production process. This provides a clash avoidance process instead of the additional cost and time of services associated with clash detection;
- Data within a CDE is finely granulated and structured to ease its re-use. It provides the ability to produce traditional drawings or documents as views of multi-authored data within the CDE. It also gives greater control over the revisions and versions of that data;
- Procurement and logistic planning for supply chain;
- Collaboration for various engineering analysis; and
- Performance validation.

The structured use of a CDE requires strict discipline by all members of a design team in terms of adherence to agreed approaches and procedures, compared with a more traditional approach. The benefits listed above can only be realised with a commitment to operate in a disciplined and consistent manner throughout a project is obtained. Information managed in the CDE should be viewable by all identified parties, depending upon security needs with information formats and delivery formats being agreed to support this.

Automated verification of information at the appropriate information gateways should be considered using digital information requirements. These can include basic verification of file nomenclature and attributes, but these can also consider objects requirements filtered on a classification in accordance with ISO 12006-2 and information requirements in accordance with ISO 12006-3 to support object data exchanges.

4.2 The CDE and Gateways

A high-level functional view of the CDE is shown in Figure 23 below is taken from ISO 19650. This provides an overview of the functional sections and gateways but provides little information regarding the processes involved.

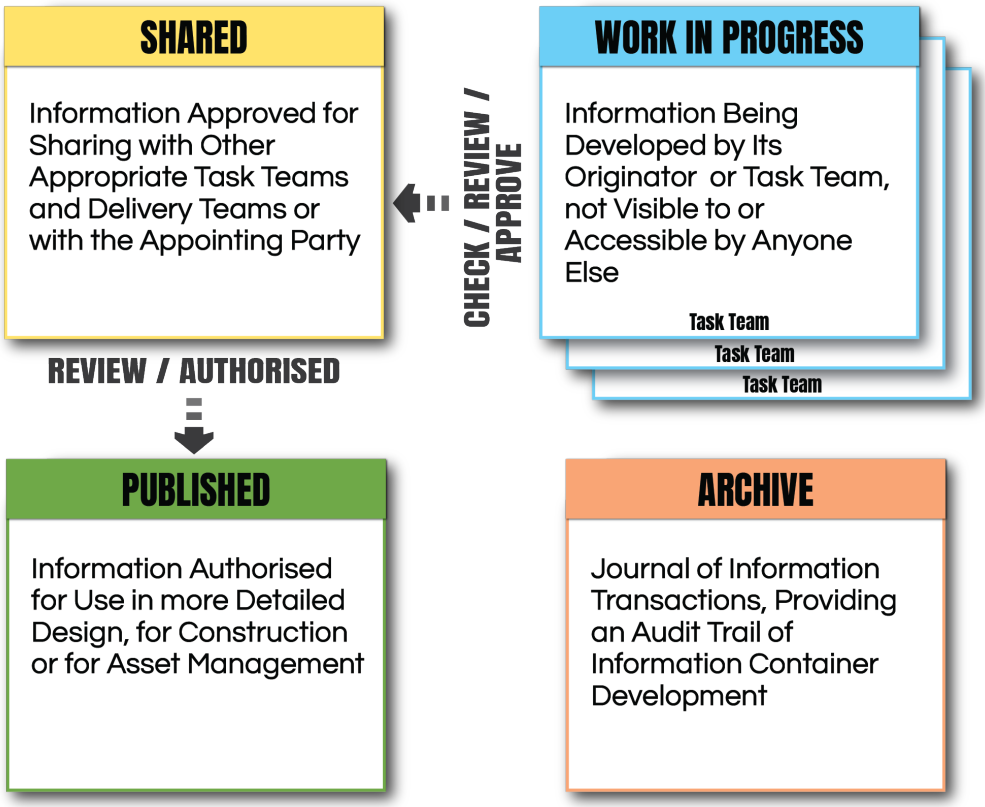


Figure 23 Common Data Environment (CDE) Concept from ISO 19650-1

The CDE contains four identified functional sections under the headings of:

- Work in Progress (WIP);
- Shared;
- Published; and
- Archive.

The Shared environment may also be split into Shared (Delivery Team) and Appointing Party / Client Shared depending on the procurement, contractual and appointment processes. The CDE also contains the predefined sign off gateways of:

- Check, Review, Approve by Task Team;
- Review, Authorise by Lead Consultant; and
- Review, Accept by Appointing Party / Client (Implied).

These gateways may also be expanded to take on board the requirements of an Appointing Party / Client Shared functional section if required and the Gateway for Review, Accept by the Appointing Party / Client.

4.2.1 Work in Progress (WIP)

To ensure compliance with existing copyright, intellectual property, insurance, appointment and contract requirements clear ownership of information and associated responsibilities needs to be established.

Therefore organisations responsible for the authoring or delivery of information need to clearly establish that they are the only party that has authored, deleted, edited or amended information that could impact on the project and that they have undertaken the appropriate quality management procedures in relation to that information delivery.

The safest method for doing this is to carry out the information authoring and editing roles within an environment where other parties **do not** have access to this information. Therefore, only information released by the authoring parties in accordance with the quality management procedures should be shared or published for use by the Appointing Party / Client or other Delivery Team members.

4.2.2 The Work in Progress (WIP) Environment

Each Task Team should establish their **own WIP** solution which is traditionally held on a company server or cloud storage solution as part of their local area network (LAN) or wider area network (WAN). Where members of different Task Teams belonging to the same organisation are working on the same project each, must have their own separate identified work in progress (WIP) location. Task Teams must only link to other Task Team information that has been shared or published and ideally directly from the Common Data Environment repository.

The WIP Environment is the only place where files shall be created, authored, or modified.

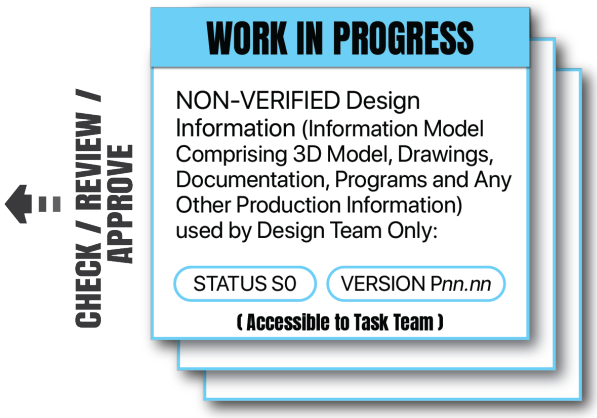


Figure 24 Work in Progress (WIP) and WIP Gateway

4.2.3 WIP Gateway

Once information is identified as suitable for an information release, the authors shall initiate the upload of the information to the common data environment in the agreed delivery file format and using the processes as defined within the Project information production method and procedures. The author shall then undertake the gateway information check process as identified within the common workflows, a review shall then be undertaken by the BIM Coordinator and finally the information shall be approved by the Task Team Lead. Each of these steps shall be undertaken by an identified role that has the appropriate competence and authority required as documented within the BIM IP.

Figure 25 WIP Gateway

4.2.4 Review

The Review step is used throughout the CDE process to ensure that deliverables meet the information requirements, comply with the project information standards, and are coordinated with the referenced information. There are multiple Reviews identified in the information management process including:

- Task Team Review, Internal (Approve);
- Information Model Review (Delivery Team Approve);
- Review information (Authorised); and
- Appointing Party / Client Review (Accept).

Whilst most authors will carry out their coordination check within their authoring software. This is unlikely to be the solution used for project or Appointing Party / Client review. It is therefore recommended that the identified check, review, and approval process from Task Teams use the same solutions, method, and procedure for the reviews at Task Team, project level and Client level.

4.2.5 WIP Check, Review and Approve

The common workflow requirements for the WIP Gateway environment include a Check, Review and Approve process prior to the release of information. The requirements of each of these elements of the Task Team process are as follows:

Check to be carried out by the information authors.

- File identification check;
- Coordination check with latest shared resources;
- Check against Standards, Methods, and Procedures;
- Spatial coordination check;
- Checking of file links for naming, status, revisions, versions, and authorisation;
- Nomenclature check;
- Revision / Version check;
- Approval or Rejection decision;
- Application of Authoring stamp including Author name, timestamp (Digital Signature); and
- Release for Review.

Review to be carried out by the BIM Coordinator.

- Confirmation of Authors Check Stamp;
- Visual review / comment and mark-up;
- Level of Information Need (LOIN) Review;
  - LOD-G verification;
  - LOD-I verification;
  - DOC verification;
- Project Information Standard review (Nomenclature, objects, layers etc.);
- Spatial Coordination;
- Approval or Rejection decision;
- Application of Status code / suitability;
- Application of Rejection stamp including reviewer name, timestamp (Digital Signature); or
- Application of Review stamp including reviewer name, timestamp (Digital Signature); and
- Release for Approval.

Approve to be carried out by the Task Team Lead.

- Confirmation of Review stamp;
- Technical approval of content;
- Visual review / comment and mark-up;
- Approval or Rejection notice;
- Application of Rejection stamp including approver name, timestamp (Digital Signature); or
- Application of Approve stamp including approver name, timestamp (Digital Signature);
- Approval of Status code / suitability; and
- Release for sharing or publishing.

The check, review and approve process ensure that information has undertaken a quality assurance approval by the authoring Task Team who have also identified what information, version, and status they have coordinated their information against.

When information is uploaded to the CDE, the Task Team should also identify whether the information is required to be authorised. The status code of the information provided may indicate whether subsequent information authorisation is required and if this is a project review and authorise process or Client review and accept process. See Section 4.4.2 Status Code (Suitability) for how this is applied.

4.2.6 Shared

Why do we Share Information?

Architects, Engineers and Designers were often reticent in using other teams released information quoting reasons such as:

- I do not want to use other teams' information because it is inevitably incorrect;
- I do not want to share information because others may use it for a purpose not intended; and
- I do not know if this is the latest information.

Purpose of the shared area

To resolve these issues the concept of the shared environment was established to allow the use of current information that had been released for an identified purpose with a known level of risk associated with it.

One of the main benefits of the Shared environment is that it reduces the time and therefore cost in producing coordinated information and facilitates a clash avoidance process. If the procedures for sharing information are consistently used by the design teams, spatial co-ordination is a by-product and should deliver production information that is right first time.

Throughout the project life cycle, there are multiple requirements for sharing information with other team members and Appointing Party / Client to either show progress, gather feedback, or collaborate on options as well as obtaining initial approvals etc. There are proven benefits to sharing information early, it does not have to be complete, but it shall be correct, and this provides a disciplined auditable process. It speeds up the iterative and collaborative process.

The shared environment includes information released suitability for different needs which is identified by the status code. Information within the shared area may be both non-authorised and authorised information which should be indicated by the authorisation code. Associated with the suitability of the information and the authorisation are different levels of risk. The Delivery Team members should establish amongst themselves and document what are the appropriate codes for information use at project stages.

For contractual published documentation, the models used should be at least 'suitable for coordination' and have been authorised as meeting this requirement. The inclusion of the referenced model files, their version status and authorisation facilitate the understanding that the documentation is based upon authorised models and identifies the level of risk for those using the information.

4.2.7 Shared Unauthorised Information

In order that information is made available, when uploaded to the Common Data Environment solution, there needs to be established workflows and permissions which ensure that only those with the appropriate rights may undertake the required actions whether this is carrying out a review or having access to sync / link information to their Task Teams WIP requirements.

To facilitate this, the CDE Solution Shared environment has some specific common requirements, which include:

- Security based file access and permission control for access, viewing, linking, syncing and download etc;
- Common file format viewing, mark-up and commenting; and
- Customised meta data fields definitions.

The shared section of the CDE should hold the Shared resources provided and verified by the Appointing Party / Client for use on the project as well as additional resources provided by the Lead Consultant. The predominant information should be produced by each Task Team which has undertaken the check, review and approve process prior to uploading to the Shared section and identified with a status code and revision.

Figure 26 Shared Environment

Depending upon the security status of a project the ability to view and access information may be restricted to specific identified roles. The project federation strategy may also indicate solutions relating to information access and the Shared section must be able to implement these requirements.

4.2.8 Authorisation Gateway

The Authorisation gateway is conceptually shown between the Shared and Published sections of the CDE, approved or authorised non-contractual model files should also have a state of Shared, but may require either a lead approved, or lead authorised code applied to them. The purpose of this approval or authorisation of the models is to facilitate the delivery of coordinated documentation for publishing from the shared model files. The documentation produced should then undertake the Authorisation Gateway prior to acceptance into the published section. The documentation published shall indicate the models that they have been produced from status, revision and authorisation.

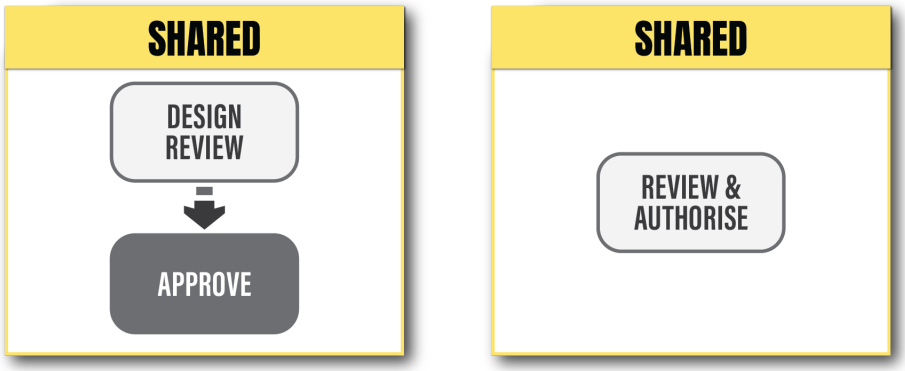


Figure 27 Shared Approved and Authorised Information

An example of this is Information within the Shared Area that has undertaken a design review and may also include an authorisation code to identify that this has been reviewed by the design team and approved by the Lead Consultant. This provides a further level of trust in the use of the models for coordination or document delivery. If CDE solutions can be configured, these processes can be automated.

To facilitate the authorisation gateway, the following functionality should be provided:

- Security based file access and permission control for review and authorisation;
- Common file viewing, mark-up and commenting;
- Application of electronic signatures;
- Customised meta data fields definitions;
- File nomenclature verification;
- Level of Information Need verification;
- File status, revision, version; and
- Review and authorisation metadata or stamps.

The Common Workflow requirements for the Authorisation Gateway environment is:

- Review of file links for naming, revisions, versions, authorisation, and acceptance status;
- Review against EIRs, Standards, Methods, and Procedures templates;
- Coordination review with latest shared resources;
- Authorisation or Rejection decision;
- Application of Rejection stamp including Lead Consultant, Authoriser name, timestamp (Digital Signature); or
- Application of Authorisation stamp including Lead Consultant, Authoriser's name, timestamp (Digital Signature); and
- Release for Publish.

4.2.9 Clients Shared

Purpose of the Clients shared environment

Depending upon the type of procurement contract, the Appointing Party / Client may be included or excluded from the shared environment. Where procurement adopts a design / build type approach, there is often a need to deal with design engineering, design options etc. in an environment which excludes the Appointing Party / Client. It is also important to understand that a lot of the design and construction information produced is not intended for Appointing Party / Client review and acceptance. A typical example would be temporary works etc.

For the inclusion of a CDE, the Appointing Party / Client Shared environment is created using security rights to the solution and the repository used for the Shared environment.

Figure 28 Appointing Party / Client Shared

The Appointing Party / Client shared section is also used for direct communication between the Lead Consultant and the Appointing Party / Client relating to contractual discussion, decision making or compare design options.

Note: Not all information released to the Appointing Party / Client Shared section is also included in the Shared section.

4.2.10 Appointing Party / Client Shared Unauthorised Information

Appointing Party / Client may also require access to unauthorised information for other purposes than review and acceptance. A typical requirement may be for checking on progress linked to payments. Another use may be for Appointing Party's / Client's review and comment whilst under progression, resolving issues or review of design options. To facilitate these capabilities, the CDE should provide:

- Security based file access and permission control for file access, viewing, linking, download etc;
- Common File format viewing, mark-up and commenting;
- Customised meta data fields definitions; and
- Appointing Party / Client Shared Authorisation Gateway.

The predominant use of the Appointing Party / Client shared area is to identify Information Models accepted by the Appointing Party / Client prior to the publishing of contractual documentation based upon these models. Prior to the acceptance of information, it should pass through the Appointing Party's / Client's authorisation gateway. The requirements of this gateway are:

- CDE Gateway Requirements;
- Security based file access and permission control for Appointing Party's / Client's review and authorisation;
- Common File viewing, mark-up and commenting;
- Application of Electronic Signatures;
- Customised meta data fields definitions;
- File Nomenclature; and
- File Status, Revision, Version Authorisation and Acceptance.

The Common Workflow requirements for Appointing Party / Client Authorisation Gateway environment is:

- Review of file links for naming, revisions, versions, authorisation, and acceptance status;
- Review against EIR, Standards, Methods, and Procedures;
- Coordination review with latest shared resources;
- Authorisation or Rejection decision;
- Application of Rejection stamp including Appointing Party / Client, Authoriser name, timestamp (Digital Signature); or
- Application of Acceptance stamp including Appointing Party / Client, Acceptor's name, timestamp (Digital Signature); and
- Release for Appointing Party / Client Shared.

Depending upon the contractual requirements, the Appointing Party / Client may be required to either review and accept or reject information within a specified timeframe. Where this is the case, if the Appointing Party / Client fails to undertake the review of the information, the default authorisation is accepted after the timeframe expires. It is recommended that CDE solution implements an acceptance stamp that differentiates between default accepted information and that reviewed and accepted.

4.2.11 Published

Why do we Published Information?

Published Information represents identified contractual deliverables to be produced at specific milestones or information against specific deliverables. Published information shall be coordinated and validated as outputs that have been reviewed and authorised by the Lead Appointed Party, where Appointing Party's / Client's acceptance is not required or shall also be reviewed and accepted by the Appointing Party / Client as appropriate.

Workflow

- Workflow requirements for Published area;
- Customised meta data fields definitions;
- Ownership, roles, and responsibilities linked to functions; and
- Gateway acceptance for contractual.

Technology

Technical requirements for a published area should include:

- Process Management and Audit trail;
- File visualisation tools for agreed project formats; and
- Customised meta data fields definitions.

4.2.12 Archive

The purpose of the Archive Functional section is to capture all information releases for the purpose of professional indemnity, contractual and legal requirements (e.g.: Health and Safety) that provide an auditable trail of all transactions. The concept of the Archive is that it includes the historical record of all transactions. The technical implementation of how this is achieved should be different depending upon the technology solutions and their dependencies on either a location or state-based approach. Through the Archive environment, it must be possible to retrieve the information released throughout the project life cycle whenever required, although it may not be stored in an archive location (folder).

The Archive history record for each file transaction should also include data for each of the following:

- Timestamp for every action / transaction;
- Revision and Version (where appropriate);
- Suitability and Status Code;
- Check, review, and approval information;
- Review and authorisation (where appropriate); and
- Review and acceptance (where appropriate).

The Archive environment must also respect the project data access requirements, security-based approach used throughout the other functional sections. See Figure 30 State based approach to CDE Sharing as defined in ISO 19650. As an example, an Appointing Party / Client should not have access to Delivery Team information not shared with the Appointing Party / Client through the Archive environment. Further complexity arises where the Appointing Party / Client is also the system administrator of the technical solution used and administers those security rights.

4.3 The CDE Functional Requirements

4.3.1 CDE Functional Sections as Locations or States

The purpose of each functional section of the CDE is to remove any ambiguity regarding the state of information and what it may be used for. Key to this is the role-based security which control information visibility and access rights. These enforces the workflows and therefore the associated trust within the information provided.

Different solutions deal with these technology challenges in different ways. The two main methods of identifying different environments are:

- Location based folders: and
- Role based security states using meta data (attributes).

The use of folders as containers to control access security was the traditional approach that represent the windows desktop workflow and traditional security-based requirements. This methodology is used to move files from folder to folder as the files progresses through the workflow. Each folder had the appropriate security controlling who had access, tasks they were entitled to undertake etc. The solution on completion of a specific task would trigger the moving of the file to the next folder, changing the security, access, and visibility.

Whilst the technology needs for this approach are less onerous this often requires a manual process of moving files where the second revision of a file (Drawing 1 Rev P2) when released requires the first revision (Drawing 1 Rev P1) to be moved to the Archive section or it should be overwritten. This often also required the creation of date related folders as duplicates of files were not allowed. The current version of the file should be stored in the shared section whilst historic versions should need to be moved to the Archive. This often leads to duplication of files in multiple locations with a possibility of these becoming out of sync.

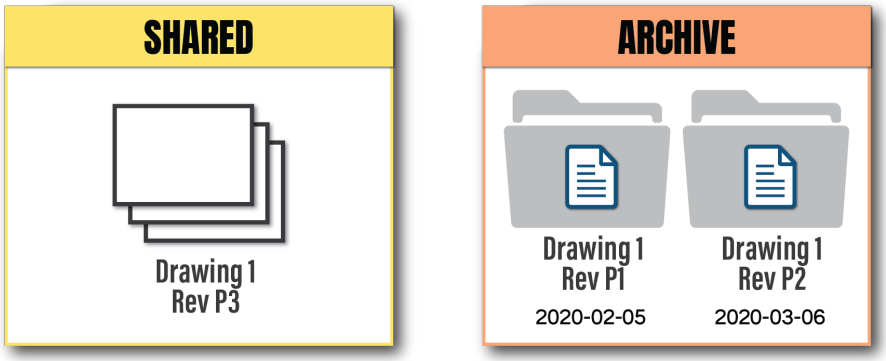


Figure 29 Folder approach to CDE Shared and Archive

The alternate approach is to use a State based approach where specific meta data (attributes), instead of locations, control how security is applied, and these identify the workflow position, controlling the access and visibility etc. This solution relies on the complexity of the technology to resolve these security, access, and visibility rights, with the removal of the files from the supporting technology sometimes be problematic. The advantage here is that all files, current and history exist in their original locations and therefore, security regarding file access along with no duplication.

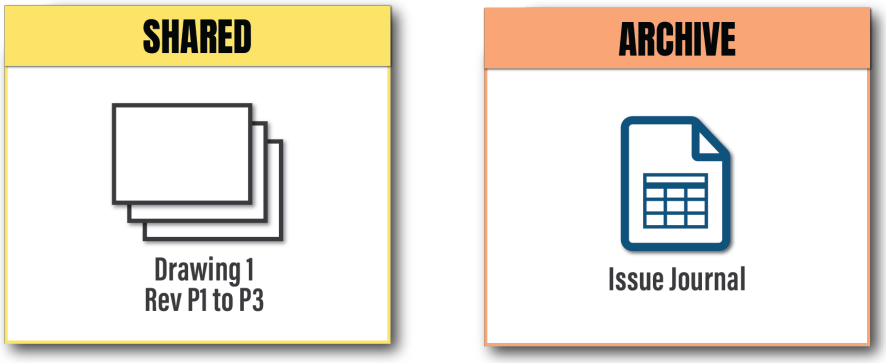


Figure 30 State based approach to CDE Shared and Archive as defined in ISO 19650

In the State based approach as shown in Figure 30, a new revision of the Drawing 1 file is shared into the same location as the previous revisions of Drawing 1. All reference links are automatically controlled, and the archive journal is updated with the authorisations and approvals that have been undertaken. The shared section includes the current version of Drawing 1 (P3) as well as all historical versions (P1 & P2)

The use of folders allows the CDE approach to be carried out as a manual process, but the workflows are limited to the competence and diligence of the individuals undertaking the information management functions. The State based approach should ensure that information is not duplicated and allows all information to existing in a single repository.

Depending upon the approach choice made, the solutions would need to be able to meet each of the specific functional requirement challenges common to the different stage workflows. Whilst for a single project, specific stage solution common approaches that each of these brings as well as dealing with the Functional Requirements of CDE

The **Functional Requirements** of a CDE include:

a. Data to be stored in a secure cloud-based or on-premises environment. Appointing Party / Client shall take note of the location of data centre that host the data when cyber security is a concern to a project, whether the data centre has to be or not necessary to be within the boundary of Hong Kong;
b. Provide a user-customisable security access right control and management system;
c. Provide a user-customisable sectional / categorisable structure;
d. Provide a workflow for managing information process; including
    - Provide file version / revision control *(Section 4.4.8 and 4.4.9 referred)*;
    - Provide file status codes to support suitability of use *(Section 4.4.2 referred)*;
    - Provide file authorisation codes to support workflows for (Section 4.4.3 and 4.4.4 referred):
        - Check, Review and Approve process *(Section 4.2.5 referred);*
        - Review and Approval (Design review) process *(Section 4.2.8 referred);*
        - Review and Authorisation process *(Section 4.2.8 referred);*
        - Review and Accept process *(Section 4.2.9 referred);*
e. Provide a user-customisable workflow for document submission and approval;
f. Support uploading, downloading, Information Models and documentation to facilitate retrieval of document attributes to support the CDE processes, including as a minimum – the document identifier (number), title, revision, version, and status codes (suitability);
g. Support review, comment, and mark-up procedures for **Information Models** in the agreed proprietary and open file delivery formats and versions as documented in the BEP;

h. Support review, comment, and mark-up procedures for **Documentation** formats and versions as documented in the BIM Project Execution Plan;
i. Allow access from portable devices and web applications;
j. Contained encryption for data security;
k. Provide sufficient capacity to store all files throughout the project stages and operate properly as requested by the Appointing Party / Client;
l. Installed with anti-virus software and maintained with updated security patches by the operating system or environment that the CDE resides on.;
m. Provide dashboards for presenting the BIM progress information to the different levels of users;
n. Provide an issue tracking system, including the issue registration, logging, update, and email notification to the selected user account;
o. Provide off-site backup of all project files including Information Models, documents and data;
p. Provide a feature of project archive that all project files and information shall be archived in Appointing Party's / Client's preferred media and transferred to the Appointing Party / Client upon the completion of the design stage and construction stage respectively or as and when requested by the Appointing Party / Client during the contract period *(Section 4.6 referred)*;
q. Provide a full audit trail of the information stored in the CDE.

Additional Functional requests may include:

- Retrieving of the attributes and information from the Information Models in an open format (not limited to .IFC) on the CDE;
- Provide a feature of comparing Information Models from different versions / revisions and automated identification of differences;
- Provide a feature of linkage between different Information Models, 2D drawings and project documents within the CDE;
- Support the use and import of information delivery manuals (IDMs*) for identifying workflow requirements in accordance to open BIM approach (*https://technical.buildingsmart.org/standards/information-delivery-manual/) ; and
- Allow electronic signature (e-signature).

4.4 The CDE Process Requirements

4.4.1 The Enhanced CDE Diagram

The enhanced CDE process diagram expands the CDE concept due to lessons learned and the need to give greater clarity of method. Many of the interpretations available are due to a lack of understanding of what problems the process is trying to overcome as well as the need to produce a project journal as specified by industry requirements.

The original diagram was misinterpreted by many because the WIP (Blue) was only shown once and this implied that the CDE was for the professional design activity only. To ensure that the diagram is accepted by both the professional design Task Teams and the Contractor specialist design teams, the WIP (Blue) is shown duplicated to the left and right of the Shared State.

This also allows for the professional design delivery to be signed off by the Appointing Party / Client or their representative and to be Published so that tender / procurement of the construction and the specialist design Task Teams can be carried out. This is indicated by the solid black arrow to the bottom left of the Published State as the construction processes commences from published information. The procurement activity should also use a Document Management solution to use the Published information for this activity (Large Arrow pointing to the left of the Published State.

Whilst the Published information is used for Tender and Procurement; once the Lead Consultant / Lead Contractor are appointed then they become part of the project Task Teams and should then have access to the Shared; latest approved information, the single source of information for the project.

To achieve a better diagram to explain the process more clearly, we have added a number of pathways and gateways to show how the process works in practice and hopefully to give better guidance to those suppliers of supporting software solutions of the actual abilities required to deliver the CDE process physically and philosophically.

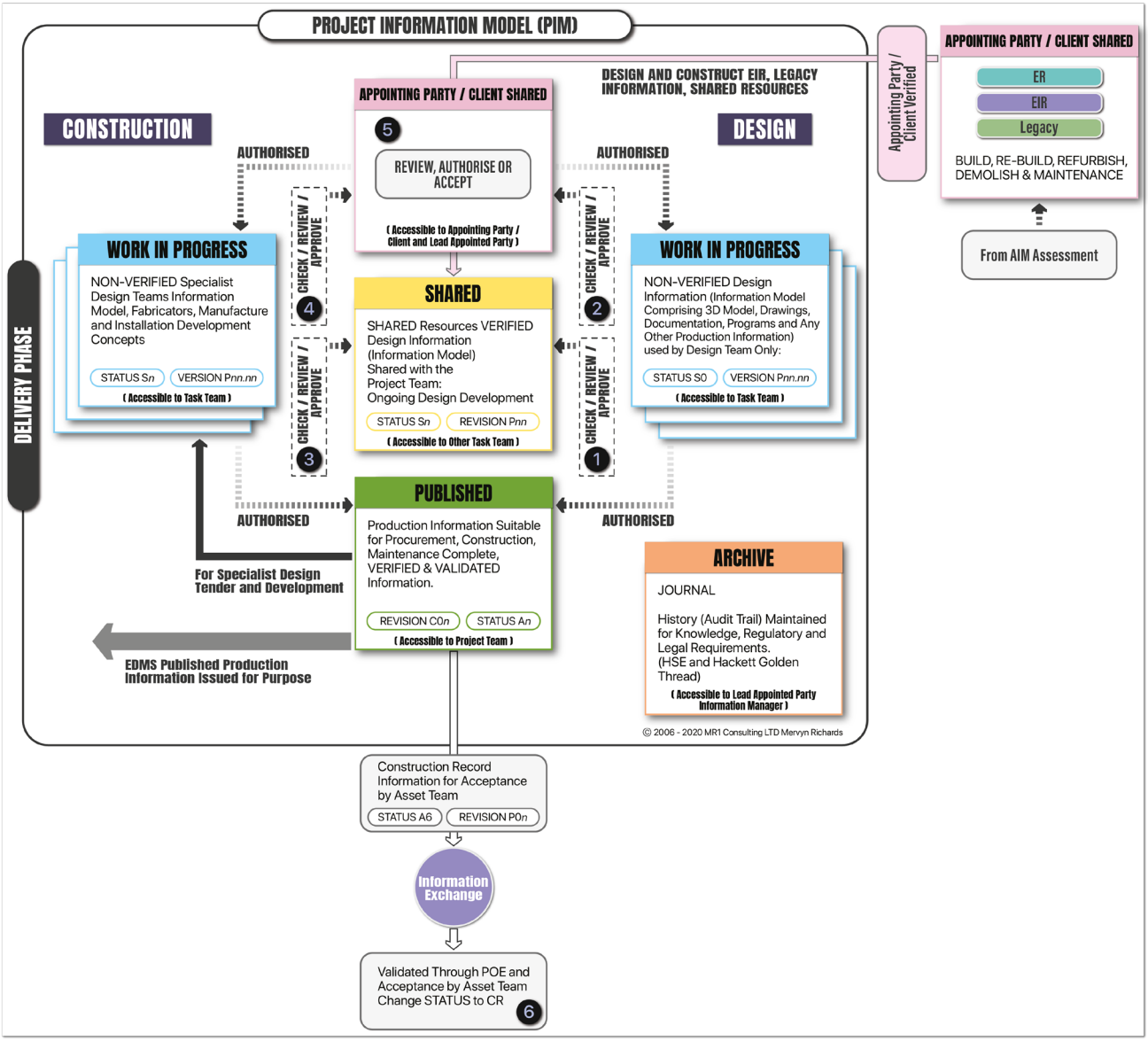


Figure 31 Enhanced CDE Diagram

The CDE Information Management Process is where information passes through a number of States as the project progresses from initial professional design, specialist design, construction delivery and 'as constructed' status at handover and on Acceptance of the digital information model at the end of the Post Occupational Evaluation (POE) Validation process.

The functional sections expand from the simplified format to:

- Work in Progress (WIP);
- Shared;
- Appointing Party / Client Shared;
- Published; and
- Archive.

However, the grey gateways indicate the process to authorise information both internally and externally from the functional sections to allow information to be shared under a controlled and disciplined process, the information should be controlled by a series of sign off gates as follows.

- **Gate 1 and 3** – by TIER 1 supplier(s) (design or construction) or by Task Team Managers during the iterative design phases to allow **Checked, Reviewed**, and **Approved** information to be made available to other Task Team's in the Shared State with the appropriate Status.

- **Gates 2 and 4** – by Lead Consultant / Lead Contractor and Task Team Managers to **Check, Review**, and **Approve, Verified** information to be submitted to the Appointing Party / Client or the Appointing Party's / Client's Representative as Authorise and Contractually complete, for each delivery stage as specified in the EIR.

- **Gate 5** – The Appointing Party / Client or the Appointing Party's / Client's Representative should **review, Verify** and **Accept** the information as satisfying the requirements of the EIR and BEP. The Appointing Party / Client or their representative should inform the Lead Consultant / Lead Contractor that the files are accepted.

- The Task Teams should change the file State and make the information available in the **PUBLISHED STATE**. It should be noted from the diagram above that information does not move from WIP to Shared to Appointing Party / Client Shared or Published but enters each of these States as approval or authorisation is assigned during the process, from WIP. The originator must always be in control.

- All these approval, authorisation, review and checks should be recorded in the Archive journal.

- Once authorised and Published the files may be used by the Lead Consultant / Contractor (Design or Construct) for many purposes, as required, using the documents management solutions. Issued for planning, issued for regulatory permissions, issued as design intent etc.

- Also once reaching the Published State the information may be handed back to the Appointing Party / Client or the Appointing Party's / Client's Representative at the agreed stages in the delivery process.

- **Gate 6 -** After project completion the final revisions of the files, that have been checked approved and Verified should be further reviewed by the Appointing Party's / Client's Asset Managers during the handover period until all snags have been removed or corrected and the Validated information is Accepted and the CR revision stated by the Asset Managers as a true construction record.

4.4.2 Status Code (Suitability)

In order that Authors are not liable for information misuse, they shall assign an appropriate status code **prior** to the release of information to identify the suitability of use. Models, drawing files and documents shall all include the status code which also identifies it has been checked, reviewed and approved by the **Authors**, and to limit the authoring organisations professional indemnity liability and any legal responsibilities etc. for the use of that information.

All work within the Work in Progress (WIP) state shall have the status code of **S0** as the initial status to indicate this information is still in an editable state. Prior to issuing information, an appropriate status code shall be applied as part of the check, review and approve process that shall be undertaken. Information with a status code of other than **S0** shall be considered "locked" and must not be edited.

Status codes indicating suitability of use are provided with Annex 1 LA.4.2 Status which provides "S" or shared codes which not only indicates what the appropriate use the Author intended, but also indicates whether a further sign off code for "Approval", "Review and Authorisation" or "Acceptance" is required at the project level.

Metadata, as properties, attributes or parameters, shall be identified across model and drawing files using a consistent methodology to be consumed by the CDE. For model files metadata shall be displayed in the "splash screen" before the exchange of information. Drawing or sheet files shall include title block metadata displayed including Status codes. CDE shall consume contained metadata including status codes when uploading models or document. If possible and practical, all these shall be automatically linked using electronic means.

Please note that the Status Codes are not sequential, and the table also indicates which type of information exchange may use the different status codes.

4.4.3 Sign Off (Authorisation Codes)

Whilst the authoring team define the Status Code to identify the suitability of information, either the **Lead Consultant** or **Lead Contractor** could apply a code to indicate information is Authorised or the **Appointing Party / Client** or their representative could indicate a code to show information is Accepted.

Traditionally the CDE software solution facilitated the authorisation acknowledgement, but these can also be included as Authorisation codes outside of the solution to indicate that the appropriate "Approval", "Review and Authorisation" process has been undertaken or that the Appointing Party's / Client's "Review and Acceptance" process has been undertaken.

Whilst reviewing the identified information deliverable proposals, such as the Master Information Delivery Plans, the Lead Consultant should identify what information is required to undertake which authorisation activity as this may impact on the information delivery timelines.

There are three levels of sign off authorisation codes which are:

1) Approval (Shared)
This is used to identify shared information and predominantly models that have undertaken a Project Design review with the Lead Consultant to confirm that the models are coordinated with the reference models identified.

2) Authorisation (Published)
This is used to identify information that has undertaken the review and authorisation gateway and has either been authorised or authorised with partial sign-off (Includes comments) prior to being Published.

3) Accepted (Appointing Party / Client Shared / Published)
Appointing Party / Client or their agents have a duty to review and accept information within a timely manner and there are generally contractual definitions of the timescales against which the acceptance must be undertaken. Appointing Party / Client who fails to undertake this review and acceptance process are missing the opportunity to contribute to the process. It is recommended that Appointing Party's / Client's review and accept codes indicate whether the Appointing Party / Client has undertaken the review and accept process or whether these have just been accepted by default as the Appointing Party / Client has failed to act in a timely manner.

For each process, the Authoriser should inform the Lead Consultant / Lead Contractor so that the Task Teams can be instructed to PUBLISH their files with the appropriate revision and status codes. e.g.: "Con" (authorised or accepted) and "An" (to show the milestone Authorised or accepted).

4.4.4 Application of Authorisation Codes (Indicating Workflow Authorisations)

Taking on board traditional contract authorisation codes, the authorisation codes should be applied as assigned properties within the CDE software solution. It is useful if these can also be used as fields within a plot stamp or digital signature when printing and could include the following:

- Approval / Authorisation / Acceptance Code
- Date applied
- Identification of Authorising or Accepting party (Name / Signature / Digital signature etc)

Authorisation Code	Description	Model files	Non-Graphical	Drawing files	Other Documents
Delivery Team Design Review Approval					
A	Shared, Review and Approval. Shared Information that has undertaken a formal design review and is identified as coordinated with the reference models identified.	√	√	X	X
B	Shared, Review and Approval with comments Shared Information that has undertaken a formal design review and is identified as coordinated with the reference models identified with minor comments. All minor comments should be indicated by the insertion of a cloud and a statement of 'in abeyance' until the comment is resolved, then resubmitted for full review and Approval. May require resubmittal of other Task Team information that is uncoordinated. Note. Authorisation B may need to be amended by authoring team to apply amendments and clouds.	√	√	X	X

Authorisation Code	Description	Model files	Non-Graphical	Drawing files	Other Documents
C	Shared Review and rejected Shared Information Rejected by the Lead Consultant to clarify reasons for rejection.	√	√	√	√
Lead Consultant / Lead Contractor Authorisation					
A	Reviewed and Authorised by the project Lead Consultant / Lead Contractor to be Published as a contractual document	√	√	√	√
B	Reviewed and Partially Authorised by the project Lead Consultant / Lead Contractor to be Published as a contractual document. For Contractual documents with minor authorisation comments. All minor comments should be indicated by the insertion of a cloud and a statement of 'in abeyance' until the comment is resolved, then resubmitted for full authorisation. Note. Authorisation B may need to be amended by authoring team to apply amendments and clouds.	√	√	√	√
C	Rejected by the project delivery manager Reviewed and NOT authorised. DO NOT PUBLISH.	√	√	√	√
Appointing Party / Client Review and Accept					
At	Appointing Party / Client Accepted (Default time exceeded) Information accepted by default as the Appointing Party / Client has not acted within the allotted timescale.	√	√	√	√
A	Appointing Party / Client Reviewed and Accepted Reviewed and accepted by the Client without comment	√	√	√	√
B	Reviewed and Partially Accepted by the *Appointing* Party / Client with identified comments. All minor comments should be indicated by the insertion of a cloud and a statement of 'in abeyance' until the comment is resolved, then resubmitted for full authorisation. Note. Authorisation B may need to be amended by authoring team to apply amendments and clouds.	√	√	√	√
C	Appointing Party / Client Rejected	√		√	√

Table 17 Authorisation codes

Whilst Authorisation is often dealt with internally within the CDE solution, it can be useful if the authorisation can be identified either on the drawing title sheet or model splash screen to indicate as an authorisation stamp. The data should ideally be driven by the CDE authorisation process and added as a plot stamp based upon field data.

Examples can include:

REVIEWED & APPROVAL

√	A - APPROVAL
	B - APPROVAL WITH COMMENTS
	C - DO NOT USE
Date	CCYY/MM/DD
I.D.	Name / Signature / Authentication

Table 18 Example Shared Lead Consultant Review / Approval Stamp

REVIEWED & AUTHORISATION	
√	A - AUTHORISED
	B - AUTHORISED WITH COMMENTS
	C - DO NOT USE
Date	CCYY/MM/DD
I.D.	Name / Signature / Authentication

Table 19 Example Lead Appointed Party Review / Authorisation Stamp

REVIEWED & ACCEPTED	
	At- ACCEPTED (Time)
√	A - REVIEWED & ACCEPTED
	B - REVIEWED & ACCEPTED WITH COMMENTS
	C - DO NOT USE
Date	CCYY/MM/DD
I.D.	Name / Signature / Authentication

Table 20 Example Appointing Party Review / Acceptance Stamp

4.4.5 Purpose of Issue

As well as a suitability code and status, a document may also include a “Purpose of issue” which is a virtual or physical plot stamp used for grouping a specific set of documentation together for a specific distribution requirement.

An ideal solution is the inclusion within the Title block properties of a field for identifying the purpose of issue and it may be beneficial to allow for these to be editable. Document management solutions may then append a specific “Purpose of issue” stamp to a document set either directly from the authoring team or where the appropriate status has been applied by the project team.

For example, a drawing for ‘Planning’ submission is likely to have a suitability of ‘S2’ – for information, if not fully approved with a Status code at that stage, but the purpose for the information can still be clearly indicated in the ‘purpose of issue’ box on the drawing sheet as ‘For Planning Submission’.

Purpose of issue
For Planning Submission
For Building Control Approval
For Licensing Approval

Table 21 Examples for the purpose of issue applied to documents

4.4.6 Model and Document References

Any shared or published information should include the references to the linked reference files, their revisions, version, status, and authorisation. These should be included in the drawing title sheet, model file splash screen as well as CDE solution metadata to ensure coordination between information.
Each Task Team should ensure that information is coordinated with the referenced files prior to releasing and undertaking the check, review and approve process. This identified the level of risk for other users of the information. Information shared for coordination is identified as coordinated by the authoring Task Team whilst information with an Approval authorisation also indicates that this has been peer reviewed.

Documentation in the form of drawings, non-graphical data and documentation should only be produced from models with the appropriate authorisation. This ensures that documentation shall only be published from a minimum of authorised shared information.

Each model file shall include a Splash Screen and each drawing file a title block which should consist of:

- Drawing Number as per Nomenclature;
- Revision Number;
- Version (Optional);
- Revision History (Author, Check, Review, Approve. Dates & Comment);
- Status Code for Suitability;
- Authorisation (Approval, Authorised or Accepted);
- Purpose of Issue;
- Lead Consultant / Appointing Party / Client Approval Reference; and
- Coordinated Reference files linked to the model or drawing.

An example reference file table to be included in the model splash screen / drawing file title block:

Linked / Referenced Model File ID	Status	Revision	Authorisation
STP171_C-ACD-XX-XX-AR_AA-M3-001	S6	C04	CA
STP171_C-BAB-XX-01-ST_SF-M3-001	S4	P03	LA
STP171_C-BAB-XX-02-ST_SS-M3-001	S4	P03	LB
STP171_C-FCM-Z1-XX-ME_HA-M3-001	S4	P02	LA
STP171_C-FCM-Z2-XX-ME_HA-M3-001	S4	P02	LB

Table 22 Referenced Files used to coordinate the information

4.4.7 Information Identification

The information container file names (container identifier) should follow a consistent file naming convention. The Appointing Party / Client may specify a file naming convention, or the Lead Consultant shall recommend a suitable naming convention for the project.

Annex 1 sets out the Hong Kong 'Local Annex' of ISO 19650-2:2018 requirements for naming of information containers as filenames. This defines main field and optional Sub-field requirements. The specific project implementation to be undertaken shall be defined and documented with in the project information standards

Example Model File Naming = **BIMS2020-CIC-ZZ-01-AR_AA-M3-001**
(Architectural AA 3D Model for 1st floor of CIC's BIMS2020 project, number 001)

Example Drawing File Naming = **BIMS2020-CIC-ZZ-01-AR_AA-DR-001**
(Drawing for GBP Submission for 1st floor of CIC's BIMS2020 project)

The file naming shall **NOT** include a revision status.
Revisions shall be tracked using metadata added to the models or by the BIM Coordinator in a change management register, or automatically by CDE.

4.4.8 Revision

The 'revision' is a file property defined in the splash screen of a model file or the title block of a drawing sheet and should also be defined in the document repository when the file is uploaded. The revision shows the iterative nature of the information as it progresses to completeness.

The revision is required to track the progression of a file or document to its completion and authorisation. The revision needs to be part of the attributed metadata, but not a part of the file name. If it is included in the file name, then it effectively becomes another document when concatenated, and it cannot be tracked effectively. This is specifically an issue with linked reference files where the automatic updating of reference is paramount to the process. In a database solution, the metadata can be used to track and retrieve the files or documents in the most efficient manner.

Revisions are divided into two main categories of Preliminary (P) and Construction (C). Preliminary revisions start at P01 and Construction revisions start at C01.

4.4.9 Version

The version is a subdivision of the revision and shows the iterative progress of the development file during Work in Progress (WIP) and before confirmed release to 'Shared'.

If it is necessary to track the iterative nature of the file, which may include design options or elements awaiting design / coordination resolutions or Appointing Party's / Client's decisions. Any extracted file for sketches, comment or review needs to know what revision / version it belongs too. It may be necessary to share various versions of the file for Appointing Party's / Client's decision regarding appropriate options etc. Any decision should be confirmed by sharing the confirmed version without the version codes to acknowledge this is the accepted Revision.

In a database solution, it should be necessary to track versions when the extracted data is modified and reconnected to the spatial file. Tracking and updating should be a constant activity, and the changing of attached properties or attributes to a file may be carried out without changing the graphical or spatial nature of the file. Versions should then need to be included in any file references included.

The '**Revision** and '**Version**' numbers are allocated as follows:

- During **WIP** (Status S0), preliminary revisions and versions are P01.1, P01.2, or P02.1, P02.2, etc;
- Before '**authorised for construction'** (Status S1-Sn), preliminary revisions are P01, P02, P03, etc; and
- Once '**authorised for construction**' (Status A), revisions are C01, C02, C03, etc.

4.4.10 Sketches, Comments, and Reviews

To facilitate the sharing of mark-ups, design reviews, coordination resolutions etc, the ability to collaborate without a formal issue of information is often important. The use of technical solutions such as BIM collaboration format (BCF) ideally through cloud-based tracking services provides an informal solution for reviewing snippets of the model and documentation whilst still providing the principles of:

- file identification;
- ownership and defined responsibilities;
- documentation of all transactions;
- document version; and
- record copy of what has been issued.

4.4.11 Drawing Title Blocks and Model Splash Screens

Each of the CDE components should be available as meta data and be shown on the drawing title blocks and the model file splash screens visible when first opening a file. This should ensure that the appropriate information has been verified and that the defined procedures have been undertaken. It also assists in data transmission between solutions.

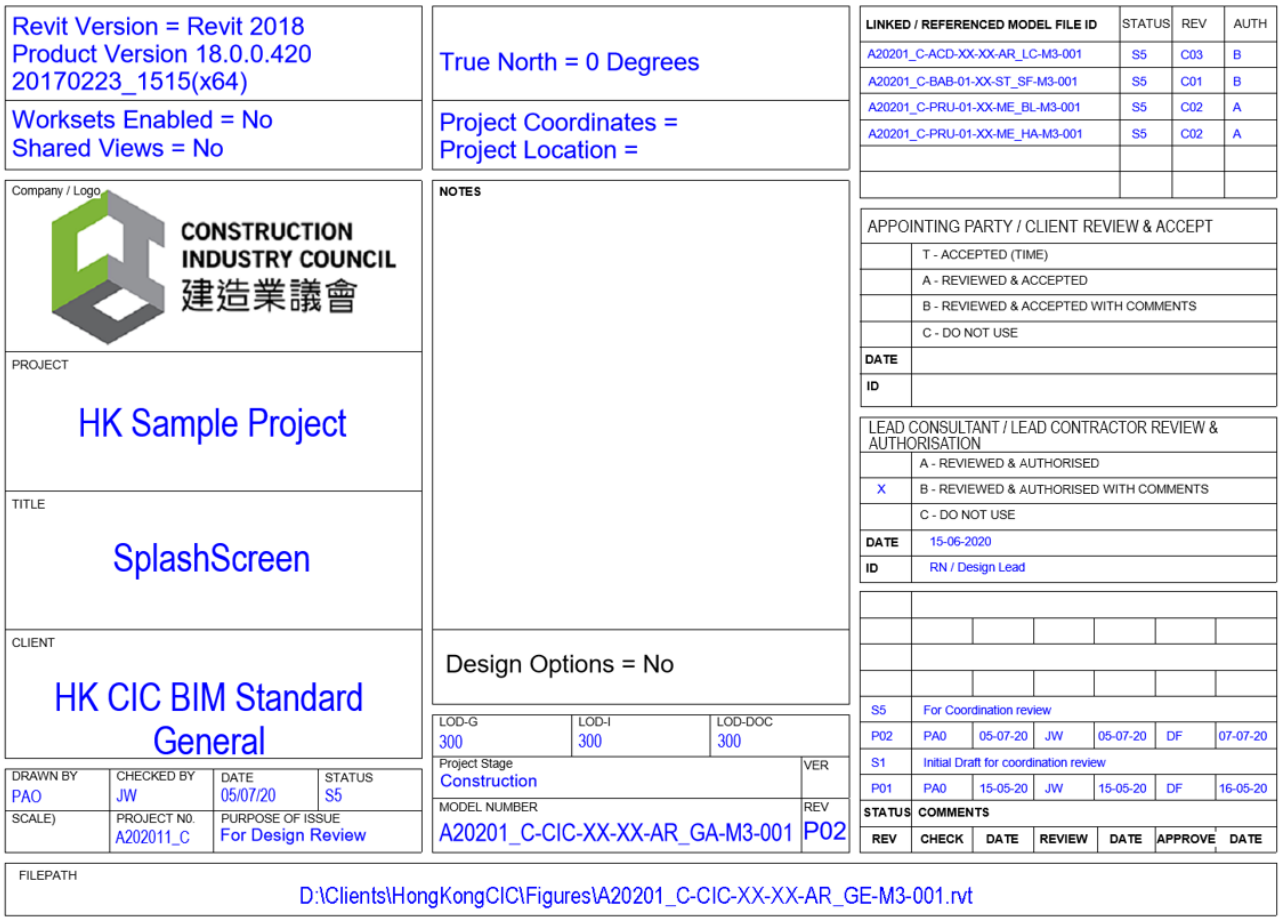


Figure 32 Model File Splash Screen Compliant with CDE requirements

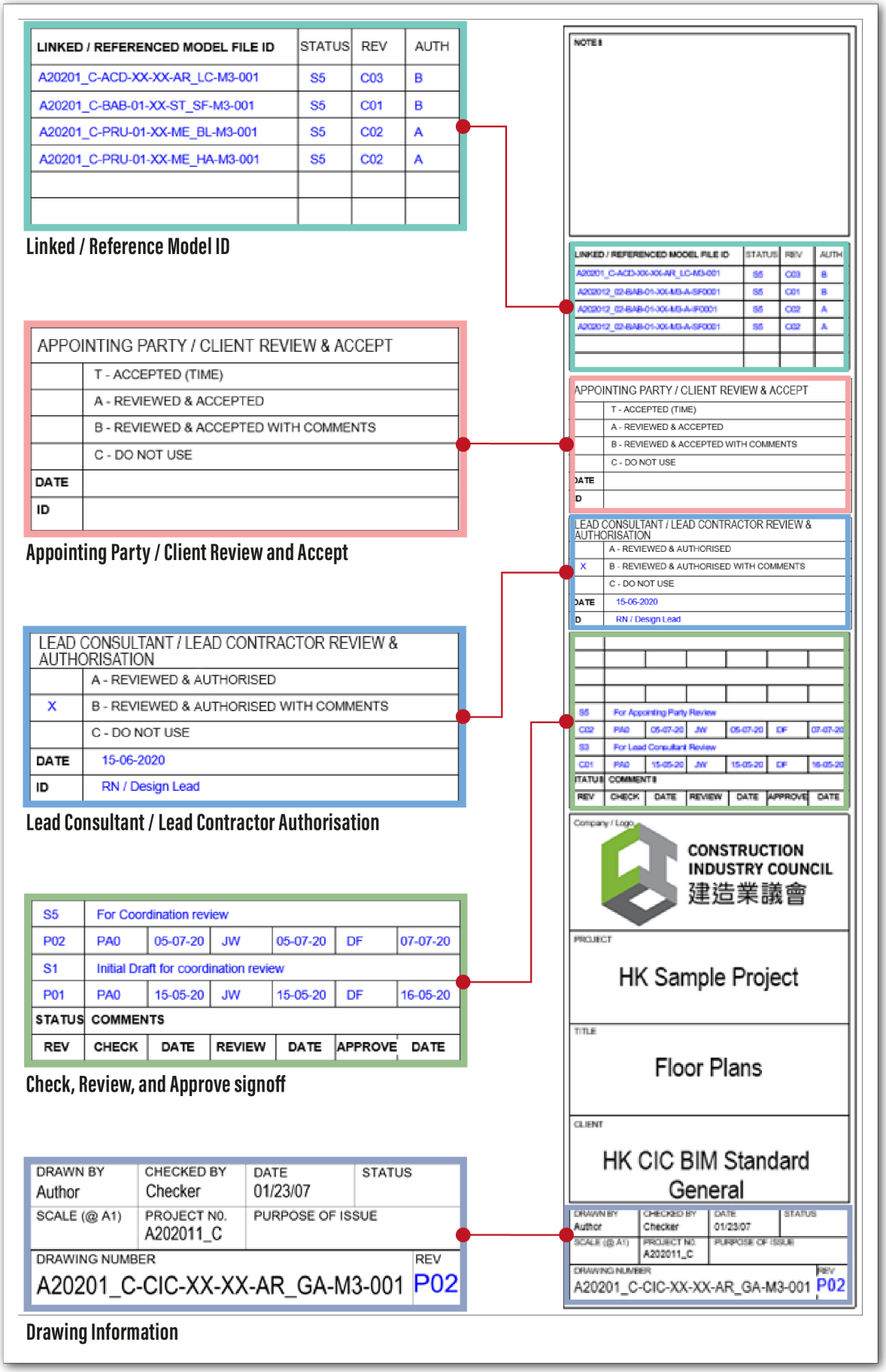


Figure 33 Example of Drawing Title Block elements for CDE compliance

The requirements for data fields in title blocks and headers (ISO 7200:*2004*) precedes the requirements within BIM standards. Identified as *a major* cause of waste in AEC is the time spent looking for the current, most relevant information and identifying what it can be used for. Therefore, models and documents that have been issued by an authoring team shall aid the authentication of the current documentation, its relevance and include the following a*s Data fields* to aid in file usage and identification both withi*n* and outside of the CDE environment:

Project Information including:

- Authoring Organisation Name and Address; *
- Authoring Organisation Project Number;
- Appointing Party's / Client's Name and Address; *
- Project Name and Address;
- Project Phase;
- Land Registration;
- Project Units;
- Project Global Positioning;
- Project Classification Information (Facility); and
- Project BIM Object Library.

Document Information including:

- Title (Description); *
- Supplementary Title; *
- Classification (ISO 19650);
- Paper Size; *
- Unique Identifier (Number) including:
    - Project (Appointing Party's / Client's Project Number);
    - Originator; *
    - Zone;
    - Level or Location;
    - File Type; *
    - Discipline
    - Index / System (Classification)*; and
    - Number.

Versioning information including:

- Revision; *
- Revision identifier;
- Revision date; *
- Revision description;
- Versions (WIP / Options);
- Status code; *
- Purpose of issue;
- Checker (Author); *
- Reviewer;
- Approve; * and
- Model Reference information.

***Note** * Refer to ISO 7200:2004 Data field requirements.*

4.5 CDE Security, Storage and Technology Specification

There are multiple types of software applications that claim to fulfil the requirements of a Common Data Environment. These include applications that advertise under the headings:

- File Storage and Sharing;
- Cloud based solutions;
- Web based Construction Management;
- Document management systems; and
- Integrated Document Management (Integrated DM).

Technology solutions to support the CDE can be procured for the following approaches:

- Single project at a specific stage;
- Multiple project stages;
- Asset Life cycle;
- A programme of projects (design or construction or asset); and
- An enterprise solution.

A CDE required to meet the common requirements and the solutions chosen should as a minimum provide the following capabilities:

WIP Common Technology
The technical requirements for a work in progress (WIP) functional section should include:
WAN / LAN Requirements

- Ownership security, roles, and responsibilities linked to file access and permissions;
- Direct access for CAD / BIM authoring solutions;
- Direct linking / downloading syncing with CDE solution;
- Project file coordination / viewing / commenting solution;
- Internal file backup procedure;
- Internal file storage structure;
- Process management and audit trial; and
- Customised meta data fields definitions.

CDE Gateway Requirements include:

- External extranet / cloud-based solution;
- Upload capability;
- Security based file access and permission control for check, review, and approve;
- Common file viewing, mark-up and commenting;
- Application of Electronic Signatures;
- Customised meta data fields definitions;
- File nomenclature;
- File status, assignment of approvals process if required; and
- File revision, version.

For example, on how to structure the work in progress area, see Sections 4.5.3-4.5.7 relating to folder structures.

4.5.1 Authorisation Gateway Technical Requirements

The solution also needs to be able to incorporate the following common workflow requirements for the shared authorisation gateway as follows:

- Review workflow;
- Checking of file links for naming, revisions, versions, authorisation, and acceptance status;
- Coordination Check with latest shared resources;
- Visual review / comment and mark-up;
- Level of Information Need Review;
    - LOD-G verification against detailed level responsibility matrix;
    - LOD-I verification against detailed level responsibility matrix;
- Project information standard review (Nomenclature for Objects, layers etc.);
- Authorise workflow;
- Authorisation or Rejection decision;
- Application of Rejection stamp including Function, Authoriser name, timestamp (Digital Signature); or
- Application of Authoring stamp including Function, Authoriser name, timestamp (Digital Signature); and
- Release for Shared or Published use.

What can be seen is that whilst these Authorisation may seem extensive by understanding the existing approvals and authorisations along with automation of specific elements an efficient solution can be found to providing quality information.

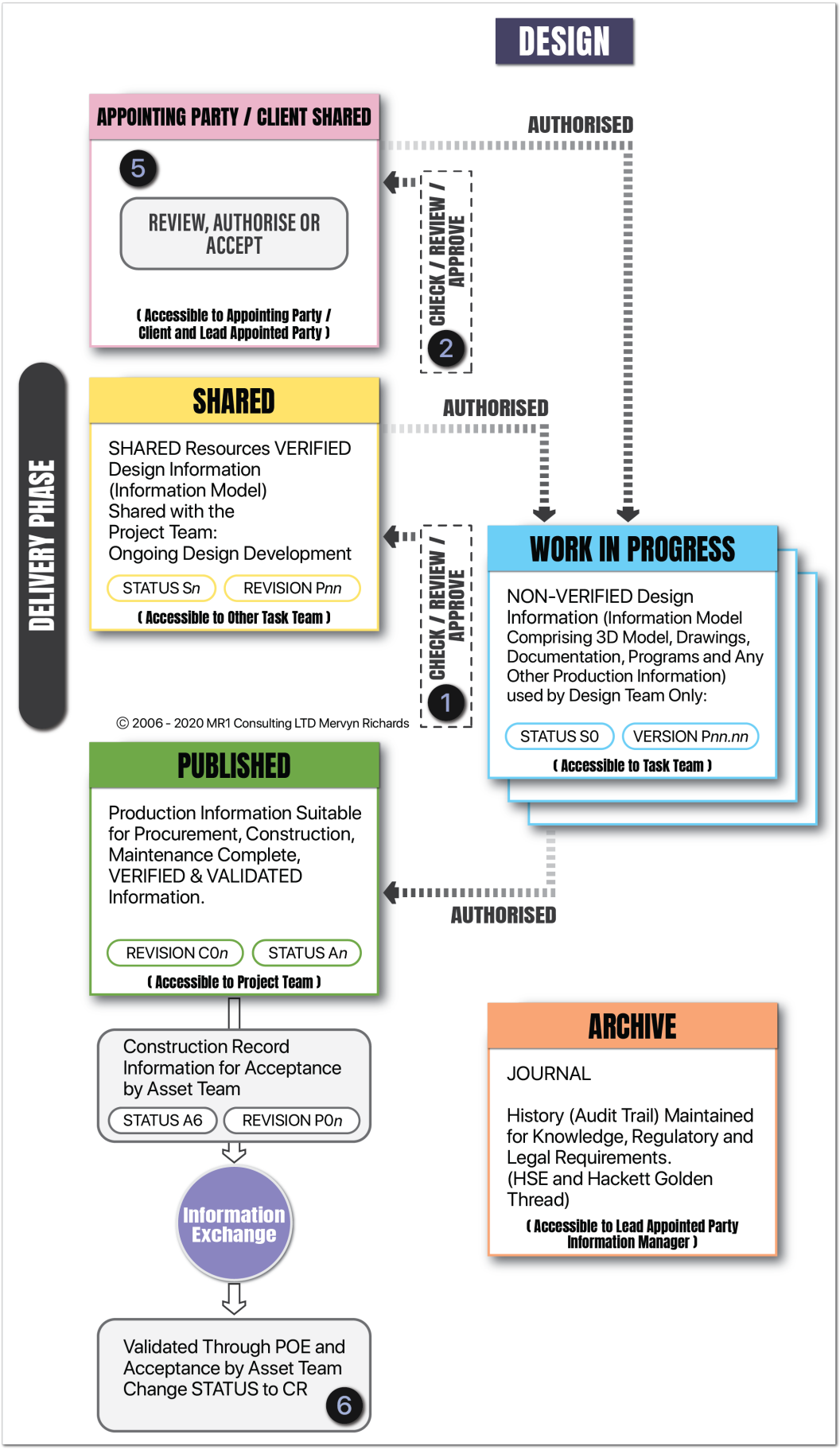


Figure 34 Design CDE workflow

4.5.2 Appointing Party / Client Shared Technology

Technical requirements for a Shared area should include:

- Process Management and Audit trail;
- File visualisation tools for agreed project formats; and
- Customised meta data fields definitions.

Workflow requirements for Appointing Party / Client Shared area:

- Customised meta data fields definitions;
- Ownership, roles, and responsibilities linked to functions; and
- Gateway acceptance for contractual.

4.5.3 Folder Structures

Most companies authoring Information Models should do so within their own Local or Wider area networks using standardised folder structures on central servers acting as that Task Teams work in progress area.

This section defines how BIM data shall be stored within that project filing system. All project model files, drawings, references and data, regardless of project size or type, shall be organised and filed into a standard folder structure on a central server. During the daily working of a model, a copy of the model could be placed on a local workstation.

All models should be stored on a central server to ensure that backup and disaster recovery facilities are provided to safeguard the models and databases. Subfolders structure under the central server should be standardised and setup by the System Administrator. In general, other users are restricted from modifying the folder structures. If there are any special needs, project team members can discuss with the administrator to setup optional subfolders.

4.5.4 Resource Folder Structure

Standard templates, drawing borders, object definitions and other non-project- specific data shall be held within the server based Central Resource Library, with restricted write access

The Central Resource Library shall be organised by software and version. Resources for each product and version, the Central BIM Resource Library, shall be maintained within each folder.

Specific elements of the Resource folder should be synced with the Appointing Party / Client shared resource area to ensure consistency.

4.5.5 Project Folder Structure

All project data shall be held within the standard project folder structure located on central network servers or an appropriate Document Management platform. This includes all work in progress files, components or assemblies.

The defined structure should follow the principles of ISO 19650-1 CDE process of 'Work In Progress (WIP)', 'Shared', 'Published' and 'Archived' segregation of data within a designated set of folders.

Where a project comprises of a number of separate elements such as multiple buildings, zones or areas, the BIM structure shall be maintained within a set of designated sub-folders representing the various project elements.

4.5.6 Local File Folder Structure

Where it is a requirement of a BIM authoring software to store files on each local workstation, a strict folder convention shall be defined and employed throughout.

4.5.7 Example Folder Structure

The following folder structure is provided as an example arrangement, designed to encourage compliance with the strategies contained within this Standards.

- 🗀 ***[Project Folder]***	
- 🗀 BIM	[BIM data repository]
- 🗀 **01-WIP**	**[WIP data repository]**
- 🗀 CAD	[CAD files (incl. 'Modified')]
- 🗀 BIM	[Design models (incl. 'Modified')]
- 🗀 SheetFiles	[Sheet/dwg files]
- 🗀 Export	[Export data e.g. gbXML or images]
- 🗀 Families	[Components created during this project]
- 🗀 WIP_TSA	[WIP Temporary Shared Area (TSA)]
- 🗀 **02-Shared**	**[Verified Shared data]**
- 🗀 CAD	[CAD data/output files]
- 🗀 BIM	[Design models]
- 🗀 CoordModels	[Compilation models]
- 🗀 **03-Published**	***[Published Data]***
+ 🗀 YYYYMMDD-Description	[Sample submission folder]
+ 🗀 YYYYMMDD-Description	[Sample submission folder]
- 🗀 **04-Archived**	**[Archived Data repository]**
+ 🗀 YYMMDD-Description	[Archive folder]
+ 🗀 YYMMDD-Description	[Archive folder]
- 🗀 **05-Incoming**	**[Incoming Data repository]**
- 🗀 Source	[Data originator]
+ 🗀 YYYYMMDD-Description	[Incoming folder]
+ 🗀 Source	[Data originator]
- 🗀 **06-Resource**	**[Project BIM Resources Library]**
+ 🗀 Titleblocks	[Drawing borders/titleblocks]
+ 🗀 Logos	[Project logos]
+ 🗀 Standards	[Project standards]

Figure 35 Example project folder structure

This is provided as an example only and should not be used in preference to or replace any internal company standard folder structures. Always consider your company processes and procedures.

No spaces are to be used in the folder naming, as this can potentially interfere with certain file management tools and collaboration across the internet.

Well-organised project data both within project folders and internally within your BIM authoring software should help to identify, locate and efficiently use the information you need. Maintaining separate folders for WIP, Shared and Published data is part of the best approach even if they are not named exactly in this manner. Structure and label your files, models and data according to requirements outlined in the software-specific supplements.

Where technologies allow the shared environment of the CDE should sync with the CDE solution automatically unless files can be linked directly to the shared environment of the CDE. Otherwise, processes need to be included within the project information production methods and procedures to ensure manual synchronisation of the Shared environment and local folders.

4.6 The CDE Handover Procedures

4.6.1 Handover Requirements

At the end of each project or project stage there is a delivery of information as an information exchange that needs to meet the contractual requirements. This is generally a straightforward delivery of the final stage published documentation issued and approved with the appropriate status and revision.

The content of the common data environment may also be requested by various parties and this may be to either:

- Establish a project record for contract, legal or professional indemnity insurance requirements; and
- Establish the AIM after construction completion.

4.6.2 Project Record

The initial requirements for a common data environment relate to the Heathrow Express Tunnel collapse within the UK. What was clear from the enquiry that followed was there was no established project audit trial of what information was available to whom and when. The requirements to establish a common data environment to establish a centralised repository with full audit trail was the output from this and now adopted within ISO 19650.

At the end of the project the CDE information including all journals of exchanges should be made available to all parties who were included within each exchange. The project record should include not just final published information, but shared information and each revision or status of information along with the agreed workflows. Information should then be kept in accordance with contract law for the identified periods of liability.

To achieve this, the CDE shall provide a **read-only interface** that enable viewing and retrieving such Project Record in the same fashion as what and how could be seen during design and construction stages before handover. The linkage and relationship among the model files and other documentations shall be retained in this read-only CDE interface.

The principal parties of the Appointing Party / Client and the Lead Appointed Party should each be provided with a backup of the information for contractual purposes. Where specific security requirements are in place the delivery and access to any information shall be strictly in accordance with the security protocols defined within the security information requirements.

4.6.3 Asset Information Model (AIM)

As well as the record of project information the Appointing Party / Client may require the delivery of asset information to facilitate the operations and maintenance needs. Whilst the project record remains a fixed in time set of information, the AIM should constantly be updated, and appropriate editable file formats are likely to be the requirements.

The contents of the AIM should be identified as early as possible within the design and construction process in response to the AIR.

The formats and delivery requirements that are needed and clarified within the EIR.

The delivery of the asset information is likely to include but is not limited to:

- ABIM in native editable format;
- ABIM in open BIM format such as IFC;
- All documents produced from Information Models;
- COBie Data sets;
- Room Data Sheets;
- Health and Safety requirements;
- Product data library; and
- Digital Operation & Maintenance including Design Narrative, Suppliers and Manufacturers, Asset Schedules / Product Data Sheets, Warranties, Spares and Replacement, Maintenance requirements and Operation Requirements.

5 Information Management Workflow
for Stages in Project Life Cycle

This section describes the general information management workflows and deliverables for the key construction stages in Hong Kong using BIM along the Project Life cycle. The applications of BIM, BIM Uses and deliverables may vary for each project.

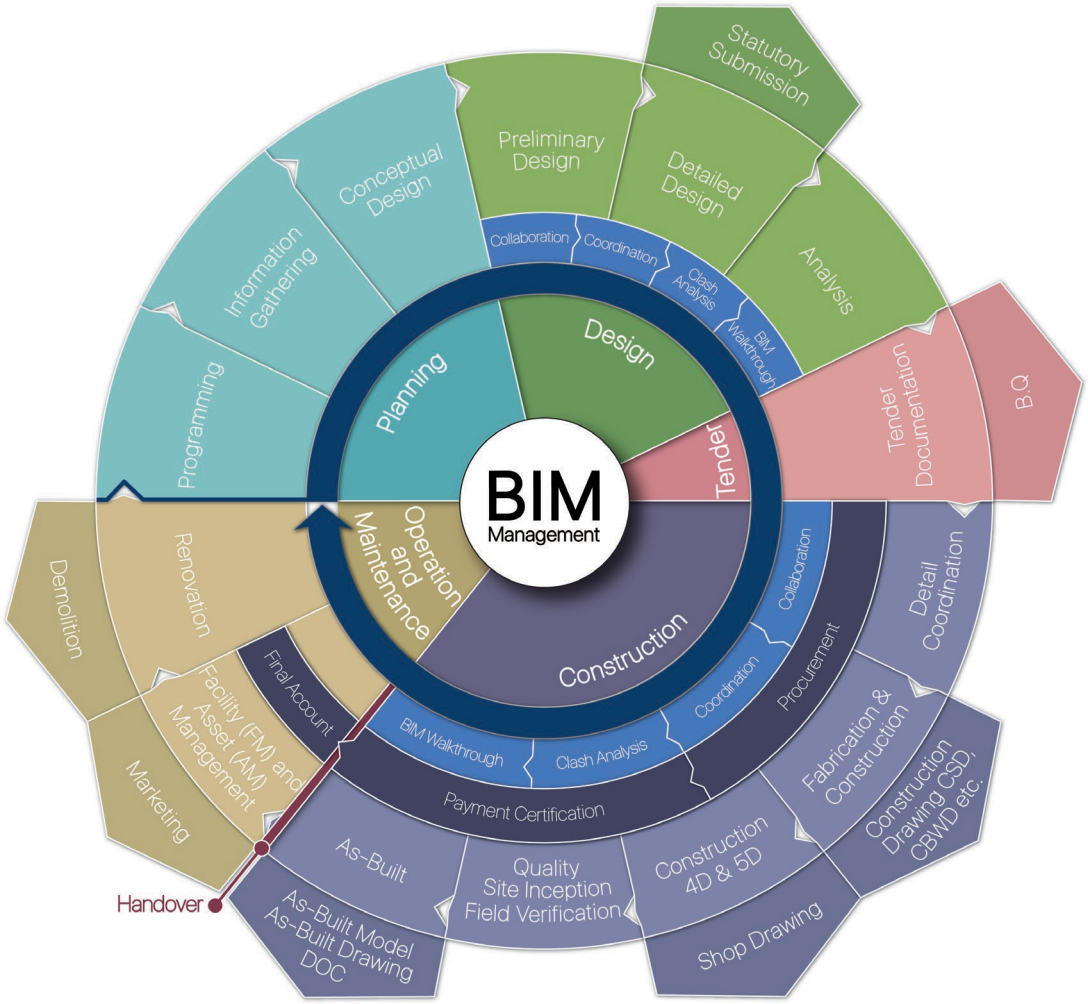


Figure 36 Information Management Workflow for Stages in Project Life cycle

Refer to the legend below for the workflow in this section.

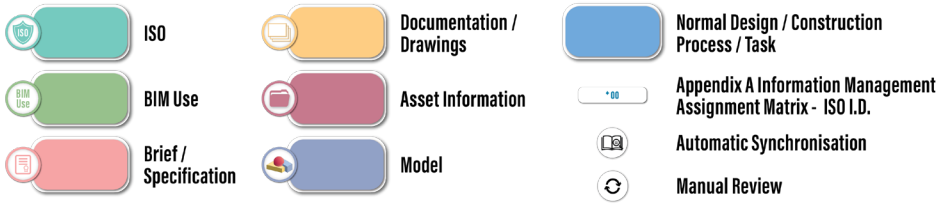


Figure 37 Icon Legend

5.1 Information Management Workflow for Planning Stage

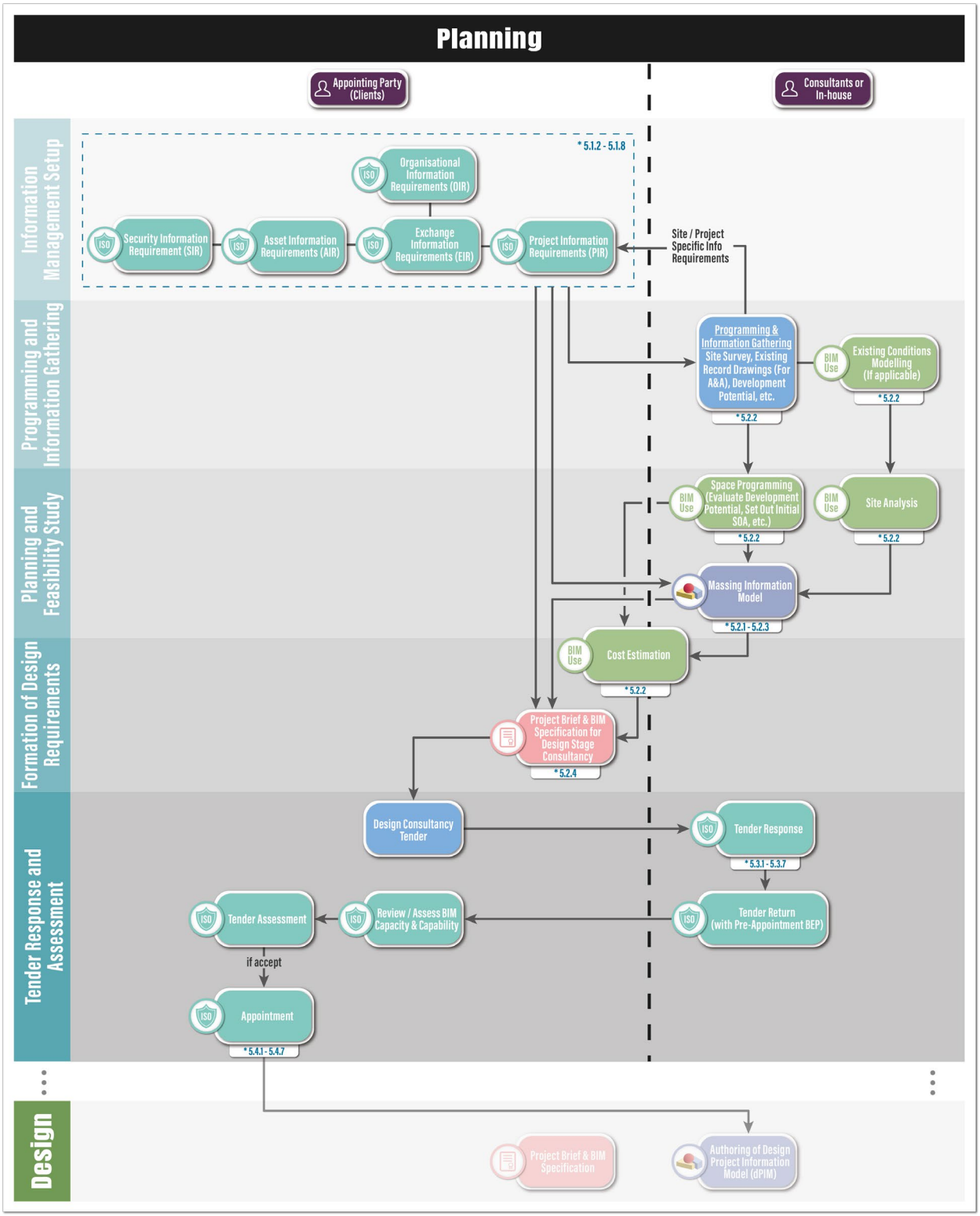


Figure 38 Information Management Workflow for Planning Stage

This stage involves various processes, typically including but not be limited to Information Management setup, programming and information gathering, planning and feasibility study, and eventually, to define the design requirements for further design and construction stages. BIM might be applied to facilitate the process.

For Information Management setup, see Section 1.0 Information Management – [ISO 19650] for further details.

Existing Conditions Modelling

Existing Conditions Modelling shall be an integral part of the information gathering process.

See the description of Existing Conditions Modelling under Section 3.6 BIM Use.

Design Authoring, Design Review, Space Programming

Information gathered shall be carried forward for a planning and feasibility study. Preliminary Information Models can be created in the form of massing models. This enables better visualisation of the project's development constraints and parameters which facilitate preliminary space programming and planning.

Site Analysis, Sustainability Evaluation

The existing condition models and the preliminary massing models can be used to carry out site analysis to evaluate the site to determine the most optimal location, position, and orientation, etc., for the project. The models can also be used to facilitate the sustainability evaluation process.

Cost Estimation

The existing condition models and preliminary massing models can also be used to facilitate the cost estimation process by extracting ballpark figures such as site areas, construction floor areas, excavation volumes, etc., and compare massing options.

5.2 Information Management Workflow for Design Stage

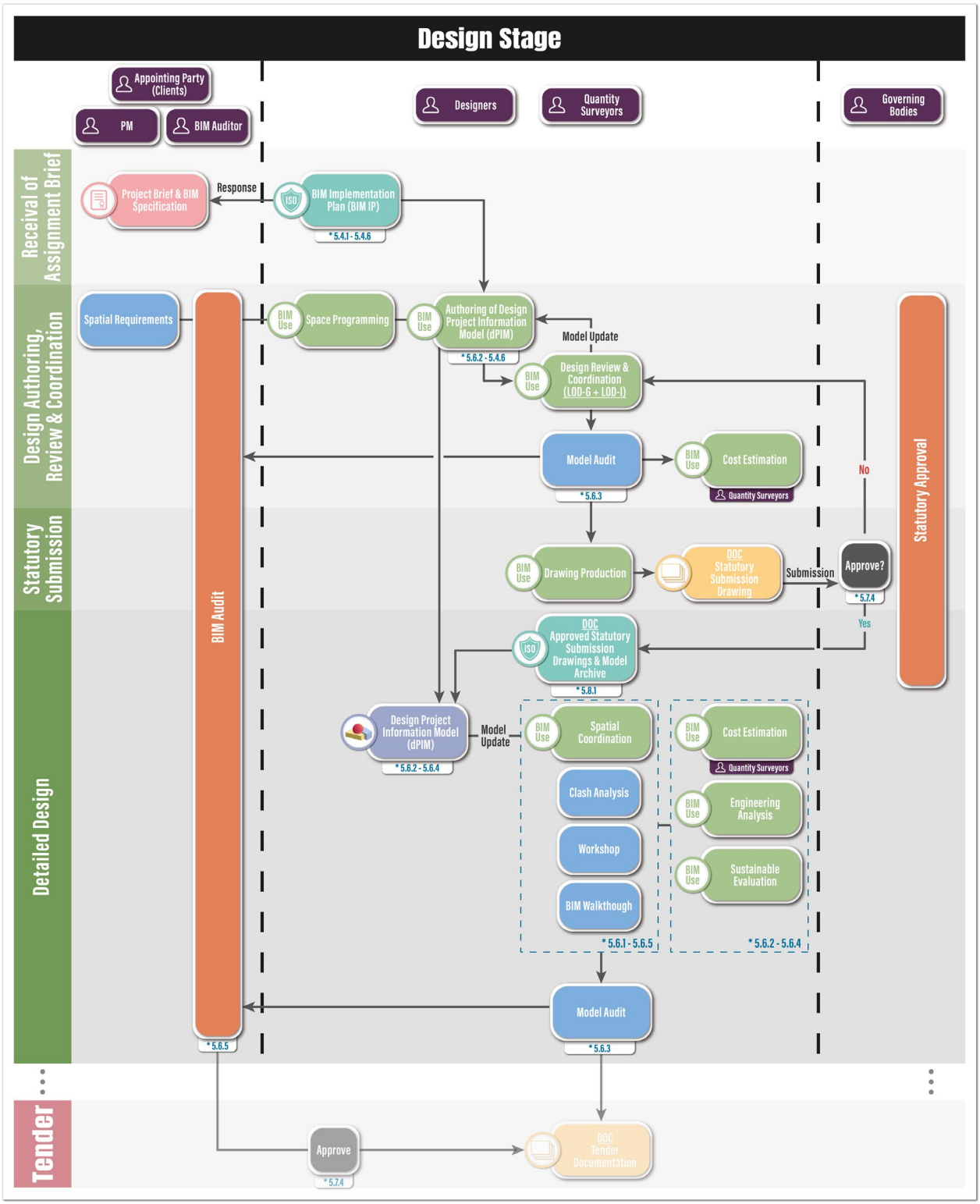


Figure 39 Information Management Workflow for Design Stage (Design-Tender-Build Project)

During this stage, the design Project Information Model is progressed and should be coordinated and dimensionally correct. By this stage, models should be sufficiently developed to verify statutorily compliance. The model should be developed to a stage whereby production information can be utilised for the purposes of tendering.

The designs and models should now be further refined to provide technical definitions of the project and the level of definition produced by each designer undertaken in accordance with the MIDP.

Collaboration
See Section 5.8.2 Collaboration for general information

Cost Estimation
See Section 5.8.3 Cost Estimation / 5D Modelling for general information

BIM Audit
See Section 5.8.4 BIM Audit for general information

Drawing Production – Statutory Submission
See Section 5.8.6 Drawing Production for general information.

Typically, statutory plan development and submission to the approving authorities of the HKSARG for approval shall be the key milestone deliverable in the design stage. Statutory plan submission and subsequent approval shall be well documented in the MIDP, and TIDP for individual disciplines' submission (see Sections 3.6.16 and 3.6.17 for further information of MIDP and TIDP). The types of statutory plans shall include but not be limited to the following items:

1. General Building Plan;
2. Superstructure Plan;
3. Foundation Plan;
4. Excavation and Lateral Support (ELS) Plan;
5. Site Formation Plan;
6. Ground Investigation Plan;
7. Demolition Plan (included Hoarding); and
8. Drainage Plan.

As far as practicable, all 2D drawings shall be generated from the BIM authoring software and tools directly. The following items shall also be determined with the aid of BIM:

1. Fundamental checking equivalent to the standards as per current Practice Notes;
2. Checking of development / planning restrictions, including but not be limited to gross floor area, building heights, no. of storeys, absolute height of building, etc;
3. Checking of means of escape and means of access;
4. Checking of sanitary fitment provision;
5. Checking of fire compartment and fire resisting construction;
6. Checking of building bulk and separation; and
7. Identification of the material and description according to the preferred colours.

The Design Information Model shall satisfy the Level of Information Need (LOIN) requirements, i.e., the model and drawings shall satisfy the LOD-G, LOD-I and DOC requirements. In particular, Documentation (DOC) requirements specific to Statutory Plan submission drawings shall apply according to the approving authorities' practices, such as the scope of the plan to be submitted, colouring of the plan, etc.

Following Standards and Guidelines shall be referred for further details:
Buildings Department - Guidelines for Using Building Information Modelling in General Building Plans Submission; and
CIC – Building Information Modelling Standards for Preparation of Statutory Plan Submission.

5.3 Information Management Workflow for Tender Stage

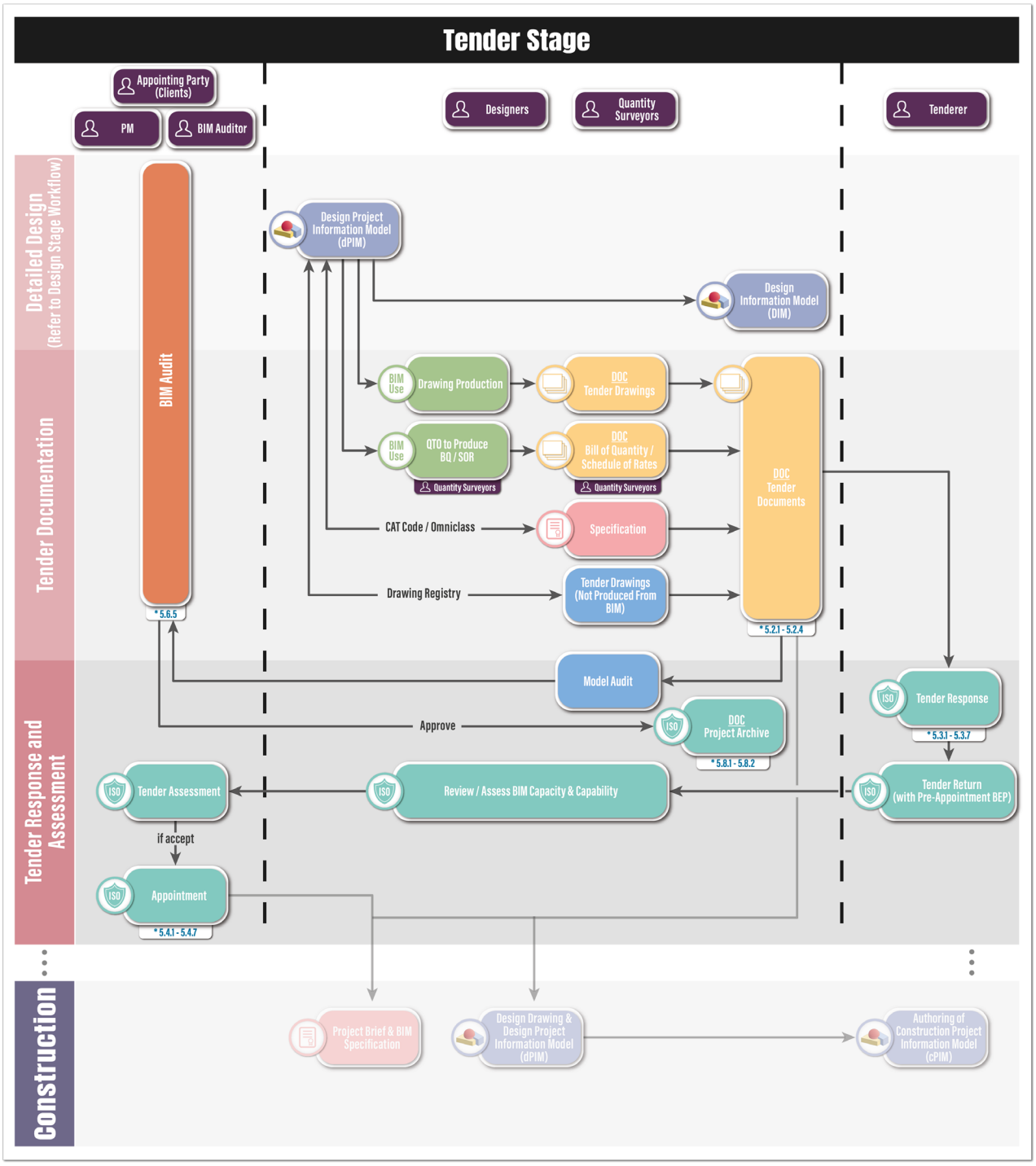


Figure 40 Information Management Workflow for Tender Stage (Design-Tender-Build Project)

During the tender stage for typical Design-Bid-Build contract, the design Project Information Model continues to be developed and design is progressed and coordinated with the use of BIM. By this stage, the process and information requirements shall be driven by the purpose of Tender documentation, which is the key milestone and deliverables.

The designs and models should now be further refined to provide technical definition of the project and the level of definition produced by each designer undertaken in accordance with the MIDP, which is sufficient to pass down the supply chain to the tenderers.

Collaboration
The Tender documentation is a process of information exchange between members of the supply chain – the designers and quantity surveyors to pass the design intent and requirements to tenderers through various forms of documentation – Drawings, Specifications, Tender documents, Bills of Quantities (BQ) and Information Models, etc. The tenderers shall then assess cost, time, resources, methodologies, etc., in response to the information received.
See Section 5.8.2 Collaboration for general information.

Quantity Take-off (QTO) to facilitate B.Q.
See Section 5.8.3 Cost Estimation / 5D Modelling for general information.

BIM Audit
See Section 5.8.4 BIM Audit for general information.

Drawing Production – Tender
See Section 5.8.6 Drawing Production for general information.

Tender drawing production shall be the key part of tender documentation. The tender information for the works contracts shall include Information Models with tender drawings generated from the Information Models, which shall be well documented in the MIDP, and TIDP for individual disciplines' submission (See Sections 3.6.16 and 3.6.17 for further information of MIDP and TIDP).

As far as practicable, all 2D drawings shall be generated from the BIM authoring software and tools directly. These drawings may include, but not be limited to the site plans, demolition plans, general layout plans, elevations, sections, details and schedules of architectural drawings, structural drawings, framing plans, building services drawings, staircase sections, details, reflected ceiling plans (RCP) and Combined Builder's Works Drawings (CBWD), landscape plans, etc.

Examples for drawings that may be exempted for being generated from BIM in Tender stage include building services schematic, reinforcement rebar details, reinforcement concrete details and other drawings that may solely require 2D details, etc. Any drawings not created natively in the BIM authoring software should be linked to the Information Models through the TIDP / drawing registry / drawing list. Such registration list shows the relationship between the Information Models and 2D drawings, and indicate whether each 2D drawing is generated from the BIM or not.

The Design Information Model shall satisfy the Level of Information Need (LOIN) requirements – the model and drawings shall satisfy the LOD-G, LOD-I and DOC requirements. In particular, Documentation (DOC) requirements specific to tender drawings shall apply in accordance with industry practice and standard for 2D drawings as specified.

Specification

- Product specification
  While information under product specification developed by individual professional disciplines may or may not be included in the design Project Information Model, the specification should link to the models. The linkage can be established by an object classification system, for example, classification number / OmniClass® system code specified in the responsibility matrix.

- BIM Specification
  BIM Specification defines the BIM scope of works.
  See Appendix A Information Management Assignment Matrix Example for more information on the checklist items for Invitation to Tender, Tender Response, Tender In / Out, Appointment and Mobilisation.

  See Section 5.8.1 Contractual for more information.

5.4 Information Management Workflow for Construction Stage

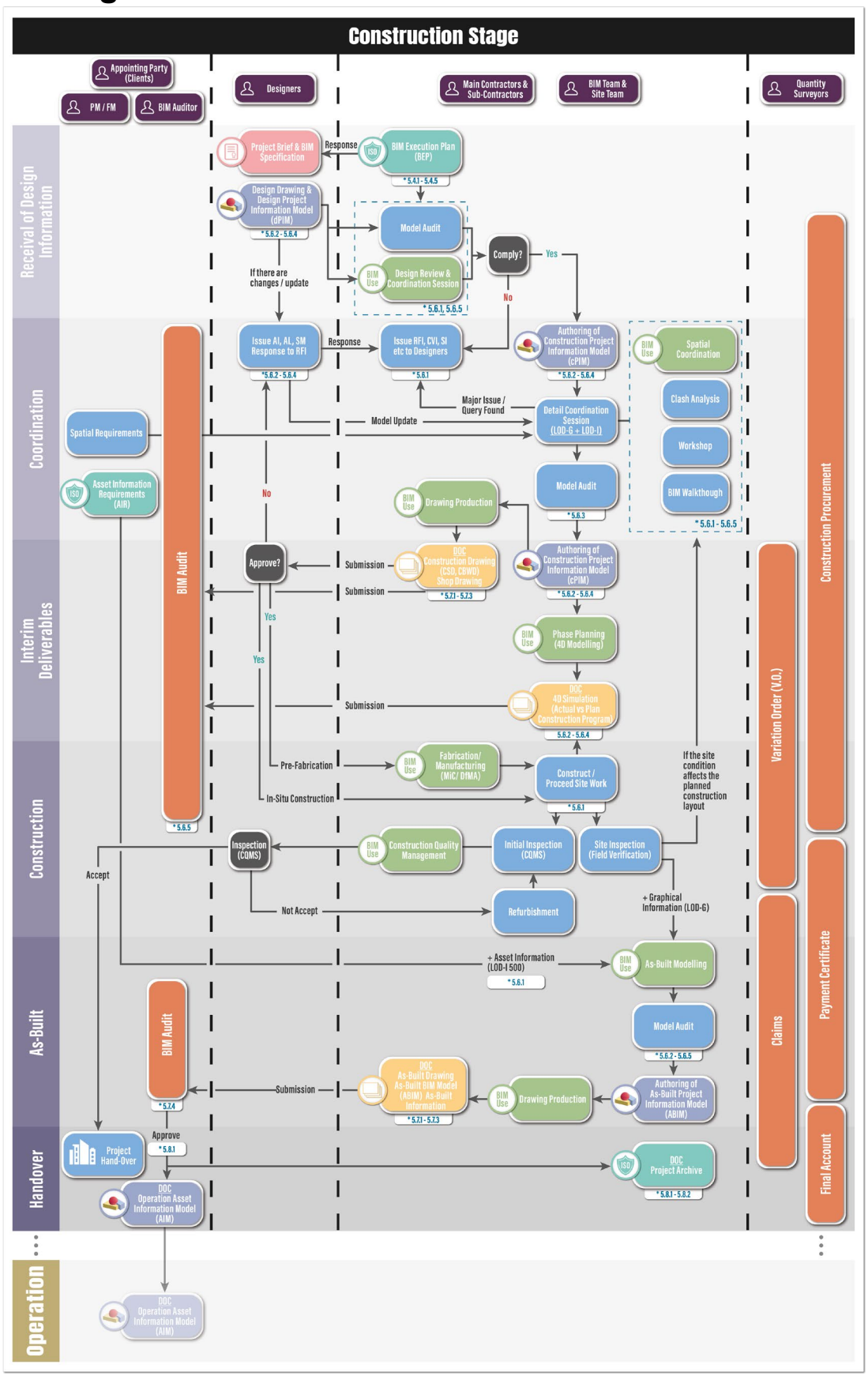


Figure 41 Information Management Workflow for Construction Stage (Design-Tender-Build Project)

Collaboration & 3D Coordination
See Section 5.8.2 Collaboration for general information.

3D Coordination is the whole process of design error avoidance using federated Information Models and a collaborative design environment.

During this stage, the cPIM is progressed and should be coordinated and dimensionally correct. The appointed parties, including main contractors, sub-contractors and even suppliers and manufacturers shall collaborate through the BIM environment.

The suppliers shall provide BIM object data for the standard parts, products (if any) or materials to represent the graphical or non-graphical information of the chosen products and the BIM objects shall be updated to reflect what is chosen and then constructed.

Main contractors and sub-contractors could provide feasible construction arrangements using the federated Information Models. Suppliers and manufacturers could further develop the coordinated Information Model for fabrication, manufacturing, logistic planning, etc.

The Appointing Party (e.g.: PM team and operation team) shall also involve in BIM Coordination Meeting or BIM Walkthrough in order to align the expectation and maintenance area for future operations with the construction team.

BIM Audit
See Section 5.8.4 BIM Audit for general information.

Phase Planning (4D Modelling)
During this stage, 4D Model simulations to the construction process of the construction works shall be provided to:

1. establish relationships between the programme and sequence of construction activities, including the delivery of material, equipment to be carried out during the construction, operation routes and installation sequence of the major machinery & plants, site logistics, typical construction cycle, site operation, etc.;
2. demonstrate the sequences of works and site access;
3. identify potential time and spatial conflicts;
4. optimise the use of critical resources;
5. enhance safety requirements, construction process control and consider using BIM for training to achieve Site Safety Supervision Plan (SSSP);
6. minimise disturbance to the operation of the neighbourhood;
7. better coordinate with affected parties and resolve interfacing issues at early stages;
8. monitor the procurement status of project materials; and
9. tie in with payment schedule.

A 4D programme for construction progress monitoring shall be progressively updated according to the detail works programme to demonstrate in specific intervals, linking all activities in the master programme and it shall be automatically matched with the activities as shown in the master programme with the appropriate file format. The 4D programme shall evolve with project progression. Time and other 4D-related information within Work-in-progress (WIP) BIM shall be concurrent with the outputs.

The 4D programme shall be used to improve project delivery and reviewed in the regular project progress meeting to indicate and compare the current **actual** construction progress with the **baseline** programme to facilitate project management.

Procurement / Payment Certificate / Final Account
See Section 5.8.3 Cost Estimation / 5D Modelling for general information.

In the construction stage, the Information Models can be used to extract quantities for project cost control, cost evaluation on the variation of works, cash flow forecast, spending analysis, interim payment, etc. as far as practicable. The 5D Model shall be adopted in the regular project progress meeting to indicate and compare the current cash flow status with the baseline forecast to facilitate project management.

Construction / Shop Drawing Production
See Section 5.8.6 Drawing Production for general information.

In the construction stage, as far as practicable, all 2D drawings shall be generated from the BIM authoring software and tools directly. These drawings may include, but not be limited to the general layout plans, elevations, sections, details and schedules of architectural drawings, structural drawings, framing plans, building services drawings, details, Combined Services Drawing (CSD), and Combined Builder's Works Drawings (CBWD), Reflected Ceiling Plans Drawings (RCPD), and other construction / shop drawings etc.

For more information on BIM object preparation, refer to

1. *CIC - Production of BIM Object Guide - General Requirements.*

For more information on drawing production, refer to

1. *Buildings Department –Guidelines for Using BIM in General Building Plans Submission for more information on drawing production; and*
2. *CIC - BIM Standards for Preparation of Statutory Plan Submissions,*
3. *CIC - BIM Standards on Generation of MEP Digital Drawings.*

5.5 Information Management Workflow for As-Built and Handover Stage

As-Built Modelling / Drawing Production

As-Built Modelling for AM and facilities upkeep is a process used to depict an accurate representation of the physical conditions, environment, and assets of a facility, which shall be adopted in the construction stage.

Transiting from the construction stage to the as-built stage, field verification shall be carried out for developing and verifying the graphical and spatial information (LOD – G 500) of the PIM. As-Built drawings (DOC) for all the disciplines and services shall be generated from the ABIM.

Supplement documents (DOC) such as catalogues, certificates, manuals and warranties etc. shall be linked to the ABIM and stored under a standardised file folder structure as a repository for hand-over.

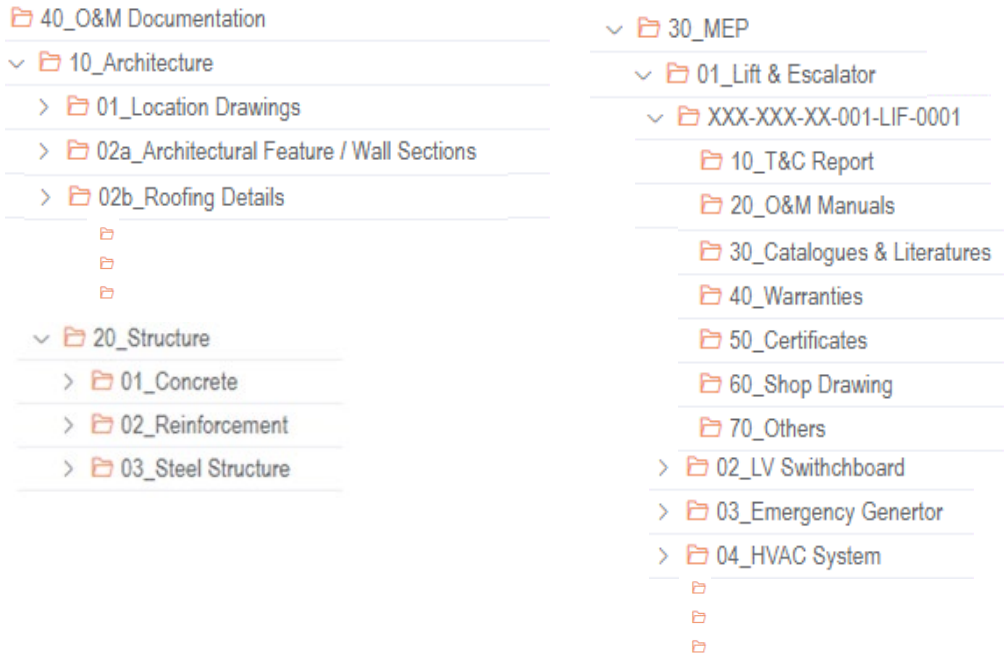


Figure 42 Sample of Asset Information Repository

Refer to Building Information Modelling (BIM) Guide for Facilities Upkeep by Architectural Services Department – Property Services Branch for more information on the ABIM.

Refer to Building Information Modelling for Asset Management (BIM-AM) Standards and Guidelines by Electrical and Mechanical Services Department for more information on ABIM for building services installations.

Asset information (LOD – I 500) shall be input and associated with the ABIM according to the AIR agreed.

Below listed two examples of Asset Information Management workflows in Hong Kong:

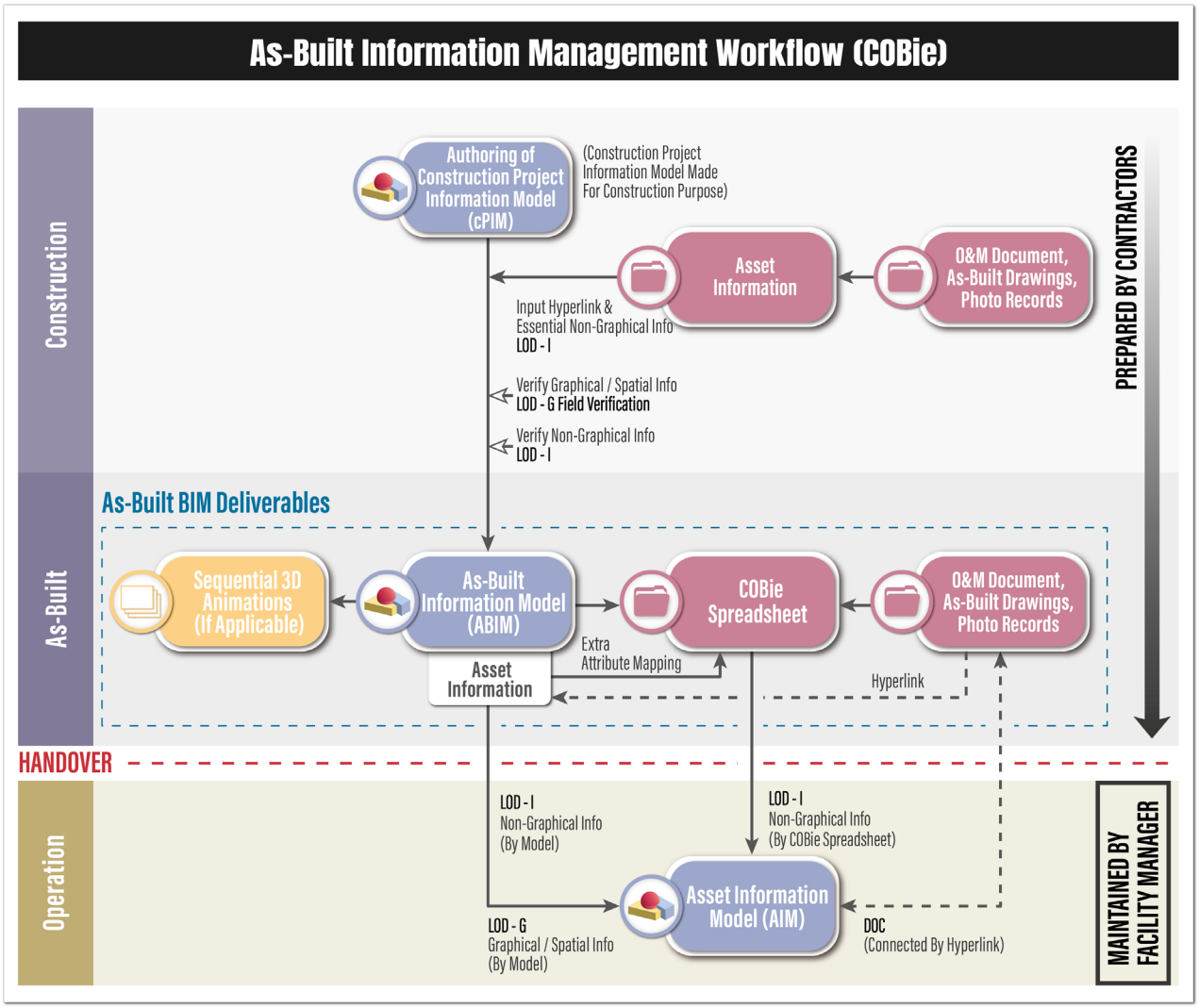


Figure 43 As-Built Information Management Workflow with COBie

If Appointing Party's / Client's operation team adopts the COBie system to transfer the asset data into their Asset Management / Facility Upkeep Management, the main contractors and sub-contractors shall attach the required asset information in the model elements.

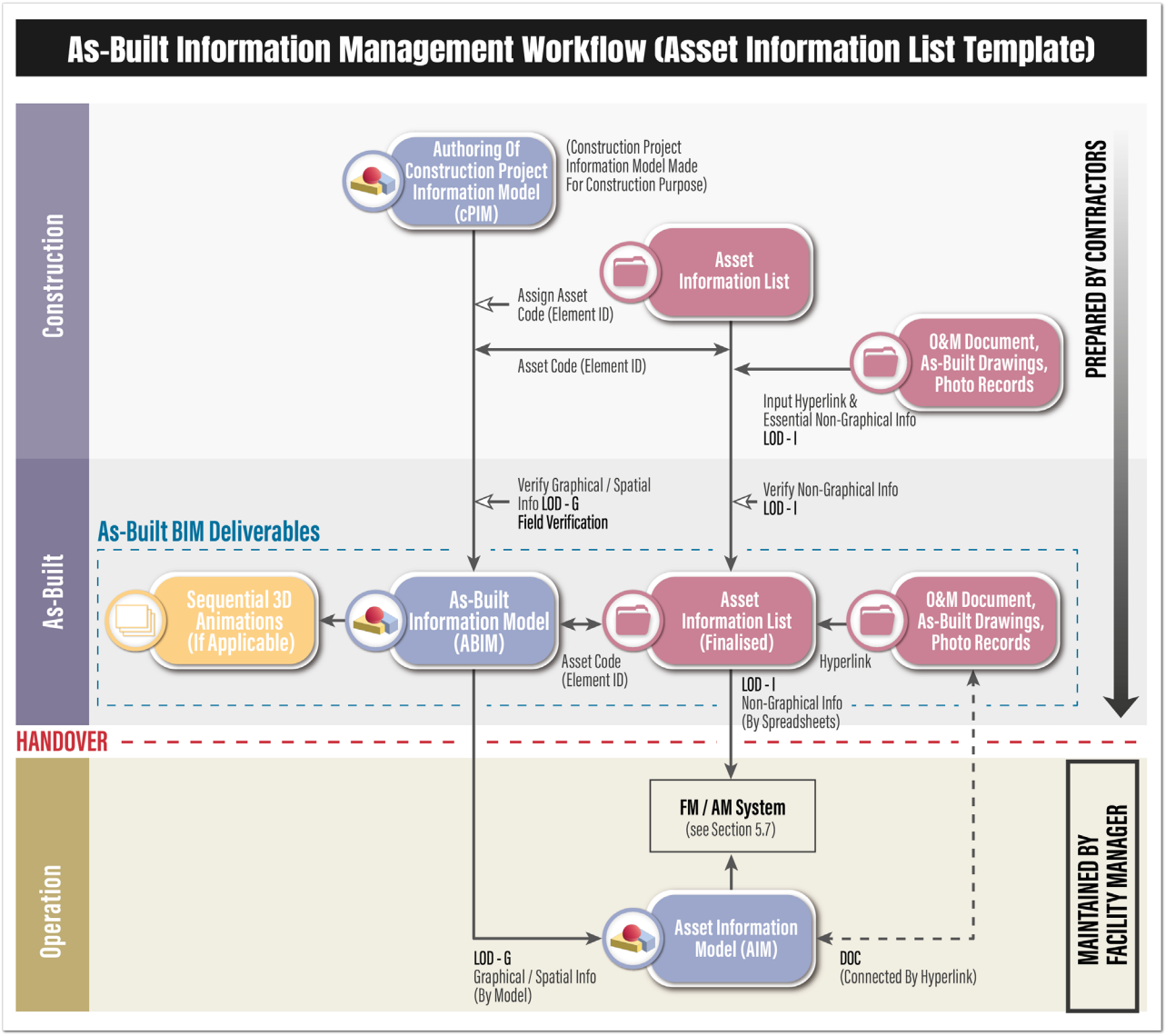


Figure 44 As-Built Information Management Workflow with Asset Information List Template

If the Appointing Party's / Client's operation team has established the connection between the AIM and the Asset Management / Facility Upkeep Management System, there shall be an Asset Information List Template for converting the asset data from excel format into the system. Hence, the main contractors and sub-contractors shall fill-in the required asset information through the document instead of embedding in the model elements.

Handover

All final BIM deliverables developed for the project shall become the property of the Appointing Party / Client and shall transfer back to the Appointing Party / Client on the completion of the project. This should be defined within the Project protocol and applied to each appointment or contract.

As-Built Information Model including native format, open format and required format for integration with the Appointing Party' AM/FM shall be submitted.

All documents should be stored under a standardised file folder structure as Hand-over repository as below sample:

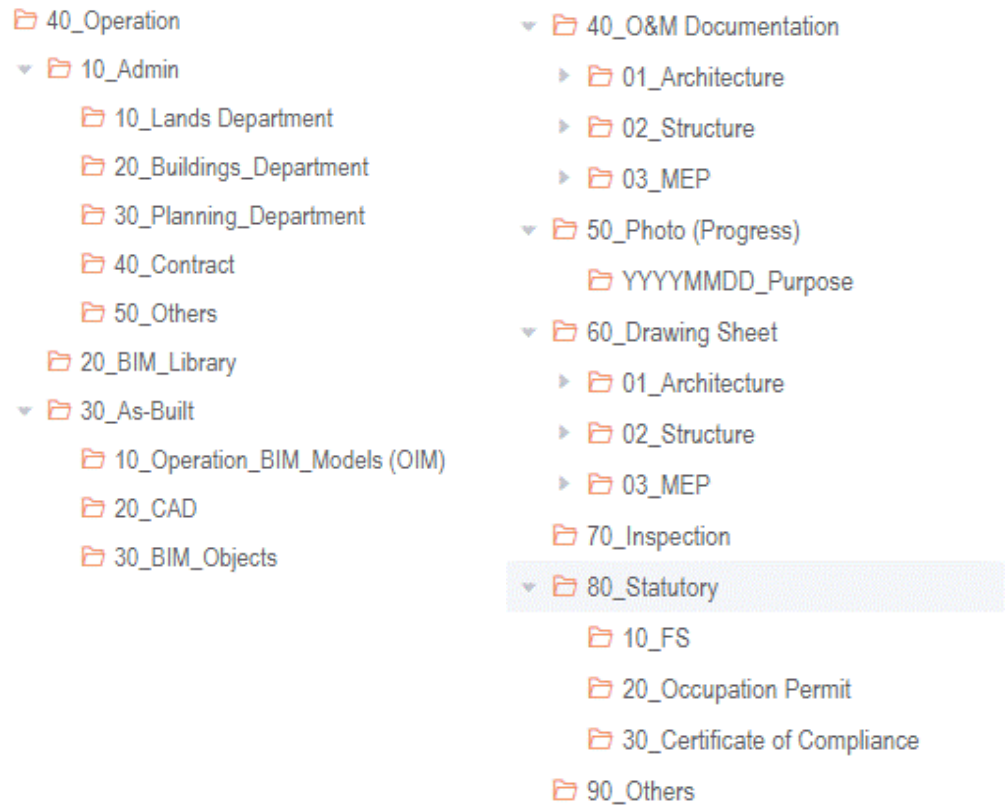


Figure 45 Recommended Hand-over repository

O&M Documentation including O&M manuals, warranties and certificates, etc. shall also be part of the documents to hand-over and stored under standardised file folder structure (40_O&M Documentation in *Figure 45*, sample sub-folder structure refer to *Figure 42*)

5.6 Information Management Workflow for Design-and-Build Project

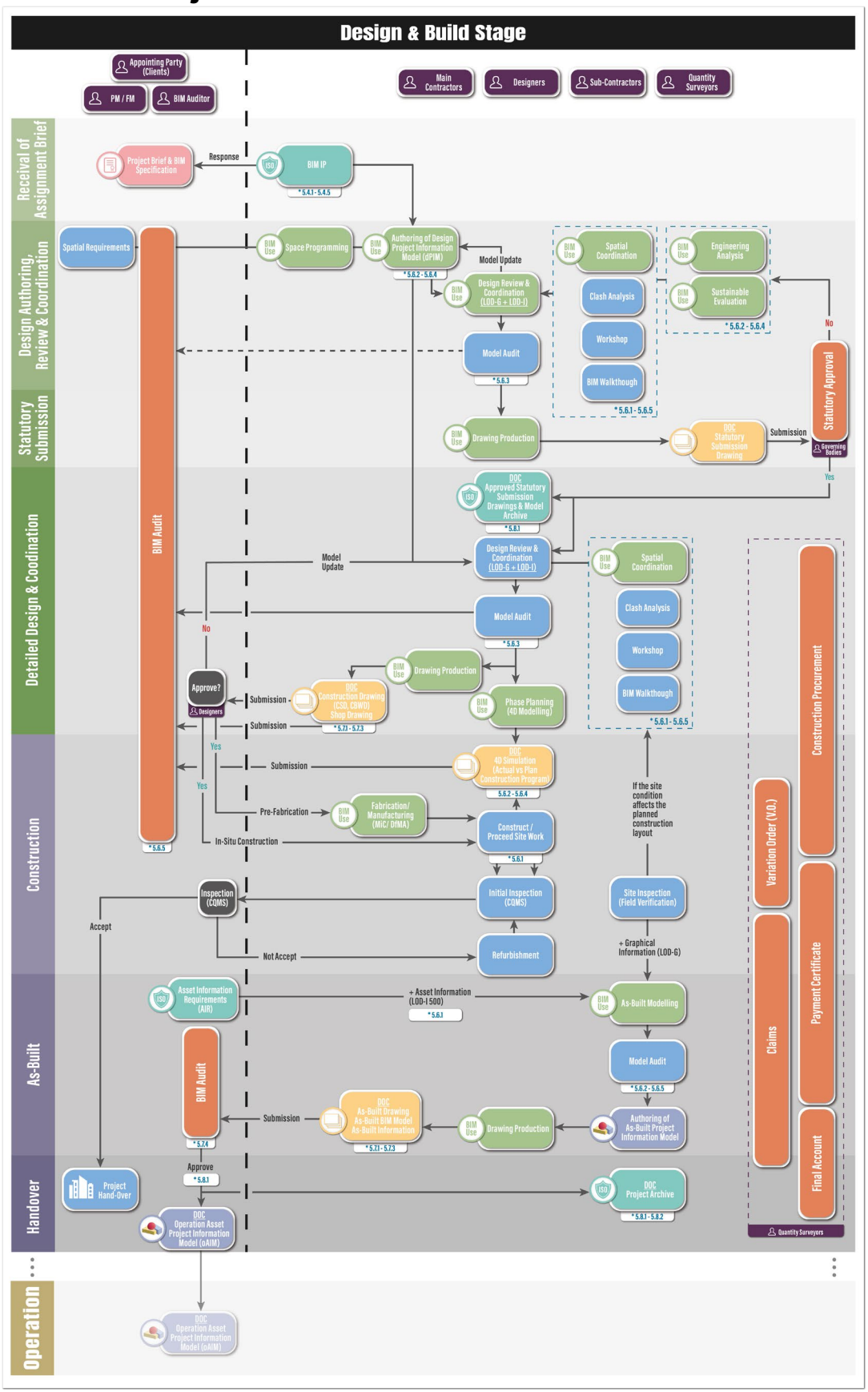


Figure 46 Information Management Workflow for Design and Build Project

Above workflow is a sample for Design and Build Project, however, the actual application of BIM and responsibility of each activity may various according to the corresponding project's contract, agreement and specific situations. Main contractors, designers and sub-contractors shall work closely in the design and coordination stage.

See Sections 5.2, 5.4 and 5.8 for the definition of the activities listed in the workflow.

5.7 Information Management Workflow for Operation Stage

After receiving the hand-over package from the project team, the operation team should connect the asset information to their own system / database. Below listed two samples for the asset information management workflow under the operation stage in accordance with the samples of the Asset Information Management workflow in Hong Kong in the preceding section.

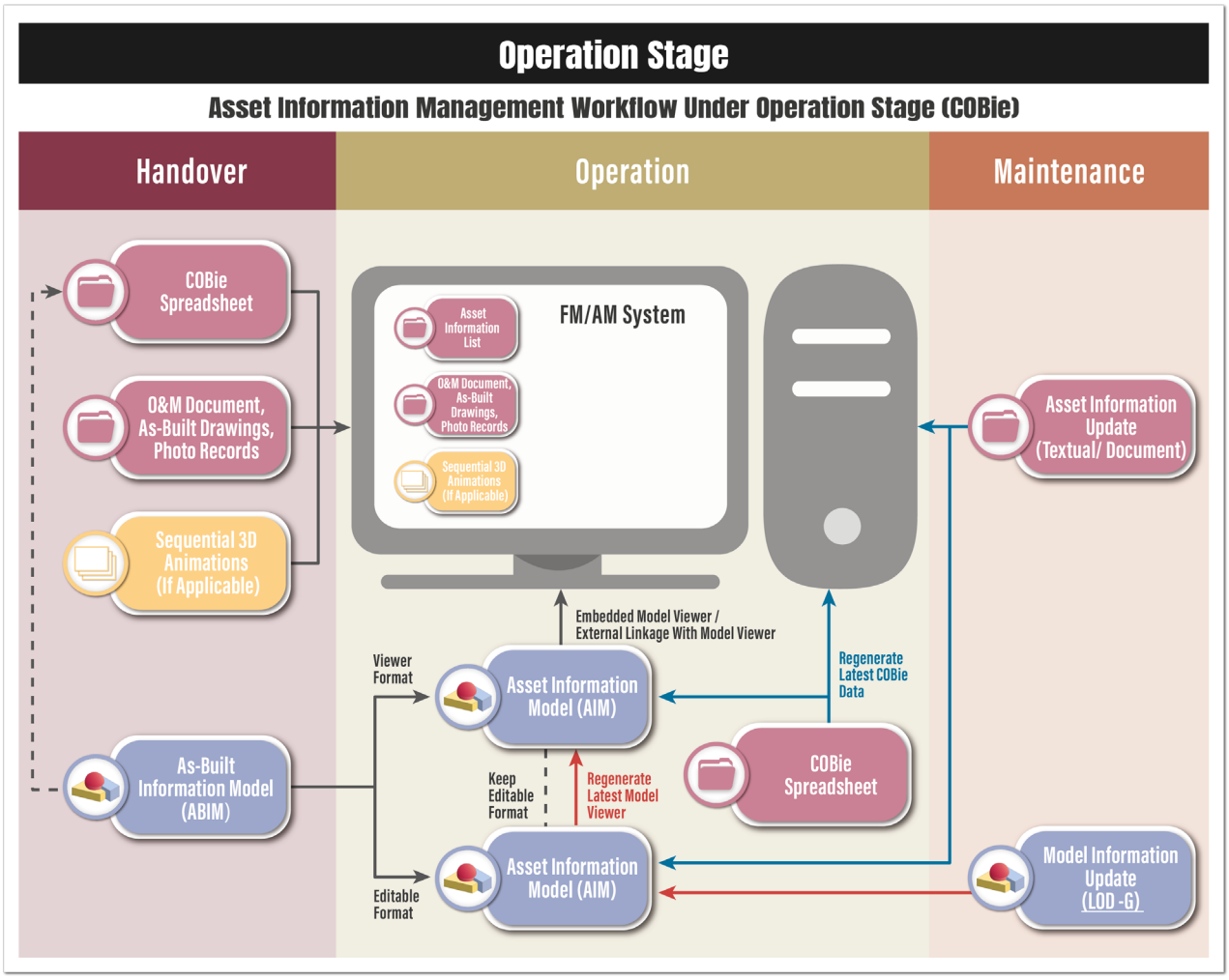


Figure 47 Asset Information Management Workflow under Operation Stage (COBie)

If Appointing Party's / Client's operation team has not established the Asset Information List Template but has adopted COBie system to transfer the asset data into their Asset Management / Facility Upkeep Management System, the asset information (textual) shall be input into the system through COBie spreadsheet and mapping with the corresponding documents. The Asset Management / Facility Upkeep Management System shall embed with 3D model viewer or external linkage with the model viewer.

The operation team shall also keep the editable format of the operation AIM for future graphical and locational model information (LOD - G) update. However, if there is any textual or document asset information (LOD – I / DOC) update, new COBie data shall be re-generated from the updated operation asset information model in order to avoid discrepancies between the data from the model and the Asset Management / Facility Upkeep Management database.

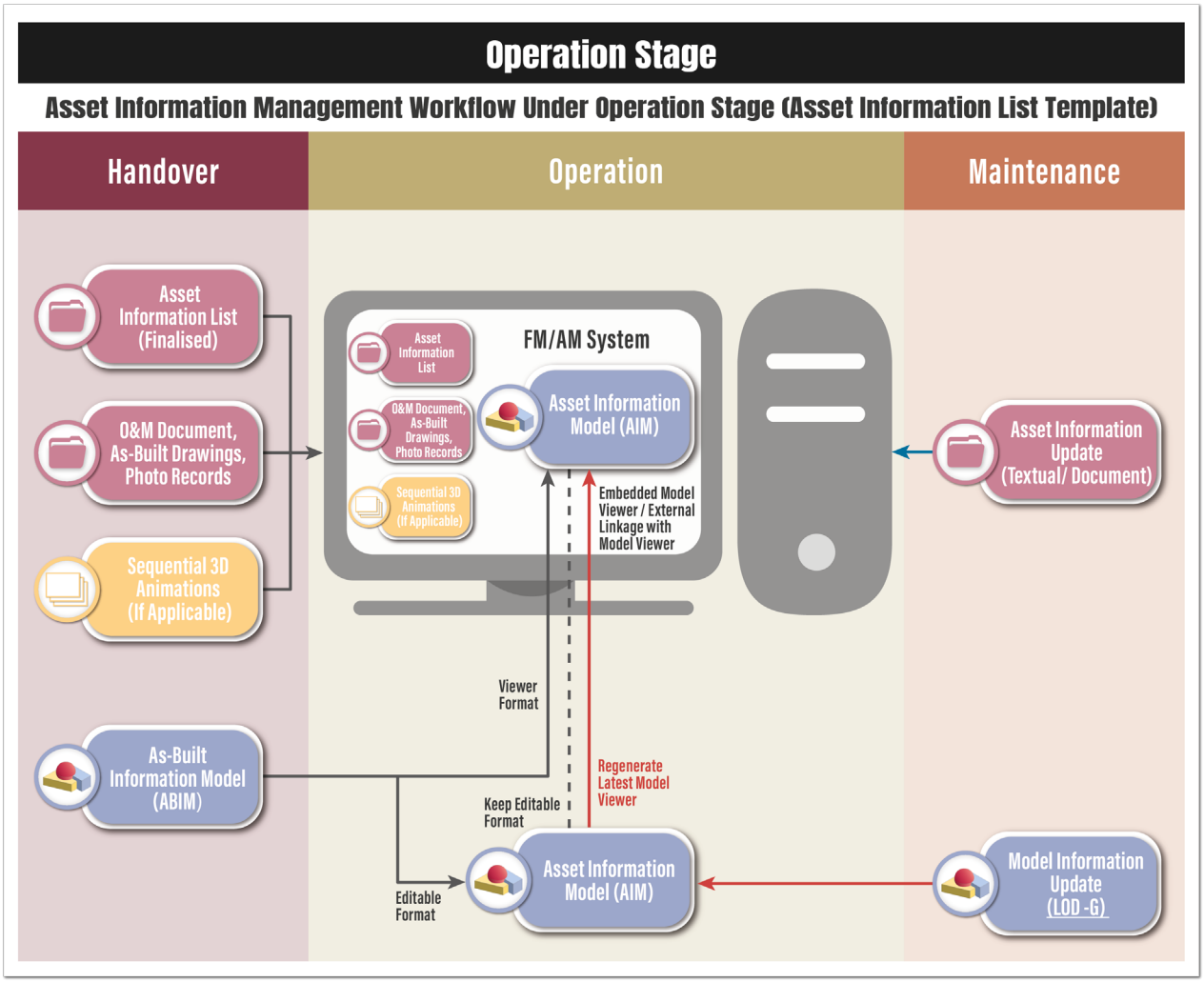


Figure 48 Asset Information Management Workflow under Operation Stage (Asset Information List Template)

If Appointing Party's / Client's operation team has established the conversion between the Asset Information List Template into their Asset Management / Facility Upkeep Management System, the asset information (textual and documents) shall be input into the system, with the embedded 3D model viewer or external linkage with the model viewer. The operation team shall also keep the editable format of the operation AIM for future graphical and locational model information (LOD - G) update. Any textual or document asset information (LOD – I / DOC) update shall be proceeded through the Asset Management / Facility Upkeep Management System directly.

5.8 Information Management Process across Various Work Stages

5.8.1 Contractual

The scope of works for BIM is a separate section to the traditional construction project's contract.

See Appendix A Information Management Assignment Matrix Example for more information on the checklist items for Invitation to Tender, Tender Response, Appointment and Mobilisation.

Refer to corresponding BIM Standards for industry practices:
CIC BIM Exchange Information Requirements (EIR) Template (BIM Specifications);
Sample Scope of Works for BIM;
Special Conditions of Contract for BIM; and
BIM Services Agreement for more information.

5.8.2 Collaboration

The BIM IP shall define how models will be exchanged and in what software formats. The BIM IP should include procedures or methods for managing shared models. To ensure the quality and integrity of information circulated within the project team, a collaborative platform – Common Data Environment (CDE) shall be used. All resources and information shall undergo all the review, authorizing and approval process before sharing. See Section 4 Common Data Environment (CDE) [aligned with ISO 19650] for more information.

BIM Coordinators should share their models with the BIM team at regular intervals. The BIM Manager and BIM Coordinators should agree on a schedule for the sharing and exchange of models. A discipline model should be provided in native or neutral (such as IFC) format for other disciplines' reference and use in relation to the project. It is recommended for the project team to map out a high-level coordination flow, which shows the interactions between the Appointing Party / Client and project team members.

To ensure the life cycle use of building information, information supporting common industry deliverables shall be provided in existing open standards, where available. For those contract deliverables whose open standard formats have not yet been finalised, the deliverable shall be provided in a mutually agreed format which allows the re-use of building information outside the context of the proprietary BIM software. The format could be any of the prevailing open standards, such as the Industry Foundation Classes (IFC) standard. The formats used should be specified in the BIM Execution Plan (BEP).

Although a discipline BIM Coordinator should check the accuracy and quality of the model before sharing with other consultants or contractors, Coordinators and Modellers should use the model for reference only, and should also check, verify and otherwise confirm the accuracy of the model. Where inconsistency is found in the model, the recipient BIM Coordinator shall promptly notify the model issuer's BIM Coordinator for clarification.

BIM is a collaborative process. If one party has not named something correctly, not followed a modelling protocol or made other errors, there is an opportunity for members of other disciplines to highlight these and request they are corrected by the originator.

It is recommended that the BIM Uses, Information Management Assignment Matrix, High and Detail Level Responsibility Matrix and LOD Responsibility Matrix should be circulated to all the parties (across the project team, design team, contractors and departments). The expectation of the project deliverables can be aligned. This can also facilitate each party to prepare for the

modelling approach, auditing mechanism and applications after receiving the Information Model and information from the preceding originator.

5.8.3 Cost Estimation

One of the benefits of producing an Information Model is the ability to extract accurate quantities directly from the model. Where the use of 5D as cost is proposed as a possible BIM Use, the requirements of the Quantity Surveyors' (QS) / Cost Manager and the needs of the Appointing Parties / Clients, designers, contractors and supply chain all need to be taken into account when defining the Level of Information Need. This does not however require that everything needs to be modelled graphically, but rather that the method of quantification to be used needs to be understood and agreed with all parties. This will ensure that the modelling process is as efficient as possible, but delivers the information required to facilitate effective cost delivery and management.

Whilst it is unlikely that Designers would model temporary works or intermittent working facilities, such as formwork, scaffoldings, etc., contractors may have other BIM Use requirements, such as health and safety to enable this. However, this information is unlikely to be available at the appropriate time frame and traditional methods of providing cost estimates from experienced QS / Cost Managers estimating are likely to be required for this, unless a specific use case can be established.

A clear trade-off between modelling effort and return should be established to identify benefits to the project and traditional fees may also need to be reviewed where effort is move from one Task Team to another. Furthermore, such adjustments should not be exhaustive nor induce notable extra effort. Otherwise, it defeats the primary objective for BIM - adding workload to the team rather than facilitating the delivery process. Therefore, identified calculation processes and the experience of QS / Cost managers in defining quantity requirements, whether based on initial space or area schedules to full bill of quantities extraction, should be used.

Quantity Take-Off (QTO) refers to the process of identifying elements of construction works that can be measured and priced. The QS / Cost manager shall be consulted about their information needs at an early stage and the BIM Execution plan (BEP) should include the QTO approaches for which elements are to be taken off manually or directly from the model. This may have an impact on how other Task Teams undertake their modelling process so should be established at the outset of a project. Furthermore, models in specific situations may not yield accurate quantities due to modelling practise (e.g.: such as issues with the joint relationship between a slab and a wall). Where these are known to occur, these shall be listed to the QS / Cost manager to seek suitable adjustments for the measurement or pricing.

Specific information deliverables such as model federation requirements, classifications and work breakdown structures should all be agreed as part of this process. Information Models can include information on everything surrounding the project: geospatial information, dimensions, materials, specifications, costs, etc. Quantity Surveyors can access or retrieve the quantities, lengths, areas, volumes, and information embedded in the elements from the models if these are considered appropriate. The format of information deliverables to meet software solutions used for cost estimating should also be considered.

One of the benefits of quantities extracted direct from models can be higher accuracy in quantity measurement. This in turn has demonstrated faster pricing capability and the delivery of more accurate tender returns within closer margins. Quantity comparisons between tender models and as-built models can aid to confirm variations and enable greater cost control. Benefits of higher accuracy in quantities can be just in time delivery which in turn reduces onsite storage requirements; a reduction in material waste as well as a reduce cost in disposing of waste. As standardised cost data from models become more widely available lifecycle costing as well as maintenance and operations cost modelling can also be added to the BIM Uses available.

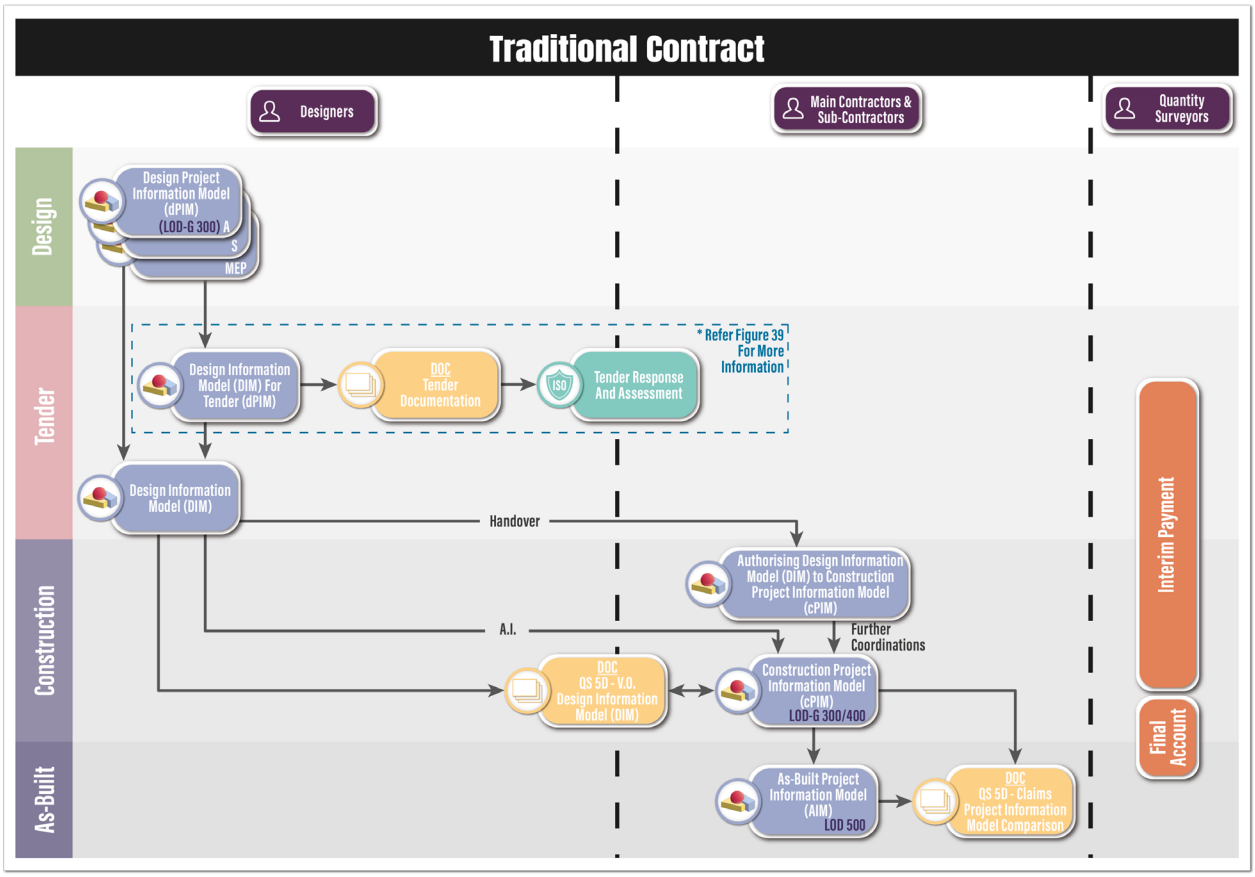


Figure 49 Cost Estimation Workflow for Traditional Contract

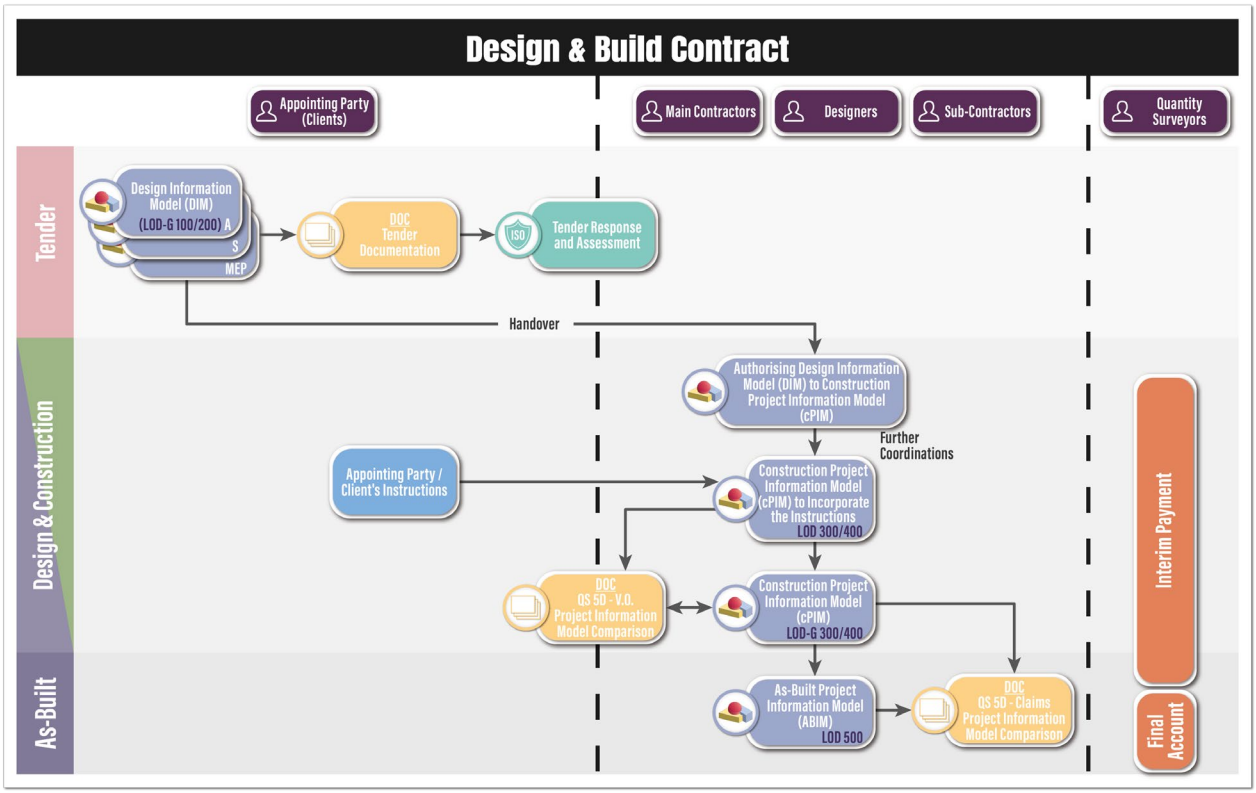


Figure 50 Cost Estimation Workflow for Design & Build Contract

5.8.4 Quality Assurance and BIM Audit

As BIM requires domain knowledge of building into the technological operations of Building Information Modelling, any incorrect representation of the building may result in incorrect output data and incorrect reports. As a result of the incorrect representation,

- **Failure to detect clashes:** with a poorly designed digital model, the project team may not be able to foresee clashes and resolve them beforehand. This could be costly to the project with many reworks requests on site.
- **Too many change orders:** while change orders are common in construction projects, an intelligently designed model can eliminate them altogether. A poorly designed model, on the other hand, may prompt too many change orders during construction.
- **Incorrect addition of critical information:** BIM embodies various dimensions such as 4D scheduling, 5D cost estimations. Adding these layers of information improperly to BIM could jeopardise the credibility and consistency of the model and hence the BIM Uses.
- **Compromised details:** an incorrect model will compromise the details of the project. Other team members may struggle to interpret the model and ultimately the entire project may be compromised. Moreover, an incorrect model may compromise the design scope.
- **Failure to meet building regulations:** ultimately, all buildings have to conform to local building regulations and relevant standards. An incorrect model may fail in conforming to building standards, building regulations and other good building practices. This includes standard naming conventions.

Also, there are many standards in general practices and specific information requirements from Appointing Party / Client. Thus a quality assurance process and **BIM Audit** are required to verify the Information Model compliance.

Regarding the resources to perform BIM Auditing, it is important to note that:

- BIM Auditing role shall be performed by resources same as BIM Manager;
- When BIM auditing carried out within the same discipline / organisation, resources of different project teams shall be adopted; or
- External or 3rd Party **BIM Auditor** shall be considered to avoid conflict of interest in order to provide unbiased views.

Level of Quality Assurance and BIM Audit Checks

	Checks	Definitions	Responsibility	Methodology	Frequency
1	**Visual check (LOD-G)**	Ensure there are no unintended model components and the design intent has been followed; Observe unreasonable modelling errors. Geometry satisfied required LOD-G level at the corresponding phase.	Own Discipline BIM Coordinator	Walk Through Meetings among stakeholders using Authoring, Viewing or Collaboration platform, CDE	Bi-Weekly or before Information exchange and end of each work stage.

	Checks	Definitions	Responsibility	Methodology	Frequency
2	**Interference check, Clash detection**	Detect problems in the model where two building components are clashing including soft and hard	Own Discipline BIM Coordinator	Clash Detection Software or Collaboration Platform, CDE BIM Co-ordination Meeting	Bi-Weekly or before Information exchange and the end of each work stage.
3	**Standards check**	Ensure that the Project BIM standards and BEP have been followed (e.g.: fonts, dimensions, line styles, levels, file naming and room numbering.) Object Standards Object Naming, Classification, Consist of 3D Geometry, Property / Parameters, 2D Symbol, Tag / Label / Annotation	Own Discipline BIM Coordinator	Review standards; automated plugin tools / code-checking software	Bi-Weekly or before Information exchange and the end of each work stage.
4	**Model data Integrity check (LOD-I)**	The process used to ensure that the project data set has no undefined, incorrectly defined or duplicated elements and satisfied the required LOD-G level at the corresponding phase. Reporting process on non-compliant elements and corrective action plans.	Own Discipline BIM Coordinator	Scheduling out from the Information Model for each category with metadata; Use of data analytic tools to compare with controlling standards and information requirements. Use of customised Automated plugins.	Bi-Weekly or before Information exchange and the end of each work stage.
5	**Document Deliverable Check (DOC)**	Ensure documentations are generated from the Single Source of Truth Information Model.	Own Discipline Leader. Different Domain Knowledge required.	Verify published documentation such as drawings and reports with Information directly generated from Information Model	Before each publication to document submission.

	Checks	Definitions	Responsibility	Methodology	Frequency
6	**Model Audit**	Spot check of the above four checks (items 1-4) carried out by Discipline BIM Co-Ordinator.	Cross Disciplines BIM Manager and / or BIM Auditor	Same methods stated above	Suggested Monthly and follow BIM Progress

Table 23 Level of BIM Audit Checks

See Annex 2 BIM Audit Checklist

5.8.5 Clash Analysis

At agreed milestones, models from different disciplines should undertake a coordination check, allowing involved parties to resolve potential conflicts upfront and avoid costly abortive works and delays at the construction stage.

Successful BIM coordination requires careful planning and a clear understanding of different types of coordination process i.e., design coordination, clash detection or space validation. The “design coordination” process resolves interferences between different disciplines. “Clash detection” is a BIM process where software tools are used to identify clashes between objects in the BIM files. “Space Validation” is a technique to check that headroom, operation clearances and delivery routes are reviewed in BIM.

In early coordination processes, entire models can be run against other models to determine the scope of interference, i.e., objects, elements and selection criteria, for future testing. However, it is important to recognise that not all conflicts detected are problems. Certain conflicts may have been intentional during the modelling process for the sake of simplifying the modelling process.

Proper element grouping and clash rules should be set up before running the respective coordination processes to :

- reduce time and resources spent on detecting false positives;
- hide elements that are unnecessary in the coordination process, for example, known issues that are to be resolved in later project stages; elements that do not impact the cost when changed on site, etc.;
- group particular elements for a specific type of coordination process, such as forming groups between the ceiling elements and a fire services model during a clash analysis.

The BIM IP shall define which clash detection software will be used for the project. The clash analysis shall be performed on the federated model to check the coordination of the discipline models. The analysis should check for spatial allowances and detect interferences between different systems. BIM Managers / BIM Coordinators from each discipline / organisation shall carry out the analysis for the internal self-clash check to resolve inter-discipline conflicts before sharing the model with other disciplines / organisations. Project Manager / BIM Auditor shall carry out the clash analysis.

Clash results need to be assessed in the context of the elements being analysed, and the type of clash detection software being used. For example, one issue that may occur is duplicate instances of the same co-ordination issue: for example, a pipe hitting steel could represent 20 clashes in a software analysis when in reality, it is only a single coordination issue.

To resolve clash conflicts, each BIM Coordinator carries out agreed changes on their discipline-specific model.

5.8.6 Drawing Production

2D drawings including presentation drawings, coordination prints, statutory drawings, contractual drawings, shop drawings and as-built drawings shall realise the principle of Single Source of Truth, shall be produced from the Information Model as far as possible.

Annotation information such as 2D symbols, dimensions and annotation text shall be extracted from the Information Model and linked to the 3D model as much as practical. Any change in the Information Model will automatically trigger the change in these annotations.

5.8.7 MMC / MiC / DfMA

Modern Methods of Construction (MMC), including Modular Integrated Construction (MiC) and Design for Manufacture and Assembly (DfMA) are approaches to construction which follows many of the principles applied to BIM and are often described as methodologies for 'improving quality through the application of efficiency'.

They seek to find the most effective method of delivering a built asset and therefore must consider reducing the resources required, including carbon, cost, time, waste, and labour, whilst also bearing in mind aspects such as health and safety, productivity, quality and certainty.

MMC approaches also allow for building to be deconstructed more safely, with components or even entire buildings able to be reconfigured or redeployed elsewhere. This supports a circular economy approach to construction, providing the ultimate form of sustainable construction; re-using available parts expends far less resource than creating new ones.

Manufacturing has used digital solutions and processes for many years and therefore the synergy between these modern manufacturing methodologies and the modern methods of construction enabled by BIM provides a common hypothesis with the application of factory or similar conditions to the delivery of construction projects.

The use of factory like conditions has many benefits which include[4]:

- Health and safety: Factory condition is shown as 80% safer than construction sites;
- Cost: Construction site labour is often more than twice as expensive as factory-based labour;
- Productivity: Factory productivity reaches 80 percent compared with 40 percent for a typical construction site; and
- Sustainability: Efficient factory environments reduce waste to 2 or 3%, often with 100% recycling.

To facilitate the advantages of any of the MMC approaches, the basic requirements must be identified early in the process and defined as one of the BIM Uses expected within the BIM Requirements. An MMC approach can also have an impact on the procurements routes chosen, the milestones, the LOIN, the software solutions and EIR. It will also impact on the BIM Implementation Plan including elements such as the model breakdown and federation strategy as well as the modelling methodology requirements which should be clearly identified in the BEP. Furthermore, the dPIM / cPIM for MMC / MiC / DfMA should be able to demonstrate the manufacturing of components, assembly, disassembly, repair and replacement method etc. for the components / modules etc.

[4] *Benefit figures based upon UK Government House of Commons select committee, Modern methods of construction Fifteenth Report of Session 2017–19*

6 Modelling Methodology and Requirements

This section of the CICBIMS provides information and recommended good practice on how to enable model development and build-up which will facilitate the efficient use or re-use of BIM data and models with modelling data consistency within a single discipline or with other disciplines.

This section includes:

- Definition of “how” each Information Model is to be created, developed and shared with another discipline;
- Model division and model structure (e.g.: structure, zones, levels, systems, etc.); and
- Drawing compilation and preparation for publication.

Good Practice

The following practices shall be followed:

- The methods adopted for data segregation shall be taken into account and be agreed by all internal and external disciplines to be involved in the modelling;
- No more than one building shall be modelled in a single file;
- A model file shall contain data from one discipline only (although exceptions may apply for Building Services where multiple disciplines converge);
- Further segregation of the geometry may be required to ensure that model files remain workable on available hardware;
- To avoid duplication or co-ordination errors, a clear definition of the data ownership throughout the life of the project shall be defined and documented;
- Element ownership may transfer during the project timeline – this shall be explicitly identified in the BIM Execution Plan (BEP); and
- Where multiple models make up a single project, a container model should be considered, whose function is to link the various assemblies together for coordination/ clash detection/ data sharing purposes.

6.1 Model Hierarchy

For a BIM project, it is NOT recommended to create a single large model and embed all the details in a single file. The project should be divided into logical groups (e.g.: by discipline, by trade) and link the models in the logical hierarchy for easy handling.

The principles of subdividing a model. For:

- *multi-user access;*
- *operational efficiency on large projects; and*
- *inter-disciplinary collaboration.*

Appropriate model divisions shall be established and elements assigned, either individually or by category, location, task allocation, etc.

The division shall be determined by the Lead Consultant in conjunction with the person responsible for co-ordination. How and when the model is split shall be defined in the BIM Execution Plan (BEP).

The model division shall be carried out in a logical manner that allows for other members of the design team to collaborate and/or assist with the model development without recourse to complicated introductions to the project methodology.

Where required, access permissions and model ownership shall be managed to avoid accidental or intentional misuse of the data.

Each discipline coordinator shall ensure that the BIM elements are aligned and reviewed across the model division interfaces to ensure continuity of the systems between the model divisions.

File Naming Convention

See Section 4.4.7 Information Identification for file naming convention.

Layer/ Workset / Container Naming Convention

Each discipline should provide the Lead Consultants with a full list of all layer/ workset/ container names to be used on the project. This list should be published to all members of the project team for information. The purposes of Layers and worksets are to provide information filters to control the presentation, visibility, and hierarchy of information to support the proposed uses, as well as the information development strategy.

6.1.1 Referencing

Referencing enables additional geometry and data to be used within a project. This may be either other parts of a project which are too big to manage in a single file or data from another discipline or external company.

Some projects require that models of single buildings are split into multiple files and linked back together to maintain manageable model file size. Various container files may exist to bring model files together for different purposes.

Task allocation shall be considered when dividing the model so as to minimise the need for users to switch between models.

When referencing, the models shall be positioned relative to the agreed project origin. The real-world co-ordinates of an origin point on the project shall be defined and coordinated in all models. See Section 6.4 BIM Project Coordinates for more information.

6.1.2 Inter Disciplinary References

Each separate discipline involved in a project, whether internal or external, shall have its own model and is responsible for the contents of that model. A discipline can reference another discipline's shared model for coordination.

Details of any discipline-specific requirements, such as the difference between Finished Floor Level (FFL) and Structural Slab Level (SSL), shall be fully documented in the BIM Execution Plan (BEP) and coordinated against agreed datums.

Ownership of elements shall be properly communicated and tracked through the project timeline (e.g.: floors may be created by the architectural team, but are then adopted by the structural team to form part of the load-bearing structure).

Each discipline shall be conscious that referenced data has been produced from the perspective of the author and may not be modelled to the required specification for other purposes. In this case, all relevant parties shall convene to discuss and agree the potential re-allocation of ownership.

Should a team develop a 'starter model' for a partner discipline, such as defining the structural model in conjunction with the architecture, this shall be done in a separate model which can then be referenced as required to allow the development of the continued design.

With models produced for Building Services, several disciplines may be collated in a single model, as a single piece of equipment may require connection to various services. In this scenario, the model may be split in various ways. This project-specific strategy shall be defined in the BIM Execution Plan (BEP).

6.2 Units and Precision

All of the BIM elements shall be modelled in consistent units, for example, in millimetres (mm) for buildings or in metres (m) for infrastructure projects; and angles (e.g.: degrees / radians measured clockwise or counter-clockwise).

All projects in Hong Kong use metric units of measurement. Alternate Imperial units for dimensions may be shown in brackets where needed.

6.3 Information Model Zones

Information Models should be broken down into individual discipline models. For large scale projects, each discipline model may be divided into separate zones.

Due to the scale, complexity or anticipated construction phases, the BIM Manager may separate the project and discipline models by zone, by subdividing the project into separate areas or levels. These zones will aid each team to model their discipline more efficiently by reducing the individual BIM file sizes. The zones and the zone file name codes shall be determined by the BIM Manager during the scheme design stage when the overall scale and complexity of the project is understood.

For building projects, zone boundaries could be structural joints or grid lines. For road projects they could be sub-divided by chainage distances.

6.4 BIM Project Coordinates

Information Models shall be set up to match true world coordinates and elevation in relation to the **Hong Kong 1980 Grid** cross referencing to the project gridlines and the **Hong Kong Principal Datum**.

The HK1980 Grid is a local rectangular grid system based on the HK80 Datum and Transverse Mercator projection. It is used in cadastral, engineering surveying and large scale mapping in Hong Kong. In Hong Kong, all heights and levels on land refer to the Principal Datum, which is formerly known as Ordnance Datum.

- The project origin point should be set-up as the basis for all of the model sharing systems among the different disciplines;
- The origin point and base point shall be defined as being located at 8YYYYY.YYY N 8XXXXX.XXX E;
- The rotation angle of the project should reflect True North. Where Project North is created it should only be used for identified sheet views and not used for any model coordination. The Ture and Project North criteria should be identified on the model splash screens; and
- The z coordinates shall be in metre in relation to the Hong Kong Principal Datum. The unit is written in XX.XXX mPD.

If a model is produced in a local co-ordinate system due to software functionality or limitations, the BIM coordinator or modeller that produced the file shall be responsible for providing clear instruction and documentation as to the origin x, y, z and bearing translations accompanying their BIM submission. The coordinate transformation shall be up to 0.001 metre precision.

Example ...
The Project Base Point is at 810500.000 N 835000.000 E on the Hong Kong 1980 grid.
The rotation angle of the Project North to True North is 0 degrees

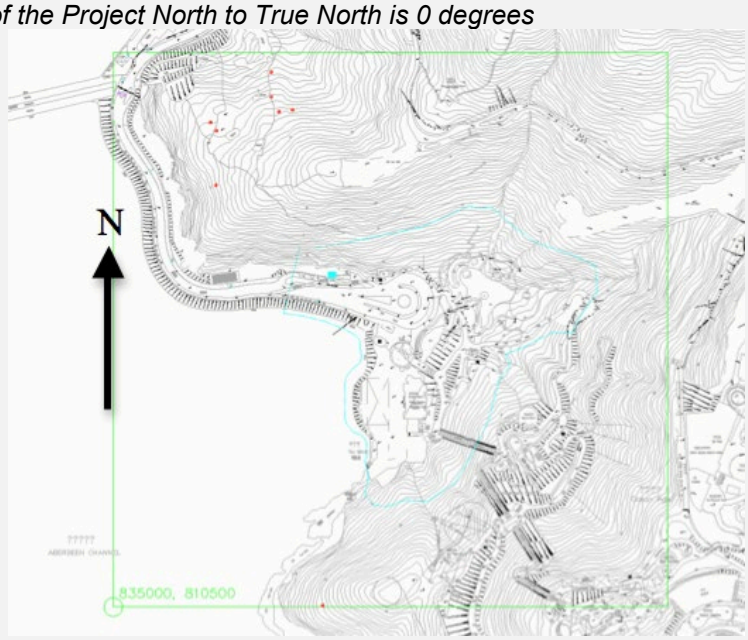


Figure 51 Example of location plan

6.5 Collaboration Procedures

The success of a BIM enabled project delivery process is highly dependent upon the level at which the entire design / construction team can collaboratively produce and manage information for the duration of the project. This section documents some of the management procedures that can be used for this purpose.

6.6 Collaboration Standards

In the absence of existing documented information requirements mandated by the Appointing Party / Client, the BIM team shall develop collaborative information requirements and BIM IP to be used on the project.

As a minimum, the BIM Requirements should meet the needs of Section 2 and the BIM Implementation Plan of Section 3.

6.7 Federated Model Creation

The BIM Manager shall manage the process of bringing all the various models together into a single “federated model”. This means a model consisting of linked but distinct component models and other data sources that do not lose their identity or integrity by being so linked. A change to one component model in a federated model does not create a change in another component model in that federated model.

If all designers are using the same modelling platform, then this could be undertaken within the native file format, or through export into an open transfer format (e.g.: IFC). If different platforms are used project review tools should be used to integrate and validate merged models. There may be benefits in using specific review software, even if all team members are using the same platform.

The method for creating and managing the federated model should be agreed and documented in the BIM IP.

6.8 Facilitating BIM Coordination

Face-to-face meetings in which Information Models are used for design review and clash detection/coordination are the preferred means of facilitating technical discipline coordination. However, different project circumstances will determine the most appropriate approach. Remote means of conducting BIM coordination, such as web conferencing, should only be considered when no other practical alternatives exist.

Consideration should be given to establishing a BIM Coordination Room (typically a physical room set aside for this purpose) configured and equipped to allow multiple parties to view the federated model. Coordination sessions should include all designers and engineers, BIM managers and BIM coordinators. Where clashes are detected, the resolution should be agreed and those impacted make the changes required in their respective models (not within the federated model).

The party responsible for providing the facilities shall be determined during the development of the BIM IP. A current clash list shall be produced and circulated to all parties (key stakeholders) before each meeting, then be updated once the revised models have been released into the federated model and a new clash detection process undertaken.

6.9 Discipline Modelling Guidelines

Refer to corresponding BIM Standards for industry practices:
CIC BIM Standards for Underground Utilities; and
CIC BIM Standards for Mechanical, Electrical and Plumbing (MEP).

For each discipline, these guidelines provide recommendations on how BIM elements should be modelled at different project stages.

6.9.1 Site Modelling Guidelines

The architect, civil engineer or land surveyor shall carry out the modelling of the site which should include topography, land uses, site formation, massing models of surrounding buildings, roads, infrastructure, and other features. The site model may consist of geological models of soil, fill and rock.

The Level of Information Need for each stage of the project shall be specified in the BIM IP. The Level of Information Need for each site element is described in Section 2.6 of this Standards and CIC BIM Standards – Architecture and Structural Engineering.

The site elements shall be created using the correct software tools and components for surfaces such as slopes, roads, site areas, pavements, geological strata etc.

Whenever possible, the modeller should use the actual level, dimension or thickness to model an area of the site accurately. The model elements shall contain the information and data available at each stage.

The site model may use the information available from the Lands Department and data from the BIM could be shared with Lands Department using the “Standard for the exchange of 3D spatial data”.

The ground investigation data may be available in AGS format and could be added to the site model for reference.

6.9.2 Architectural Modelling Guidelines

The Architect shall carry out the modelling at each stage of the project and the Level of Information Need of the elements produced at each stage should be specified in the BIM IP. The Level of Information Need for each architectural element is described in Section 2.6 of this Standards and CIC BIM Standards – Architecture and Structural Engineering.

The building or feature elements shall be created using the correct software tools and components for walls, slabs, doors, windows, roofs, etc. If the features of the BIM authoring tool are not sufficient for modelling an element, then it shall be created using other appropriate objects and defined with an appropriate “Type” name.

Building or feature elements shall be modelled separately for each floor level of a project.

2D lines and symbols may be used to complement the model when smaller elements are not modelled in 3D. For example, some elements smaller than 50mm may not need to be modelled. 2D standard details may be used on drawings produced using BIM authoring tools to complement overall drawing packages.

If an architectural models or structural elements, the size and location shall be as per the information from the structural engineers. It is recommended that the architect uses the structural model as a reference within the architectural model to avoid duplication of building elements.

Whenever possible, the architect and all other disciplines shall use the actual dimension, thickness, or detail to model an element accurately. The model elements shall contain the information and data available at each stage.

6.9.3 Structural Modelling Guidelines

The structural engineer shall carry out the modelling at each stage of the project and the Level of Information Need of the elements produced at each stage should be specified in the BIM IP.

The structural engineer may produce both a Information Model with actual member sizes and positions. The model shall be used for documentation.

The building or feature elements shall be created using the correct tools (Wall tool, Slab tool, etc.). If the features of the BIM authoring tool are not sufficient for modelling the element, the required building elements shall be created using other appropriate objects. In that case, define the "Type" of the element correctly.

A Structural BIM may include all load-bearing concrete, wood and steel structures, as well as non-load-bearing concrete structures. Building Elements shall be modelled separately for each storey or floor level. If the structural design includes precast or prefabricated components, the element can be modelled and incorporated into the model.

Reinforcement and steel joint details may be done in the detailed design or construction stage based on the project need and the capability of the BIM authoring tool and the requirements should be stated in the BIM IP.

2D drawings or standard details may be used to complement the Information Model when the elements are smaller than the agreed size, e.g.: Elements Smaller than 50mm do not need to be modelled. 2D drawings with standard hatching and annotations may also be used for loading plans.

Structural models may not be required at the concept or feasibility stage of a project. For new building projects, the structural engineer may provide alternative framing options as sketches for the architect to assess alternative design layouts for different massing models.

For existing buildings, the structural engineer may develop an initial model from record drawings if considered necessary for the project. The as-built model may be verified on site as part of a survey.

6.9.4 Mechanical, Electrical and Plumbing (MEP) Modelling Guidelines

The building services engineer shall carry out the modelling at each stage of the project and the Level of Information Need of the elements produced at each stage should be specified in the BIM IP. The model shall be used for documentation.

The building or feature elements shall be created using the correct tools (ductwork, pipework etc.). If the features of the BIM authoring tool are not sufficient for modelling the elements, the required building elements shall be created using other appropriate objects.

In that case, define the "Type" of the element correctly.

2D drawings or standard details may be used to complement the Information Model when the elements are smaller than the agreed size, e.g.: Elements (excluding pipes, cable trays and trunkings) smaller than 50mm do not need to be modelled. 2D drawings with standard annotations may also be used for schematic diagrams.

Building Services models may not be required at the concept or feasibility stage of a project. For new building projects, the building services engineer may provide mechanical, electrical, plumbing & drainage and fire protection options as sketches for the architect to assess alternative design layouts for different massing models.

For existing buildings, the building services engineer may develop an initial model from record drawings. The as-built model may be verified on site as part of a survey.

For details, refer to CIC BIM Standards for Mechanical, Electrical and Plumbing (MEP).

6.9.5 Underground Utilities Modelling Guidelines

The civil engineer or building services engineer shall carry out the modelling at each stage of the project and the Level of Information Need of the elements produced at each stage will be specified in the BIM IP.

The utility elements shall be created using the correct tools (cables, pipework etc.). If the features of the BIM authoring tool are not sufficient for modelling the element, the required utility elements shall be created using other appropriate objects. In that case, define the "Type" of the element correctly.

For existing utilities, the engineer may develop an initial model from record drawings. The as-built model may be verified on site as part of a survey.

For details, refer to CIC BIM Standards for Underground Utilities (UU).

6.10 Component Modelling and Its Drawing Presentation Style

All BIM objects/ components shall include, where appropriate, the following components:

	Requirements	Descriptions
1	3D geometry	To provide a spatial reference for coordination.
2	Property/ Parameter	To provide non-graphical information for tabulation, scheduling and other calculations.
3	2D-symbolic presentation	For drawing production indicating symbolised 2D representations.
4	Annotation/ Tag	For drawing production indicating embedded Information.

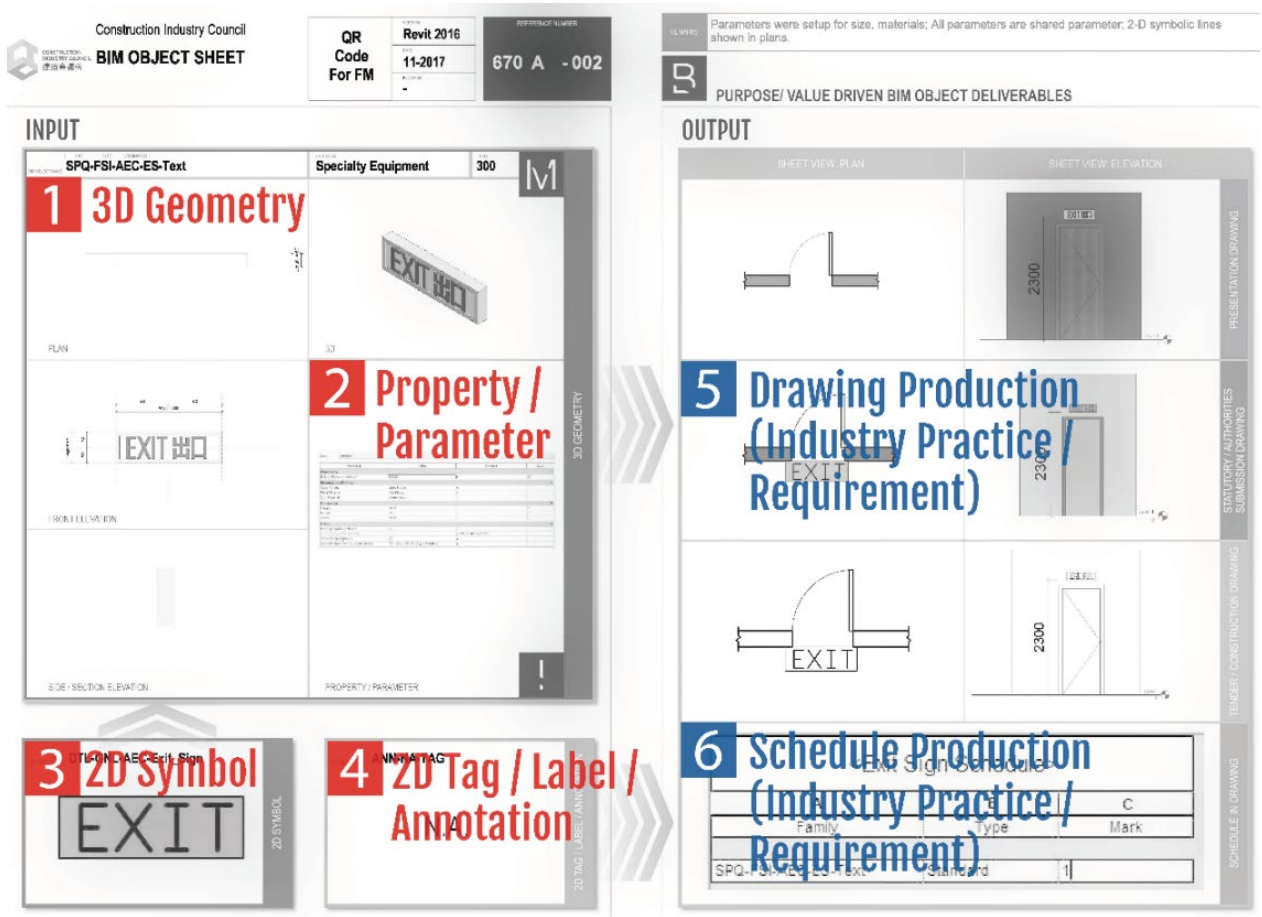


Figure 52 BIM Object Sheet extracted from CIC Production of BIM Object Guide

Refer to CIC Production Of BIM Object Guide - General Requirements.

6.11 Drawing Production

A key principle of the CICBIMS is that the architect, engineers and other involved in a project can produce an important deliverable – Drawing Production coming out from the BIM process. While drawings may bear Statutory and Contractual implications, drawings produced impose professional liabilities from the Design Author. Thus industry accepted presentation style amongst different BIM Uses, e.g.: presentation drawings, statutory drawings, construction drawings, shop drawings, fabrication drawings and as-built drawings all bear certain industry expectations.

The Appointing Party / Client shall specify when the consultants and contractors shall create and publish drawings such as plans, sections, elevations, details, images and schedules directly from the Information Models. Drawings or documents which are not produced from the building information models should be clearly labelled as "**2D CAD**" or "**NOT FROM BIM**".

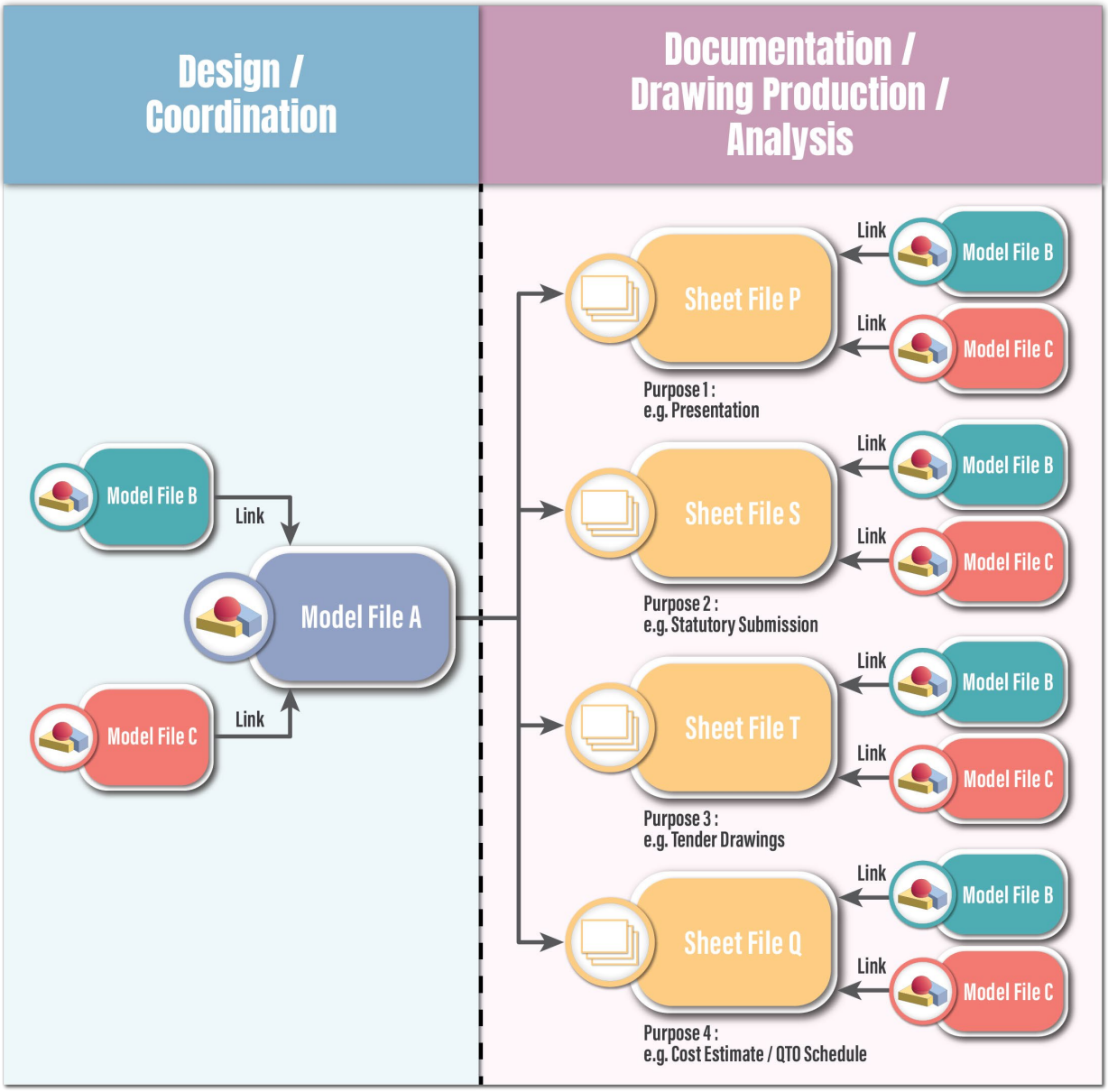


Figure 53 Relationship Between Model Files and Sheet Files

Figure 53 is a sample relationship between model files and sheet files. Drawings are composed of a series of relevant linked model files to achieve the necessary drawing requirements. However, it varies according to project needs, purposes and compositions of model hierarchy.

The BIM Manager and BIM Coordinators should agree and document the model file and sheet hierarchy, common naming convention and drawing numbering systems for model views, legends, schedules and drawing sheets. The drawing naming and numbering system may vary for design drawings, authority submission drawings, tender drawings, working drawings and as-built drawings. The numbers of drawings should be kept to a minimum and organised logically.

Each drawing shall contain design information solely for the intended use of the drawing. To maximise efficiency, a policy of minimum detailing without compromising quality and integrity shall be adopted and repetition of details should be eliminated.

There are existing standards and guidelines for BIM drawing production/ submission:

- *Refer to Guidelines for Using Building Information Modelling in General Building Plans Submission by Buildings Department; and*
- *Refer to CIC BIM Standards for Preparation of Statutory Plan Submissions by CIC.*

6.12 Preparation for Publication

Prior to the transmittal of the model, the file contents and structure need to be agreed. Drawing sheets from the BIM shall be published to PDF (preferred), DWF/ DWFx or another non-editable format, where they can be checked, approved, issued and archived as traditional documents.

Key Points to consider:

- *Does the drawing border and title block need amending for work-in-progress?*
- *Is there a need for a model matrix to explain the file structure?*
- *If Phasing and Design Options are utilised these will require an explanation.*

6.13 Model and Drawing Detail

At the outset of the project, consideration shall be given to the maximum level of detail to be included in the BIM. Too little and the information will not be suitable for its intended use; too much and the model may become unmanageable and inefficient.

It shall be dictated in the BIM Execution Plan (BEP) the point at which 3D geometry ceases and 2D detailing is utilised to prepare the published output.

Intelligent 2D line work shall be developed to accompany the geometry and enhance the required views without undue strain on the computer hardware. The use of 2D line work is not exclusive to detailed/ fabrication information.

Detailing and enhancement techniques shall be used whenever possible to reduce model complexity, but without compromising the integrity of the model.

6.14 Drawing Compilation

Drawing compilation and preparation for publication can be carried out in the following ways:-

i. Fully assembled compilation of views and sheets within the BIM environment (preferred).

ii. Export views in the form of output files for assembly and graphical enhancement using 2D detailing tools within a CAD environment. Exporting data in order to 'finish off' in CAD negates the advantages of the BIM data for coordination purposes and should be avoided where possible.

iii. Some drawings, such as large scale blow up details, typically drawn in CAD system, can be imported into BIM system and become BIM drawings to enhance a consistent drawing sheet numbering system.

iv. Schematic diagrams shall also be drafted in BIM system

Whichever methodology is chosen, the 3D model shall be developed to the same maximum extent before 2D techniques are applied.

When CAD or BIM data is referenced into a project, the project team shall ensure that the latest validated and checked design information is accessed directly from the project Shared folder structures when composing drawing sheets.

6.14.1 Sheet Composition Direct from within BIM

Drawing sheet composition from within a BIM environment shall be established through the linking of views, callouts, elevations and drawing sheets fully within the BIM authoring software.

Care shall be taken to ensure that any referenced data is available and visible prior to the publication of documentation from the BIM. References should be identified on the title sheet, along with their revision, status and authorisation.

6.14.2 Sheet Composition from Views / Output Files

Views exported from the BIM for sheet compilation in CAD, or for use as a background to other drawings in CAD, shall be placed on a plain border which clearly indicates the following:

- *The status and intended use of the data;*
- *Details of the origin of the data;*
- *The date of production or issue.*

Where output files are exported from the BIM for further 2D detailing in CAD, originators shall ensure that changes occurring within the BIM are correctly reflected and updated within the CAD files used to produce the final drawing.

If it is a requirement to export data from the BIM authoring software in 'Real-World' co-ordinates, then the export operation shall be performed from a model view (such as a floor-plan) and not from a compiled sheet view which should be scaled and/or rotated.

6.15 View Naming

Conventions in the naming and use of views are necessary to coordinate team activity and prevent inadvertent changes in the output documents. View naming shall be consistent across all references to that view. Renaming of views shall be carried out with care as any changes should be automatically reflected across all documentation.

6.16 Sheet Naming

Sheet naming shall be based on the document and drawing numbering protocols established for the project. These names automatically match the text as it appears in the title block and any schedules.

6.17 Presentation Styles

This section defines the criteria which ensure the plotted appearance of drawing output from the BIM is consistent and of the highest quality. It is not the remit of this Standards to dictate aspects covered by existing drawing standards. Most of the aspects covered in this section are software-specific and further information should be obtained from the relevant software providers.

Where Appointing Party's / Client's requirements deviate from those expressed in this Standards, project-specific template files shall be created. These shall be stored within the Project BIM Resources Library

6.17.1 Drawing Sheet Templates

All drawing templates shall be rendered and presented at one of a number of approved scales according to organisation's requirement or specification. Scales other than those approved should not be used. The templates shall also be in the standard format for sharing and interoperability.

Drawing Sheet Scales	
Scale	Description of detail
1:1000	Site layout / overall shape and layout
1:500	Site / overall layout
1:200	General layout
1:100	Shape, layout and construction elements
1:50	How the construction elements meet at junctions
1:5	Shape, dimensions and assembly of the separate construction elements
1:1	All model files shall be modelled at 1:1 Scale

6.17.2 Annotation

- Where no pre-defined text standards exist, the Text Style shall be **ARIAL NARROW**. The appearance of the text shall be consistent across a set of drawings;
- Annotation shall be legible, clear and concise;
- An opaque background may be considered as an aid to clarity;
- The text shall remain legible when drawings are plotted at a reduced size;
- Wherever practical lettering shall not be placed directly on top of lines or symbols; and
- Dot style arrowheads shall be used instead of closed filled arrowheads when calling up hatched/ shaded areas.

6.17.3 Text Assignment

All text shall be restricted to the following sizes:

Text height (mm) Plotted full size	Usage
1.8	General text, dimensions, notes used on A3 & A4 size drawings
2.5	General text, Dimensions notes
3.5	Sub-headings, General text, dimensions, notes – A0 drawings
5.0	Normal titles, drawing numbers
7.0	Major titles

Alternative text sizes shall not be used without clarification in the BIM Execution Plan (BEP).

6.17.4 Line Weights

The line weights control the graphical display of on-screen data as well as all published output. The plotted appearance of modelled components shall be consistent across the project.

The plotted appearance of modelled components shall be represented in a manner that provides 'depth' to the drawing and allows for adequate differentiation of elements cut in section, profile view and priority elements. For Line Patterns, Line Styles, Hatching and Filled Regions and View Templates, the modellers should need to refer to software-specific supplements.

Line Weight	1:10	1:20	1:50	1:100	1:200	1:500		Perspective	Annotation
1	0.1300	0.1300	0.1300	0.0600	0.0600	0.0600		0.0600	0.0600
2	0.1500	0.1500	0.1500	0.1300	0.0600	0.0600		0.1300	0.1300
3	0.1800	0.1800	0.1800	0.1500	0.1300	0.0600		0.1500	0.1500
4	0.2000	0.2000	0.2000	0.1800	0.1500	0.1300		0.1800	0.1800
5	0.2500	0.2200	0.2200	0.2000	0.1800	0.1500		0.2000	0.2000
6	0.3500	0.2500	0.2500	0.2200	0.2000	0.1800		0.2200	0.2200
7	0.4000	0.3500	0.3500	0.2500	0.2200	0.2000		0.2500	0.2500
8	0.5000	0.4000	0.4000	0.3500	0.2500	0.2200		0.3500	0.3500
9	0.6000	0.5000	0.5000	0.4000	0.3500	0.2500		0.4000	0.4000
10	0.7000	0.6000	0.6000	0.5000	0.4000	0.3500		0.5000	0.5000
11	1.0000	0.7000	0.7000	0.6000	0.5000	0.4000		0.6000	0.6000
12	1.4000	1.0000	1.0000	0.7000	0.6000	0.5000		0.7000	0.7000
13	2.0000	1.4000	1.4000	1.0000	0.7000	0.6000		1.0000	1.0000
14	3.0000	2.0000	2.0000	1.4000	1.0000	0.7000		1.4000	1.4000

Line Weight	1:10	1:20	1:50	1:100	1:200	1:500		Perspective	Annotation
15	4.0000	3.0000	3.0000	2.0000	1.4000	1.0000		2.0000	2.0000
16	5.0000	4.0000	4.0000	3.0000	2.0000	1.4000		3.0000	3.0000

Table 24 Recommended Line Weight

Name	Pattern															
	1		2		3		4		5		6		7		8	
	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value	Type	Value
Demolished	Dash	3	Space	1.5												
Elevation Swing	Dash	2	Space	1												
Grid Line	Dash	12	Space	3	Dash	3	Space	3								
Hidden	Dash	4	Space	2												
Overhead	Dash	2.5	Space	1.5												
Window Swing	Dash	6	Space	3	Dash	3	Space	3								
AEC_Centre	Dash	12	Space	4	Dash	4	Space	4								
AEC_Dash 1.5mm	Dash	1.5	Space	1.5												
AEC_Dash 3mm	Dash	3	Space	3												
AEC_Dash 3mm Loose	Dash	3	Space	6												
AEC_Dash 9mm	Dash	9	Space	4												
AEC_Dash Dot 3mm	Dash	3	Space	2	Dot		Space	2								
AEC_Dash Dot 6mm	Dash	6	Space	4	Dot		Space	4								
AEC_Dash Dot 6mm	Dash	6	Space	4	Dot		Space	4	Dot		Space	4				
AEC_Dot 1mm	Dot		Space	1												
AEC_Dot 4mm	Dot		Space	4												
AEC_Double Dash	Dash	15	Space	4	Dash	6	Space	4	Dash	6	Space	4				
AEC_Hidden 2mm	Dash	2	Space	1												
AEC_Triple Dash	Dash	15	Space	4	Dash	6	Space	4	Dash	6	Space	4	Dash	6	Space	4

Table 25 Recommended Line Pattern

6.17.5 Dimensioning

Default dimension styles should be provided for the consistent appearance of dimensions across all project documentation. New styles shall be added only if authorised.

Where practical, all dimensioning shall be created using relevant software dimensioning tools. The dimensions should not be entered as 'text' as they are purely graphic characters having no relationship with the underlying coordinates and will cause the relative positions of elements in a drawing to be compromised. The dimension text shall not be exploded or overridden.

Where practical avoid duplicate dimensioning either within a drawing or within a set of drawings.

Where practical, dimension lines shall not be broken and shall not cross other dimension lines.

Dimensions shall be placed on a drawing so they may be read from the bottom or right-hand side of the drawing.

Dimension text shall be placed above the dimension line and shall be clear of other lines so that they are legible. The default dimension styles shall not be overridden.

6.17.6 Drawing Borders and Title Blocks

Project-specific title blocks shall be created and stored in the Project BIM Resources folder.

6.17.7 Symbols

Standard symbols such as North point, section marks and call-ups shall be made available from within the project or central resource folder.

6.17.8 Section and Detail Marks

All sections and details shall be correctly cross-referenced in both directions i.e., cross reference to where the section/detail is actually drawn.

Drawing cross referencing shall not include the revision code.

7 openBIM

The openBIM concept represents an important direction for the development of BIM, emphasising a universal approach to the collaborative design, realisation, and operation of buildings based on open standards and workflows.

- **Importance of Open Standards:** Open standards are fundamental to the openBIM framework, ensuring interoperability between diverse software tools. This fosters broader participation among project stakeholders, regardless of their technological preferences.

- **Vendor-Neutral Collaboration:** By promoting vendor-neutral collaboration, openBIM allows project teams to work seamlessly across various platforms. This reduces dependency on specific software vendors, enabling more flexible and innovative project solutions.

- **Digital Twin Integration**: The openBIM approach supports the integration of digital twin concepts, facilitating real-time data exchange and analysis. This enhances the ability to monitor and optimise building performance throughout its life cycle.

- **Data Sustainability:** openBIM ensures the longevity and sustainability of project data, allowing valuable information to be leveraged for years to come. This minimises data redundancy and errors, creating a reliable repository for future use.

- **Enhanced User Demand:** openBIM energises the online product supply side by refining user demand searches, delivering precise product data directly into the BIM environment.

- **Encouragement in Hong Kong**: The adoption of buildingSMART International's IFC and BCF formats is encouraged in Hong Kong projects, promoting consistency and transparency in project coordination.

8 BIM Object Coding and Classification

While BIM captures the information flow across all phases in a project, the need for a common classification system to all parties is obvious.

OmniClass® is a comprehensive classification system for the construction industry. It can be used for filing physical materials or organising project information, but more importantly provide a classification structure for electronic databases and software, enriching the information used in those resources. It allows for organising, filtering, sorting, retrieving information, and standardising digital data exchanges.

OmniClass® provides a method for classifying the full built environment through the full project life cycle, from conception, design, and creation to its eventual demolition. It intentionally includes content from all types of construction. It may also be used to communicate exchange information such as that required by the Construction Operations Building Information Exchange (COBie), and other information generated during a project life cycle.

The classification of the model elements recommended in this Standards is the OmniClass® Table 23 – Products[1]. However, since Table 23 may not cover all the element categories for construction industry, any related categories listed in other OmniClass® tables could also be made reference to, such as Table 14 related to Topography.

Project BIM manager should add or remove any model elements from the matrix to suit project specific needs and make reference to the OmniClass® Table 23 system code and related categories tables in OmniClass®* if no project specific classification system is required by the project Appointing Party / Client.

[1] https://www.csiresources.org/standards/omniclass/standards-omniclass-about

Table 23	Products
OmniClass Number	OmniClass Title
23-11 00 00	Site Products
23-11 11 00	Ground Anchorages
23-11 11 11	Retaining Stabilizing Ground Anchors
23-11 11 11 11	Retaining Stabilizing Ground Components
23-11 11 11 11 11	Stabilizing Ground Anchor Heads
23-11 11 11 11 13	Stabilizing Ground Tendons
23-11 11 11 13	Stabilizing Ground Grouted Anchors
23-11 11 11 15	Stabilizing Ground Plate Anchors
23-11 11 11 17	Stabilizing Ground Rock Bolts
23-11 11 11 19	Stabilizing Ground Rock Anchors
23-11 11 11 21	Stabilizing Ground Anchor Tiebacks
23-11 11 13	Earth Reinforcement Anchors
23-11 11 13 11	Earth Reinforcement Soil Nails
23-11 13 00	Ground Improvement Products
23-11 13 11	Soil Stabilization Products
23-11 13 11 11	Soil Stabilization Injectable Chemicals
23-11 13 11 13	Soil Stabilization Pressure Grouting
23-11 13 11 15	Ground Freezing Soil Stabilization
23-11 13 11 17	Soil Stabilization Fills
23-11 13 11 17 11	Soil Stabilization Fill Blocks
23-11 13 11 17 13	Soil Stabilization Compressible Fill
23-11 13 11 19	Other Soil Stabilizations
23-11 13 11 21	Piped Field Drainage
23-11 13 11 21 11	Field Drainage Land Drainage Pipes
23-11 13 11 23	Field Drainage Blocks
23-11 13 11 25	Field Drainage Geocomposite Drains
23-11 13 11 25 11	Field Drainage Geocomposite Edge Drains
23-11 13 11 25 13	Field Drainage Geocomposite In Place Wall Drains
23-11 13 11 27	Geotextile Subsurface Drainage Filtration

Table 26 Sample OmniClass® Table 23 - Products

With the assigned classification number / system code, its application is summarised in the following workflow:

Common Classification and Coding are the keys to line up different tasks and deliverables across different stakeholders in different phases. Below is the possible workflow with common coding to facility understandable protocol in a general building phase.

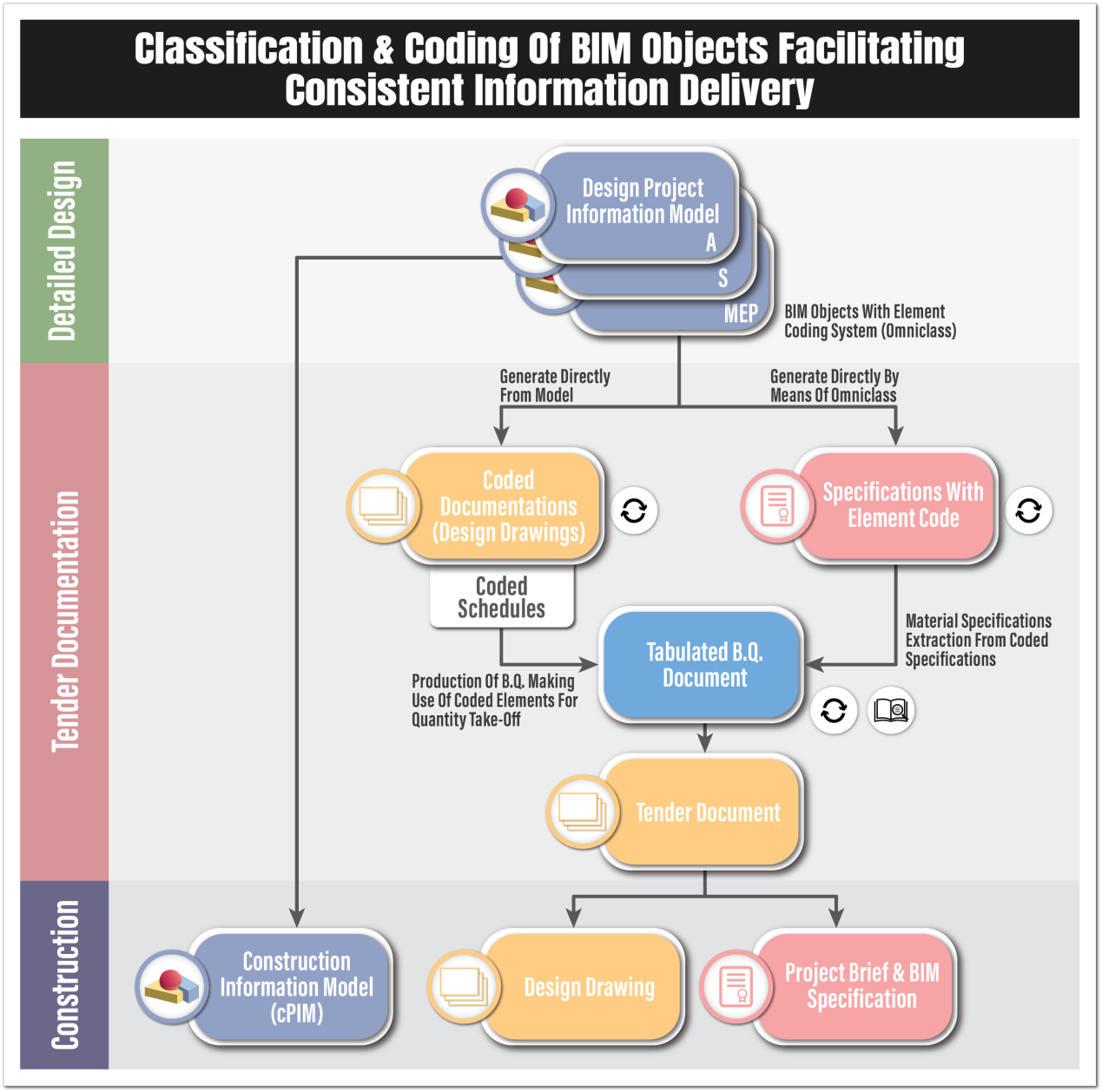


Figure 54 Classification and Coding of BIM Objects facilitating consistent information delivery

Annex 1 Hong Kong 'Local Annex' of ISO 19650-2:2018

It should be noted that CIC is not a recognised national standards body as identified within ISO 19650 and therefore the content is not provided in the form of a 'National Annex' as per Clause 0.2 of ISO 19650 Part 2 :2018. Quotation marks have been added to the term 'Local Annex' to indicate that it is not an official annex to ISO 19650. The 'Local Annex' still provides "localised guidance and advice on how to implement" as identified in Clause 0.2 of ISO 19650 Part 2 :2018.

LA.1 General

The role of the 'Local Annex' of ISO 19650-2:2018 is to clarify its implementation within a country or local region, but it should not preclude international cooperation and agreement. A 'Local Annex' should clarify any regional, language or country-specific usage. For international collaborative projects, an international or a specific Local or National Annex may be selected. This 'Local Annex' will assist the user in understanding the Hong Kong implementation of ISO 19650-2:2018 by translating the key terms and expanding on the requirements.

LA.2 Information Container Identification (ID)

LA.2.1 Clarification

ISO 19650-2:2018 (5.1.7.a) states: 'The project's Common Data Environment shall enable each information container to have a unique ID, based upon an agreed and documented convention [comprising] fields separated by a delimiter'.

LA.2.2 Information Containers As Files

In Hong Kong, the unique ID for information containers as files within a common data environment should be defined using the following fields, separated by a delimiter, in accordance with the following convention.

Max. Chars	Field 1		Field 2		Field 3			Field 4			Field 5			Field 6			Field 7	*Total Chars
	Project Code	-	Originator	-	Volume	(System)	-	Location	(Sub-Location)	-	Discipline	(Sub-discipline)	-	Type	(Characteristic)	-	(Sequential Number)	
Main Field	8	-	3	-	3		-	4		-	2		-	2				27
(Optional Sub-Field)				_		3	_		2	_		2	_		1	-	3	16
																	Total chars for main field and optional sub-fields including delimiters =	43

Table 27 Identification of information containers within a common data environment

(Optional Sub-Field): Supplement or adopt according to Project setting
**Total Chars: Total maximum characters for the fields including delimiters*

LA.2.3 Delimiters

In Hong Kong, the following delimiters are to be used:

- For a delimiter between Main Fields the Hyphen (-) or Minus character using Unicode Reference U+002D shall be used; and
- Where a delimiter is required between Main Fields and Sub-Fields if Sub-Field is required, then the Underscore (_) character using Unicode reference U+0332 shall be used.

LA.3 Field Codification

LA.3.1 Clarification

ISO 19650-2:2018 (5.1.7.b) states: 'The project's common data environment shall enable each field to be assigned a value from an agreed and documented codification standard'.
In Hong Kong, the codification for each field for file identification should be defined from the following codifications.

LA.3.2 Field 1: Project Code

A unique identifier should be used as project code (e.g. agreement, contract, future asset categorisation). A unique code should be assigned to each project stage (e.g. design, construction and operations) to determine the relationship with a particular asset.

It is suggested that the code for the project field be a maximum of eight characters in length.

LA.3.3 Field 2: Originator

A unique identifier based on Agent Responsible Code (ARC) should be used to indicate the model's responsible authoring party. The ARC is updated from time to time to include new or updated codes. See CAD Standard for Works Projects – Agent Responsible Codes (https://www.devb.gov.hk/en/construction_sector_matters/electronic_services/cad_standard/computer_aided_drafting/cad/index.html) for the full list.

To follow the ARC, it is suggested that the code for the originator field be a maximum of three characters in length.

LA.3.4 Field 3: Volume / (System)

A unique identifier should be used to indicate specific geospatial zone or volume. For the purpose of this Standards the word volume and zone are considered as synonyms.

(Optional) An identifier should be used to indicate a collection of interconnected model elements across main disciplines under a system (e.g., sewerage system, water supply system, highway). System is used to facilitate data sharing instead of creating multiple interdisciplinary data sets.

It is suggested that the code for the volume or system field be a maximum of three characters in length.

The following generic codes should apply.

- ZZ all volumes / systems; and
- XX no volume / system applicable.

Note: The list can be expanded with project-specific codes.

LA.3.5 Field 4: Location / (Sub-location)

An identifier should be used to indicate specific location (e.g., slope number, feature code, building code) for geospatial coordination and future asset management. Common abbreviation codes should be used as far as practicable in the format of "common location ID + optional identification suffix" (e.g., "FB1" for footbridge number 1).

For additional locations that cannot be sufficiently covered by common location ID with suffix, project-specific codes should be used.

(Optional) An identifier should be used to indicate a sub-location (e.g. level) within the same location. Additional sublocations, if any, should be defined in the project information standard. This field's value should not duplicate that of Location.

It is suggested that the code for location field be four characters in length while the code for Sub-location sub-field be two characters in length

The following generic codes should apply.

- ZZ multiple levels / locations; and
- XX no level / location applicable.

Note 1: This list will be expanded with project-specific codes.
Note 2: The location codes for assets other than buildings are likely to require project-specific codes.

LA.3.6 Field 5: Discipline / (Sub-discipline)

An identifier should be defined for each primary discipline to facilitate appearance settings and information filtering for interdepartmental coordination. In the case that data filtering and collaboration is required, Information Models should be authored separately for each sub-discipline.

It is recommended that the code for the discipline field be a maximum of two characters in length.

The following standard codes should apply.

ID	Discipline
AR	Architect / Architectural
BS	Building Services Engineer / Building Services
CD	Chilled Water Distribution
CL	Appointing Party / Client
CN	Contractor
CV	Civil Engineer
DR	Drainage Engineer
EL	Electrical Engineer / Electrical
FM	Facilities Manager
FO	Sewage
FS	Fire Services Engineer / Fire Services
FW	Fresh Water System
GE	Geotechnical Engineer
GI	Geographical Information System Engineers
GS	Gas Supply
HY	Highways Engineer
IN	Interior Designer
IR	Irrigation
LA	Landscape Architect
LS	Land Surveyor
ME	MVAC Engineer / Mechanical

ID	Discipline
PL	Plumbing Engineer
PM	Project Manager
PS	Electrical Power Supply
QS	Quantity Surveyor
RD	Road
RW	Raw Water System
SC	Sub-Contractor
SD	Stormwater Drainage
SF	Site Formation
SL	Slope
SR	Building Surveyor
ST	Structural Engineer / Structural
SW	Salt Water System
TL	Telecommunication
TP	Town Planner
WR	Recycled Water System
XX	General (non-disciplinary)
ZZ	Multiple disciplines for combined model

Note: This list can be expanded with project-specific codes.

Sub Discipline (Optional Sub-Field)
(Optional) An identifier should be used to indicate each sub-discipline appointment. Additional sub-disciplines, if any, should be defined in the project information standard. Additional abbreviations should be based on those commonly used as far as practicable.

It is recommended that the optional code for the sub discipline field be a further two characters in length and separated by an underscore (_) from the discipline.

The following example codes illustrate how these could apply.

ID (Discipline)		Code	Definition
AR	Architectural	**CW**	Curtain Wall
		MC	Modular Integrated Construction, Precast
		WD	Window
		DO	Door
		IM	Ironmongery
		BU	Build Maintenance Unit
		CL	Ceiling
		MW	Metal works
		PW	Painting works
		FE	Furniture and Fixed Equipment
		PS	Plastering
		FL	Flooring
		DM	Design for Manufacture Assembly

ID (Discipline)		Code	Definition
ST	Structural	**BG**	Bridge
		DM	Dam
		FD	Foundation
		NB	Noise Barrier
		RC	Reinforced Concrete
		SS	Structural Steel
		SU	Superstructure
BS	Building Services	**LE**	Lift & Escalator
		LV	LV Switchboard
		EG	Emergency Generator
		HA	Heating, ventilation, and air conditioning
		BL	Boiling System
		FP	Filtration plant
		UP	Uninterrupted Power Supply
		BA	Burglar Alarm
		RN	Radar and Navigation System
		ML	Microwave Link System
		TD	Timing & Display System
		AV	Audio Video System
		AU	Audio Electronics System
		RS	Radio system
		CC	Closed Circuit TV System
		BR	Broadcast Reception
		LG	Lighting
		EL	Electrical Distribution
		PT	Pneumatic Tube Transport
		PL	Plumbing
		DR	Drainage
		LD	Water Leakage Detection System
CD	Chilled Water	**N/A**	N/A

Note: This list will be expanded with project-specific codes.

LA.3.7 Field 6: Type / (Characteristic)

An identifier should be used to indicate the information held within the container. Type is not limited to information unique to Information Models.

(Optional) An identifier should be used to indicate the model's characteristic when relevant.

It is recommended that the code for the type field be two characters in length while one character for Characteristic.

The following standard codes should apply:

Code	Type of Document
AF	Animation file (of a model)
BQ	Bill of quantities

Code	Type of Document
CA	Calculation
CM	Combined model (combined multidiscipline model)
CO	Correspondence
CP	Cost plan
CL	Clash rendition
DB	Database
DR	Drawing rendition
FN	File note
HS	Health and safety
IE	Information exchange file
M2	2D model
M3	3D model
MI	Minutes / action notes
MR	Model rendition for other renditions, e.g.: thermal analysis, etc.
MS	Method statement
PP	Presentation
PR	Programme
RD	Room data sheet
RI	Request for information
RP	Report
SA	Schedule of accommodation
SH	Schedule
SN	Snagging list
SP	Specification
SU	Survey
VS	Visualisation

Note: This list will be expanded with project-specific codes.

LA.3.8 Sub-Field 7: Sequential Number

(Optional) A sequential number should be assigned when it is necessary to further distinguish the model from the others. It can also be used to distinguish other documents such as drawings.

The numbering for standard coding should be fixed within the project information standard and it is suggested that the code for the number field be a maximum of three numbers in length.

Note: Leading zeros should be used and care should be taken not to embody information that is present in other fields.

LA3.9 Total Length of Information Container Identifier

Delivery Team should study, understand and conform to appointing parties' specific software solutions, systems, and databases, taking into account the maximum overall path limitation. Delivery Team shall ensure data delivery is not impacted prior to proposing an optimum file length.

LA.4 Information Container Metadata

LA.4.1 Clarification

ISO 19650-2:2018 (5.1.7.c) states: 'The project's common data environment shall enable each information container to have the following attributes [metadata] assigned: status (suitability); revision; classification (in accordance with the framework defined in ISO 12006-2)'.
In the Hong Kong, attributes (metadata) for information containers within a common data environment should be defined from the following codification table.

LA.4.2 Status

Then following Status codes for information containers within a common data environment shall be used:

Status Code	Suitability	Description	Model files	Drawing files	Documents	Approval required
S0	Initial status or WIP	Initial state of all information in the WIP to indicate it is editable and only accessible by the authoring Task Team	√	√	√	X
For the Common Data Environment 'Shared' section						
S1	Shared for Co-ordination.	Available to be 'shared' and used by other disciplines as a background for their information.	√	√	X	X
S2	Shared for Information	Available to show current progress. Self-checked, reviewed and approved by authoring team	√	√	√	X
S3	Shared for Lead Consultant/ Contractor Review, Comment	Available for design review and requires comment from the Design Lead.	√	√	√	X
S4	Shared for Lead Consultant/ Contractor Review, Comment and Authorisation	Available to be Shared after design review, comment, and approval by Lead Consultant/ Lead Contractor. This is likely to be used where revisions include versions requiring decisions on which option should be taken forward.	√	√	√	√
S5	Shared for Appointing Party / Client Review, Comment and Accept	Available for Appointing Party / Client Shared after design review and approval, prior to Appointing Party / Client review and acceptance.	√	√	√	√
S6	Shared for PIM Stage Authorisation	Identified as suitable for stage milestone delivery	√	√	√	√

Status Code	Suitability	Description	Model files	Drawing files	Documents	Approval required
Status Code	Suitability	Description	Model files	Drawing files	Documents	Approval required
S7	Shared for AIM Authorisation and Acceptance	Acceptance as information suitable for inclusion in the Asset Information Model by the Lead Consultant and Appointing Party / Client	√	√	√	√
For the Common Data Environment 'Published' section						
CR	Construction Record	Acceptance as information suitable for inclusion in the Asset Information Model by the Lead Consultant and Appointing Party / Client	√	√	√	√

NOTE: This list can be expanded for project-specific codes and fixed within the project information standard.

LA.4.3 Revision

Preliminary revisions of information containers should be two integers, prefixed with the letter 'P'. Preliminary revisions of information containers in the 'work in progress' state may also have a two-integer suffix to identify the version of the preliminary revision or option, e.g.: P02.01 and P02.02.

Contractual revisions of information containers should be two integers, prefixed with the letter 'C'.

LA.4.4 Classification

Classification of information within information containers should be in accordance with Omniclass® (in Particular Table 23) as a comprehensive classification system for the construction industry.

LA.5 Information Model Exchange

LA.5.1 Clarification

ISO 19650-2:2018 (5.2.1) states: 'The appointing party shall establish their exchange information requirements to be met by the prospective Lead Appointed Party during the appointment.

In Hong Kong, Information Models exchanged with the appointing party, unless specified to the contrary within the project information standard, should include:

- Editable geometrical information in proprietary formats and open data formats[5];
- Non-geometrical information in open data formats[6], structured in accordance with COBie 2.4; and
- Documentation in open data formats[7].

LA.6 Project Information Requirements

LA.6.1 Clarification

ISO 19650-2:2018 (5.1.2) states: 'The appointing party shall establish the Project Information Requirements, as described in ISO 19650-1:2018 (5.3), to address the questions to which the appointing party needs answer(s) at each of the key decision points throughout the project.'

In Hong Kong, the appointing party's defined information exchange points (key decision points) within each of the principal work stages are to be used in defining the project's information requirements.

The identified project work stage codes may be used at the end of the project field as identified in LA.3.2 Field 1: Project Code.

[5] *NOTE 1 Open data formats recommended for information containers containing geometrical information include ISO 16739 (IFC) schema files in ISO 10303-21 and ISO 10303-28 (second edition).*
[6] *NOTE 2 Open data formats recommended for information containers containing non-geometrical information include ISO/IEC 29500-1 (xlsx) and ISO 16739 (IFC) schema files in ISO 10303-21 or ISO 10303-28 (second edition).*
[7] *NOTE 3 Open data formats recommended for information containers containing documentation include those in ISO 32000-1 and ISO 32000-2 (PDF).*

Annex 2

BIM Audit Checklist

Auditing items include but not limited to the followings:

1 Project Setup

- Project setup for individual practice, it is necessary to follow local professional practices;
- Consistent language for the project to ensure the information integrity among all parameters. e.g.: all English or all Chinese;
- Same base point for all parties for effective linkage;
- Hong Kong 1980 Grid MUST be referenced;
- Appropriate scale must be observed e.g.: civil in metre, building works in millimetres; and
- Resources such as templates, object libraries, data dictionary made available for all parties;
- General model status and project information / parameters;
- Project summary;
- Project discipline summary;
- Model authors comments;
- Software version and plugins etc. used;
- Current model size not to exceed certain software efficient working limitations;
- General notes;
- Conformity to naming standards;
- File naming and use of CDE for information exchange;
- View and sheet naming;
- BIM object / component naming;
- Check for BIM objects has properties defined in CIC Production of BIM Objects (General Requirements), including 3D geometry, parameters, 2D symbol and tag / annotations;
- Parameter / metadata naming according to AIR; and
- Room / space naming.

2 Information Model (LOD-G)

- Same categories for all similar BIM objects whenever possible;
- Appropriate LOD-G must be addressed at that particular stage as specified in BEP;
- Space containers to denote operation needs, in particular for MEP objects, or when insufficient information is known at the time of modelling;
- Repeated elements use BIM objects from library other than live in projects;
- Never over model than the actual LOIN. e.g.: details, as this will overburden the system;
- Observe maximum file size as hardware can handle with acceptable performance;
- Matching hardware, software and network to handle appropriate size of project;
- A checking mechanism to find out same overlapping objects which cannot be seen visually but will be detected in information;
- Purge unused geometry to manage file size;
- Real life natural material pattern and colour are the default for the real life model. Overriding presentation for DOC to suit for its industry practice e.g.: concrete wall shall be in grey colour but can be set to green for statutory submission and hatch pattern for construction drawings production;
- Symbolisation is the industry practice, especially in MEP discipline. Industry 2D symbols shall be embedded or linked into geometry to facilitate DOC production;

- Model coordinates;
- Classification / layer activated and used;
- Design options / phasing;
- Models and files linked;
- Check for overlapping elements;
- Scheduled quantity check;
- Family / components classifications and data continuity;
- Correct classification of intended use for model components, e.g.: ceilings not used as floors;
- A brief review of LOD-G / LOD-I / DOC and appropriateness to project stage;
- Asset coding in accordance to AIR; and
- The general perception of model integrity, detail and quality – common sense / visual inspection.

3 BIM / Asset Information (LOD-I)

LOD-I is the description of non-graphical information in a model element and will evolve as the project progresses. LOD-I requirements should be defined and agreed beforehand. As the required LOD-I varies for each project, this Standards is not able to provide an exhaustive list of information for each model element, but instead indicates a suitable approach for adoption.

It is recommended that the LOD-I required for the model elements should be determined to meet their intended usage and NOT over specified. This Standards indicates a suitable approach by giving examples of minimum LOD-I associated with typical elements / objects, namely LOD-I 100, LOD-I 200, LOD-I 300, LOD-I 400, LOD-I 500.

Example of LOD-I includes:

- Folder naming (See *Sections 4.5.3-4.5.7*);
- File naming (See *Section 4.4.7*);
- Classification / Workset naming (See Section 6.1);
- BIM Object naming (*Refer to CIC - Production of BIM Object Guide - General Requirements);*
- Parameter / Data naming (Make reference to AIR);
- Appropriate LOD-I must be addressed at that particular stage (See Section 2.6.3); and
- Information can be input directly onto the model or can utilise the external database to link information to model for better information management.

The following table lists the attributes commonly attached to individual model elements / objects.

Type	Information / Attributes	Data Type	Unit	Example	Descriptions	LOD-Information				
						100	200	300	400	500
General Properties	Equipment Type	Text	N/A	Pump	Equipment type (e.g.: pump, valves)	**R**	**R**	**R**	**R**	**R**
	Equipment Name	Text	N/A	AHU-1F-01	Equipment name* (Follow the rule by Appointing Party / Client)		**R**	**R**	**R**	**R**
	Locations	Text	N/A	AHU Room	Locations* (Follow the rule by Appointing Party / Client)		**R**	**R**	**R**	**R**
Design Properties	Design properties of the equipment, using a Chiller as an example						**R**	**R**	**R**	**R**
	Cooling Capacity	Number	kW	214	Cooling capacity of chiller		**R**	**R**	**R**	**R**
	Rated Power Input	Number	kVA	30	Rated power input		**R**	**R**	**R**	**R**
Classification Properties	Classification Title	Text	N/A	Chillers	Classification title agreed by Appointing Party / Client if necessary			**R**	**R**	**R**
	Classification Code	Number	N/A	23-33 21 00	Classification coding agreed by Appointing Party / Client if necessary			**R**	**R**	**R**
Manufacturer Properties	Brand	Text	N/A	ABC	Name of the brand				**R**	**R**
	Manufacturer	Text	N/A	DEF	Name of the manufacturer				**R**	**R**
	Model No.	Text	N/A	234	Model number of the equipment				**R**	**R**
	Serial No.	Text	N/A	B5678	Serial number of the equipment				**R**	**R**
	Weight	Number	kg	50	Weight of the equipment				**R**	**R**
Condition Properties	Commission Date	Text	N/A	05/05/2016	Date of equipment commission				**R**	**R**
	Installation Date	Text	N/A	03/03/2016	Date of the equipment installation				**R**	**R**
	Life expectancy	Number	Year	5	Life expectancy of the equipment				**R**	**R**
Specification Properties	Product Specification	Hyperlink	N/A	http://www.cic.hk	Hyperlink of the specification or technical documents. The file path/directory should be agreed by Appointing Party / Client				**R**	**R**
Verification Properties	Verification Method	Text	N/A	Laser Scanning	The field verification method used for verifying the as-built elements					**R**

R: Required

Table 28 Sample of LOD-Information for MEP (Appointing Party' Asset Information Requirement)

*** If no naming convention is provided by the project Appointing Party / Client, the naming conventions stated in the latest EMSD BIM-AM Standards and Guidelines are recommended.**

4 Documentation (DOC)

- Check Presentation Style setting such as line weight, colour, font, annotation sizes, 2D symbols to be used;
- Standard Title Block;
- Sheet numbering system;
- Sheet versioning;
- Appropriate DOC must be addressed at that particular stage to suit its purpose. e.g.: Submission drawings, tender drawings, construction drawings, as-built drawings etc;
- Professional domain knowledge must be applied to DOC as deliverable when statutory and contractual liabilities are involved.
- Geometry representations on published documents from Information Model;
- Information on published documents from Information Model;
- Identify and review non-Information Model generated presentations such as added text, 2D linework, un-associated dimensions etc; and
- Published documentation complies and satisfies with its intended **BIM Use** requirements.

5 BIM Audit Report

- Feedback / Recommendations to Appointing party at regular interval; and
- Review model Errors and Warnings and record and review any Key Performance Index (KPI).

Annex 3

Way-Forward for BIM Development

Over the recent years, the potential of BIM adoption has been extended extensively to a point even beyond its initial use in building and construction applications. The following forward-looking aspects outline the extended way in which BIM can be further developed. They may not be applicable for every project but certainly provides some glimpses of integration with other disciplines to achieve significant value in the industry.

1 Digitalisation

Digitalisation is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities. It is the process of moving to a digital business. The construction industry has long been a paper-centric practice – Drawings, specifications, B.Q., tender, contracts, instructions, catalogues, inspection records, inspection reports, engineering analysis reports, etc.

Transformation of a paper-based workflow to a digital workflow requires the collaboration of policy, technology, and people changes – a cultural change. BIM with a coding system brings that links all the processes together throughout the project development life cycle. Organisation that embraced BIM digitalisation brings accuracy, quality, suitability and productivity to the projects.

Suggested steps for an organisation to transform into a BIM-literate Company.

1. Get to know BIM;
2. Communicate the change to staff;
3. Account for software and hardware needs;
4. Develop a management plan;
5. Start a pilot BIM project, train the pilot team;
6. Document preferred processes;
7. Cultivate BIM champions;
8. Train and transition other teams with qualified trainers, get BIM certified;
9. Integrate with other models;
10. Expand and innovate with BIM; and
11. BIM integrates with other technologies.

2 Digital Work Supervision System (DWSS)

Development Bureau Technical Circular (Works) 3/2020 sets out the policy and requirement on the adoption of the Digital Works Supervision System (DWSS) aiming to enhance the standard and efficiency of works supervision as well as quality and safety of works.

The forms or records in the DWSS shall be designed to include fields to store the Object ID / Location ID, for the purpose of interfacing with Information Models. Hence, BIM information can be linked and accessed to the DWSS information for better collaboration.

Agreed data format and APIs are yet to be developed to facilitate the viewing of digital data from Information Model or vice versa.

3 Common Spatial Data Infrastructure (CSDI)

While the built asset environment involves many different professionals, most of the time, they have spatial implications. Different sectors use different software platforms to meet their own requirements. BIM is certainly part of the process. As a result, much useful information generated is limited to their use and may not be compatible with each other. Thus it is an initiative from various government departments to align all these useful spatial data by having an aligned platform so that this information can be made useful. CSDI initiate the followings:

- Develop Common Spatial Data Infrastructure (CSDI) to facilitate sharing of geospatial data across government departments and government-to-business (G2B) applications, including the launch of CSDI portal, 3D digital map, electronic submission hub for building plans;
- Enhance data interoperability;
- Promote the use of geospatial intelligence and applications;
- Improve geospatial capability and knowledge;
- Increase accessibility and usability of spatial data; and
- Foster a collaborative culture.

This Standards will be further required to align with digital data from other sources in due course.

4 BIM Standards Harmonisation - Shareable BIM

Government works departments are working to align and formulate common BIM standard(s) and guideline(s) on naming conventions and attributes of BIM objects/models. The focus is on aligning the modelling requirements of BIM models that would be extracted to as shareable BIM data for data sharing across government departments on BIM data repository; integrating BIM and Geographic Information System; and updating Lands Department's 3D Map.

The fundamental idea of the sharable BIM is to have a lightweight BIM information sit preferable in a cloud environment for sharing purpose, of which relevant information (not all) can be retrieved as per user department's need.

This involves the collection of BIM information from various sources, the organisation and lightening of the Design and As-Built *Information Models* via a conversion engine, and the posting all the BIM information onto an access-controlled cloud. Current study is ongoing at New Development Area to achieve this objective.

5 Block Chain

While ISO 19650-5:2020 has just rolled out the requirements of information security in 2020, its processes, methodologies and implications are not yet well known to local BIM practitioners. At the same time, the ownership of BIM information, copyright, authentication of shared information, traceability of information sources, etc are of growing concerns from the industry.

Recently in the I.T. arena, Blockchain is a distributed database system that acts as an "open ledger" to store and manage transactions. Each record in the database is called a block and contains details such as transaction timestamp and links to the previous block. This characteristic makes it impossible for anyone to change the information about the records retrospectively. Moreover, since the same transaction is recorded on multiple distributed database systems, the technology is considered safe in design.

It appears that the Blockchain technology can satisfy the project information delivery of BIM data nature among large number of stakeholders within a project and it provides an audit for historical modifications even in mobile cloud with big data sharing.

Despite at this infancy stage, academic research is on-going and some pilot testing is under study. It is expected that Blockchain can generate a unified format to support future open data sharing, data audit, and data provenance in Information Models and CDE applications.

6 GIS - BIM Integration

While BIM is the digital representation of a built asset; geographic information system (GIS) is a framework for gathering, managing & analysing data. GIS analyses spatial location and organises layers of information into visualisations using maps and 3D scenes.

Both GIS and BIM deal with the issues of graphical, non-graphical information and documentation. Each has different technology, delivery formats and data standards to support their approach and resolve their perspective challenges.

Both require accurate validated information to make informed decisions and the creation and application of defined data structures will support both approaches.

The development of open formats using API based approaches is recommended by both to facilitate information exchanges. The integration of BIM and GIS involves the matching of entities in the IFC (BIM) and the CityGML (GIS) schema. However, not all the entities are well defined and documented under these two schemas and this will lead to confusion and inconsistencies in the matching process.

It is essential for ACE professionals such as architects, planners, engineers, surveyors, landscape architects and facility managers to identify what kind of tasks would involve spatial data analysis and to recommend whether these tasks should better be carried out in a BIM or GIS environment

The professionals should spell out the most desirable level of accuracy that would be required for various tasks of a development project, including positioning, length and area measurement as well as the intended applications for designing the data flow from BIM to GIS at different stage of project life cycle.

The problem of data loss and inaccuracy during the integration process is rather common. It is essential to identify all these problems and technical solutions to overcome them. Current study of BIM-GIS integration is ongoing at New Development Area.

With the integration of GIS (geospatial) and BIM, interoperability between different systems is the most fundamental requirement. The industry shall refer to ISO/TR 23262:2021 on GIS/GIS interoperability for international standards.

7 Digital Twin

Digital twin refers to a digital replica of physical assets, processes and systems that can be used for various purposes. A digital twin is more than just a digital model of a building or structure – it's an operations model.

A good digital twin definition is a virtual model of a physical asset that contains real-time data of that asset during its operation. With this information, the current asset condition can be quickly determined, and any historical operating data interrogated as well. The aim of the digital twin is to understand how the daily operations affect the structure or asset in real-time and use this information for informed decision-making.

7.1 BIM and The Digital Twin Model

As BIM creates a virtual model of an asset which assists with its design, construction and operation, it contains much of the information that a digital twin would require, making it the perfect basis for a digital twin. By incorporating the real-time data – i.e., from sensors – real-time analysis based on current operating conditions such as traffic flows, temperature and other environmental factors can be undertaken. Not only can this help with predicting maintenance issues, it will also allow the comparison of actual conditions to be compared against the analytical or as-designed values. With accurate data, future performance can be evaluated and improved, efficiencies can be found, and remediation activities can be automated.

7.2 The Future of BIM and Digital Twins

As a digital twin has significant value for owners and operators, it is not difficult to imagine a time when "BIM" and "digital twin" become interchangeable terms. In many ways, the digital twin is the next evolution of the Information Model, as BIM has enabled the design, construction, operation and maintenance cycles of an asset to be blended together. As this evolution continues, tools that can support the entire building process from the cradle to the grave will become increasingly important.

8 Smart City

Innovation and Technology Bureau published the Smart City Blueprint for Hong Kong in 2017 in which six recommended areas, namely: “Smart Mobility”, “Smart Living”, “Smart Environment”, “Smart People”, “Smart Government” and “Smart Economy”. Three of which are BIM related and form the foundation of the Smart City:

1 Smart Mobility:

- Real Time Parking Vacancy: and
- Walkability and way Finding.

2 Smart Living:

- Green Building Design; and
- More sustainability Building Design.

3 Smart Government:

- Adopt Building Information Modelling (BIM) for major government capital works projects;
- Acceptance of BIM Format for General Building Plan (GBP) Submission;
- Study on the integration of BIM/GIS;
- Setting up a BIM Data Repository; and
- develop Common Spatial Data Infrastructure (CSDI) to facilitate the sharing of geospatial data across government departments and government-to-business (G2B) applications, including the launch of the CSDI portal, 3D digital map, electronic submission hub for building plans.

4 Smart Environment:

- Green and intelligent Building and Energy efficiency.
- Promote retro commissioning and building based smart / IT technologies

While BIM initiates the first information source for the built asset environment; and Smart City is a collection of information from various domains to create new insights and values for the smarter living, the need for accurate and complete data integrity is of paramount importance to the Smart City development. This standard intends to maintain a high level of BIM information quality which in turn will contribute to the betterment of Hong Kong living environment.

Appendix A

Information Management Assignment Matrix Example

R = Responsible for undertaking activity;
A = Accountable for activity completion;
C = Consulted during activity; and
I = Informed following activity completion.

ISO I.D.	Information Tasks	Appointing Party / Client	Lead Consultant / Lead Contractor	Task Team
5.1 ASSESSMENT & NEED				
5.1.1	Appoint individuals to undertake the Appointing Party / Client information management function	R		
5.1.2	Establish the project's information requirements	R		
5.1.3	Establish the project milestones	R		
5.1.4	Establish the Project Information Standards	R		
5.1.4a	Consider the exchange of Information	R		
5.1.4b	Consider the means of structuring and classifying information	R		
5.1.4c	Consider the method of assignment for Level of Information Need	R		
5.1.4d	Consider the use of information during the operational phase of the asset	R		
5.1.5	Establish the project's information production methods and procedures	R		
5.1.5a	Consider the capture of existing asset information	R		
5.1.5b	Consider the generation, review, or approval of new information	R		
5.1.5c	Consider the security or distribution of information	R		
5.1.5d	Consider the delivery of information to the Appointing Party / Client	R		
5.1.6	Establish the project's reference information and shared resources	R		
5.1.6a	Consider the existing asset information	R		
5.1.6b	Consider the shared resources	R		
5.1.6c	Consider the library objects	R		
5.1.7	Establish the project's common data environment	R		
5.1.7a	Enable each information container to have a unique ID	R		
5.1.7b	Enable each field to be assigned a value	R		
5.1.7c	Assign Status codes (Suitability), Revision & Classification	R		
5.1.7d	Ability to transition between states (WIP, Shared, Publish & Archive)	R		
5.1.7e	Recording of user and date information	R		
5.1.7f	Controlled access at file level.			
5.1.8	Establish the project's information protocol			

ISO I.D.	Information Tasks	Appointing Party / Client	Lead Consultant / Lead Contractor	Task Team
5.2 INVITATION TO TENDER				
5.2.1	Establish the Exchange Information Requirements	R		
5.2.1a	Consider the Organisational Information Requirements	R		
5.2.1a	Consider the Asset Information Requirements	R		
5.2.1a	Consider the Project Information Requirements	R		
5.2.1b	Establish the Level of Information Need	R		
5.2.1c	Establish the acceptance criteria for information requirements	R		
5.2.1d	Establish the supporting information	R		
5.2.1e	Establish the dates relative to milestones and key decision points	R		
5.2.2	Assemble reference information and shared resources	R		
5.2.3	Establish tender response requirements and evaluation criteria	R		
5.2.4	Compile invitation to tender information	R		
5.3TENDER RESPONSE				
5.3.1	Nominate individuals to undertake the information management function		R	
5.3.2	Establish the Delivery Team's (pre-appointment) BIM execution plan		R	
5.3.2a	Names and résumés of prospective individuals for information management roles		R	
5.3.2b	information delivery strategy		R	
5.3.2c	proposed federation strategy		R	
5.3.2d	Delivery Team's high-level responsibility matrix		R	
5.3.2e	proposed additions or amendments to the project's information production methods and procedures		R	
5.3.2f	proposed additions or amendments to the project's information standard		R	
5.3.2g	proposed schedule of software (including versions), hardware and IT infrastructure		R	
5.3.3	Assess Task Team capability and capacity		R	C
5.3.3a	capability and capacity to manage information		R	C
5.3.3b	capability and capacity to produce information		R	C
5.3.3c	availability of information technology (IT) within the Task Team		R	C
5.3.4	Establish the Delivery Team's capability and capacity		R	
5.3.5	Establish the Delivery Team's mobilisation plan		R	
5.3.6	Establish the Delivery Team's risk register		R	
5.3.7	Compile the Delivery Team's tender response		R	
5.3.8	Activities for tender response		R	
5.4 APPOINTMENT				
5.4.1	Confirm the Delivery Team's BIM execution plan		R	
5.4.1a	Confirm the names of the information management function		R	

ISO I.D.	Information Tasks	Appointing Party / Client	Lead Consultant / Lead Contractor	Task Team
5.4.1b	Update the information delivery strategy		R	
5.4.1c	Update the high-level responsibility matrix		R	
5.4.1d	Confirm and document the proposed information production methods and procedures		R	
5.4.1e	Agree with the Appointing Party / Client any additions or amendments to the project's information standard		R	
5.4.1f	Confirm the schedule of software, hardware and IT infrastructure.		R	
5.4.2	Establish the Delivery Team's detailed responsibility matrix		R	
5.4.3	Establish the Lead Appointed Party's Exchange Information Requirements		R	
5.4.3a	Define each information requirement		R	
5.4.3b	Establish the Level of Information Need	C	R	
5.4.3c	Establish the acceptance criteria	C	R	
5.4.3d	Establish the dates that need to be met for each requirement		R	
5.4.3e	Establish the supporting information		R	
5.4.4	Establish the task information delivery plan(s)			R
5.4.5	Establish the master information delivery plan		R	
5.4.6	Complete Lead Appointed Party's appointment documents	R		
5.4.7	Complete Appointed Party's appointment documents		R	
5.4.8	Activities for appointment	R		
5.5 MOBILISATION				
5.5.1	Mobilise resources			R
5.5.2	Mobilise information technology			R
5.5.3	Test the project's information production methods and procedures			R
5.5.4	Activities for mobilisation			R
5.6 PRODUCTION				
5.6.1	Check availability of reference information and shared resources			R
5.6.2	Generate information in accordance with the TIDP			R
5.6.2.a	Generate information in accordance with SMPs			R
5.6.2.b	Generate information in accordance with Level of Information Need			R
5.6.2.c	Generate information coordinated and cross referenced with Shared Information			R
5.6.2.d	Generate information that is spatially coordinated			R
5.6.2.d	Generate information with appropriate suitability (Status Code)			R
5.6.3	Undertake quality assurance check against SMPs			R
5.6.4	Review information and approve for sharing			R
5.6.5	Information Model review			R
5.6.6	Activities for collaborative production of information			R
5.7 MODEL DELIVERY				

ISO I.D.	Information Tasks	Appointing Party / Client	Lead Consultant / Lead Contractor	Task Team
5.7.1	Submit Information Model for Lead Appointed Party authorisation		A	R
5.7.2	Review and authorise the Information Model		R	
5.7.3	Submit Information Model for Appointing Party / Client acceptance		R	
5.7.4	Review and accept the Information Model	R		
5.7.5	Activities for Information Model delivery			
5.8 PROJECT CLOSE OUT				
5.8.1	Archive the Project Information Model	R		
5.8.2	Capture lessons learned for future projects	R		
5.8.3	Activities for project close-out	R		

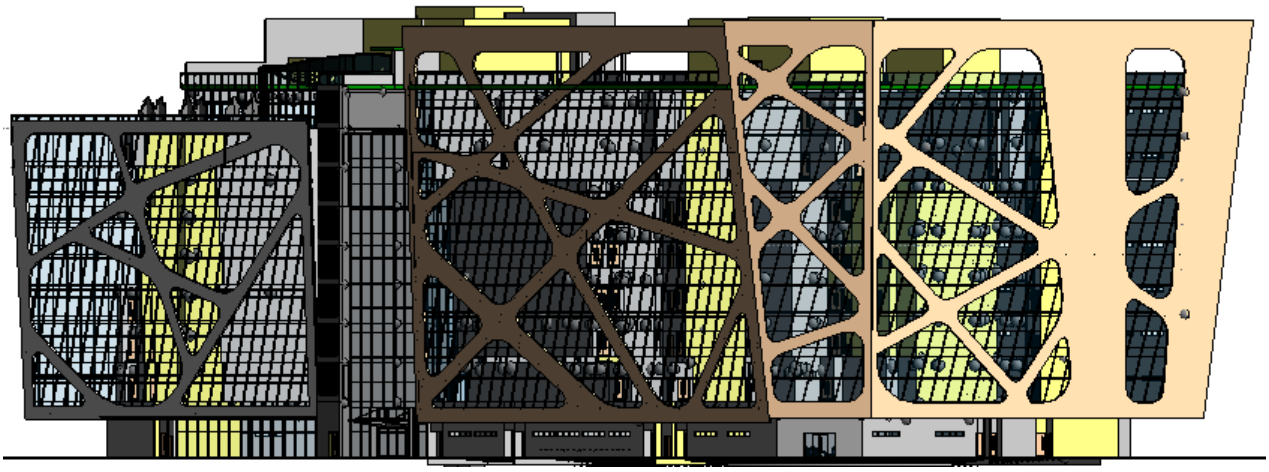
Appendix B

Examples of Model Zones and Levels Definitions

Example 1 Tall Building Example

Single Tower Example - Simple

For a simple tower project, it is recommended to model discipline elements in one model file to keep the relationship and continuity of the elements.



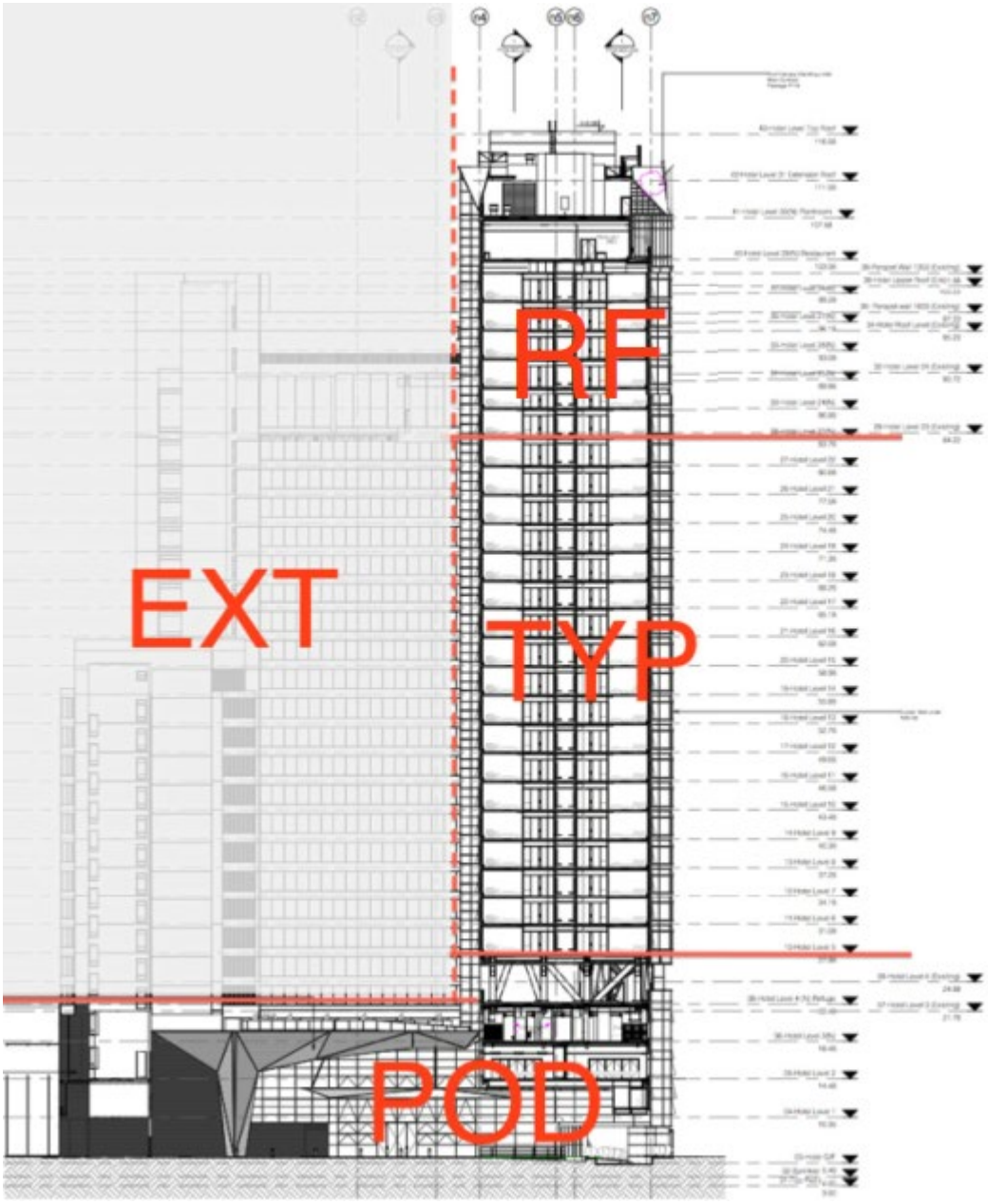
The file naming for the model files should be as follows:-

Project Code	-	Originator	-	Volume	-	Location	-	Discipline	-	Type
BIMS2020	-	CIC	-	XX	-	ZZ	-	AR	-	M3
BIMS2020	-	CIC	-	XX	-	ZZ	-	ST	-	M3
BIMS2020	-	CIC	-	XX	-	ZZ	-	FS	-	M3

Single Tower Example – Typical / Complex

For tall buildings, the project may be divided into basement, podium and tower models. In this example, a new residential tower will be constructed adjacent to existing development. The models should be separated as follows;

BAS	**=**	**Basement**	**POD**	**=**	**Podium**
TYP	**=**	**Typical Levels**	RF	=	Roof Level

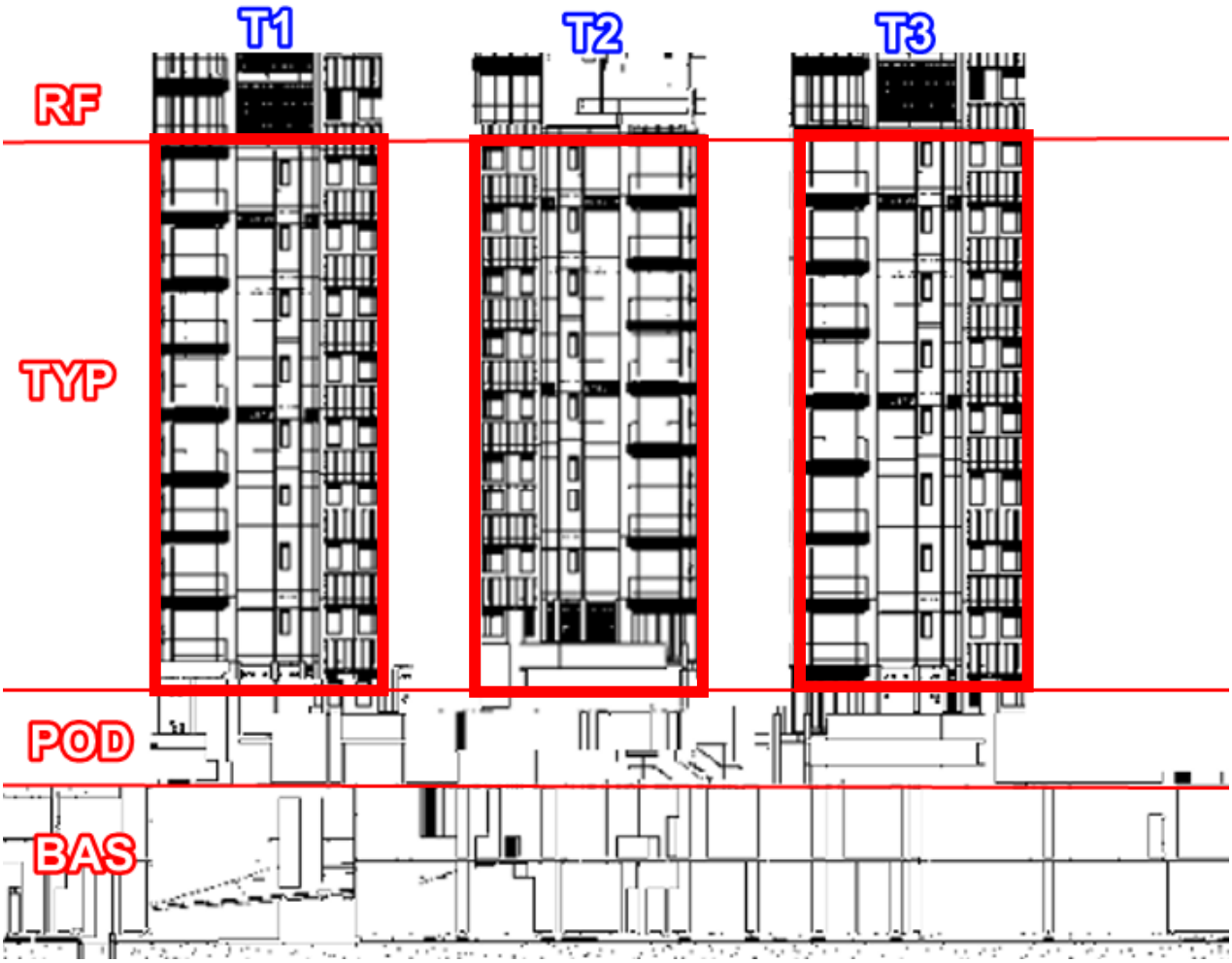


The file naming for the model files should be as follows: -

Project Code	-	Originator	-	Volume	-	Location	-	Discipline	-	Type
BIMS2020	-	CIC	-	POD	-	XX	-	AR	-	M3
BIMS2020	-	CIC	-	TYP	-	XX	-	AR	-	M3
BIMS2020	-	CIC	-	RF	-	XX	-	AR	-	M3

Multiple Towers and multiple Zones Example – Typical / Complex
For a large scale of the project site, it would be better to classify the blocks / buildings into zones.

Considering the buildings are divided into zones, basement, podium and tower, the file naming for the model files should be as follows:-



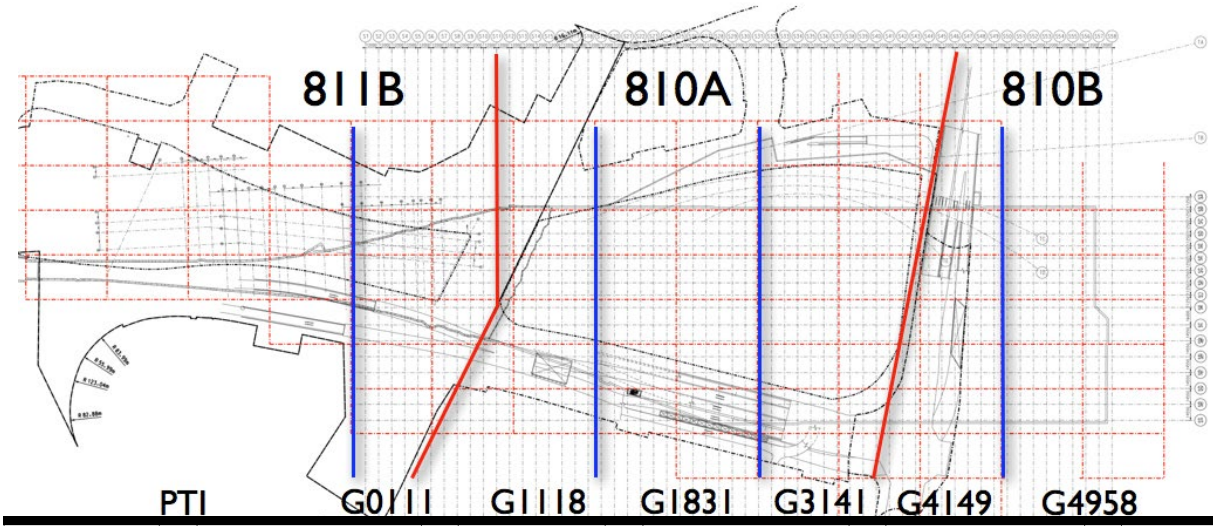
Project Code	-	Origin -ator	-	Volume	-	Location	-	Discipline	_	Sub-discipline		Type
BIMS2020	-	CIC	-	T1	-	TYP	-	AR			-	M3
BIMS2020	-	CIC	-	T2	-	TYP	-	AR			-	M3
BIMS2020	-	CIC	-	T3	-	TYP	-	AR			-	M3

Example 2 MTR West Kowloon Terminus

Large plan project with multiple contracts

The models for the project shall be created by sub-dividing the project on plan into three zones representing the 811B, 810A and 810B contracts. These zones should be further sub-divided to control the Revit file sizes. The files are identified by the project gridlines.

The file naming for the model files should be as follows:-



Project Code	-	Originator	-	Volume	-	Location	-	Discipline	-	Type
811B	-	MTR	-	WKT	-	G0111	-	AR	-	M3
811B	-	MTR	-	WKT	-	G0111	-	ST	-	M3
810A	-	MTR	-	WKT	-	G1118	-	AR	-	M3
810A	-	MTR	-	WKT	-	G1831	-	AR	-	M3
810A	-	MTR	-	WKT	-	G3141	-	AR	-	M3
810B	-	MTR	-	WKT	-	G4149	-	AR	-	M3
811B	-	MTR	-	WKT	-	PTI	-	AS	-	M3

Example 3 Hong Kong International Airport

Large plan project with different phases of construction

Due to the scale, complexity and planned construction phasing, the BIM Manager should separate the models by zone and by discipline, by sub-dividing the Midfield Concourse on plan into 11 separate Location.

The zones and the zone file name codes are defined as:-

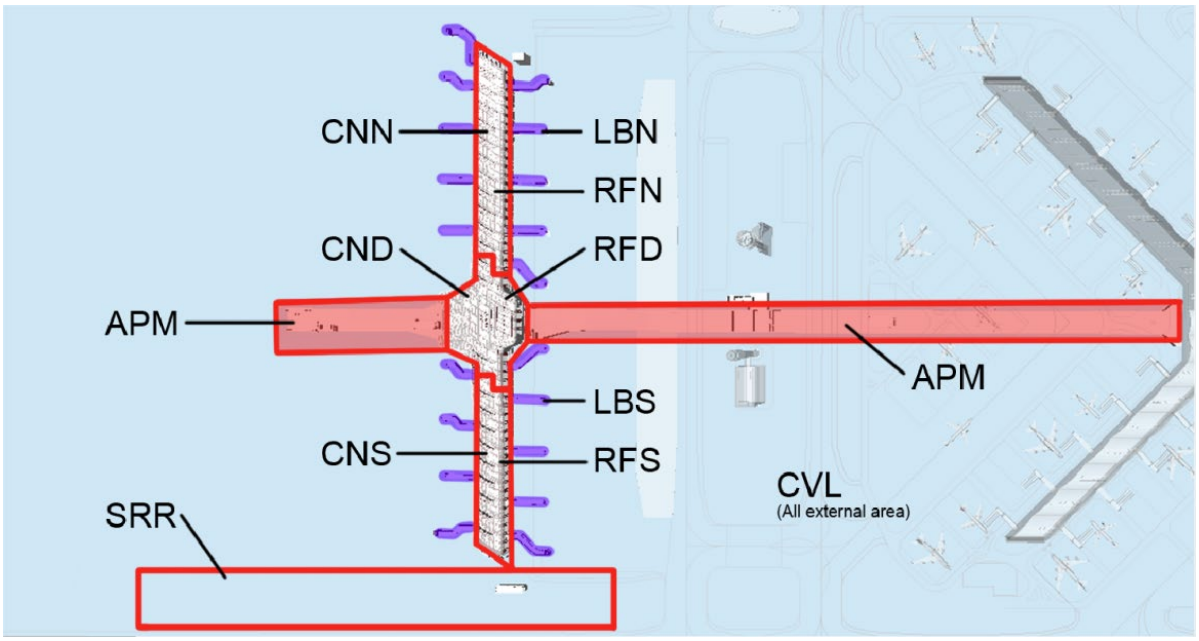


Figure 55 Information Model Zones

Location	Sub-Location (Levels)
CNN - Concourse North	Foundation Level to L7 Mezzanine (see section below)
CND - Concourse Central Node	L0 APM track to L7 Mezzanine (see section below)
CNS - Concourse South	Foundation Level to L7 Mezzanine (see section below)
LBN – Fixed Link Bridge North	Foundation Level to L7 Mezzanine
LBS – Fixed Link Bridge South	Foundation Level to L7 Mezzanine
RFN - Roof Framing North	L6 Departure to L8 Roof (see section below)
RFD - Roof Framing Central Node	L0 APM track to L7 Mezzanine (see section below)
RFS - Roof Framing South	L6 Departure to L8 Roof (see section below)
APM - APM Tunnel	L0 APM track to Foundation Level
SRR - South Runway Road	Foundation Level to L5 Arrival
CVL - Civil Airfield Services	

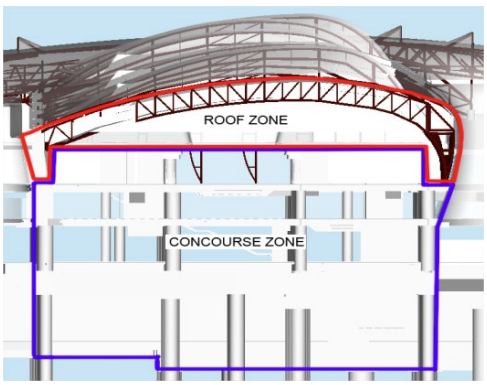


Figure 56 Information Model Zone Cross Section

The match lines between the Concourse Node and the North/South Concourse are shown along the structural movement joints as below:-

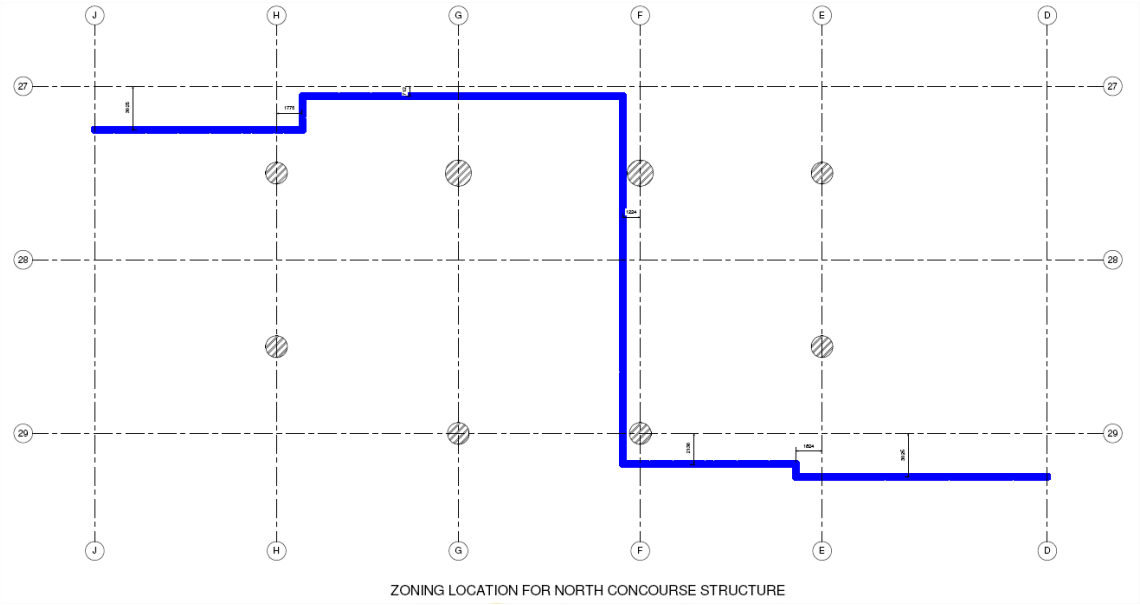


Figure 57 Information Model Zone Break Line at North - Concourse

The match lines between the Roof Node and the North/South Roof follow the structural steel roof framing, as shown below, and match with the concourse movement joints.

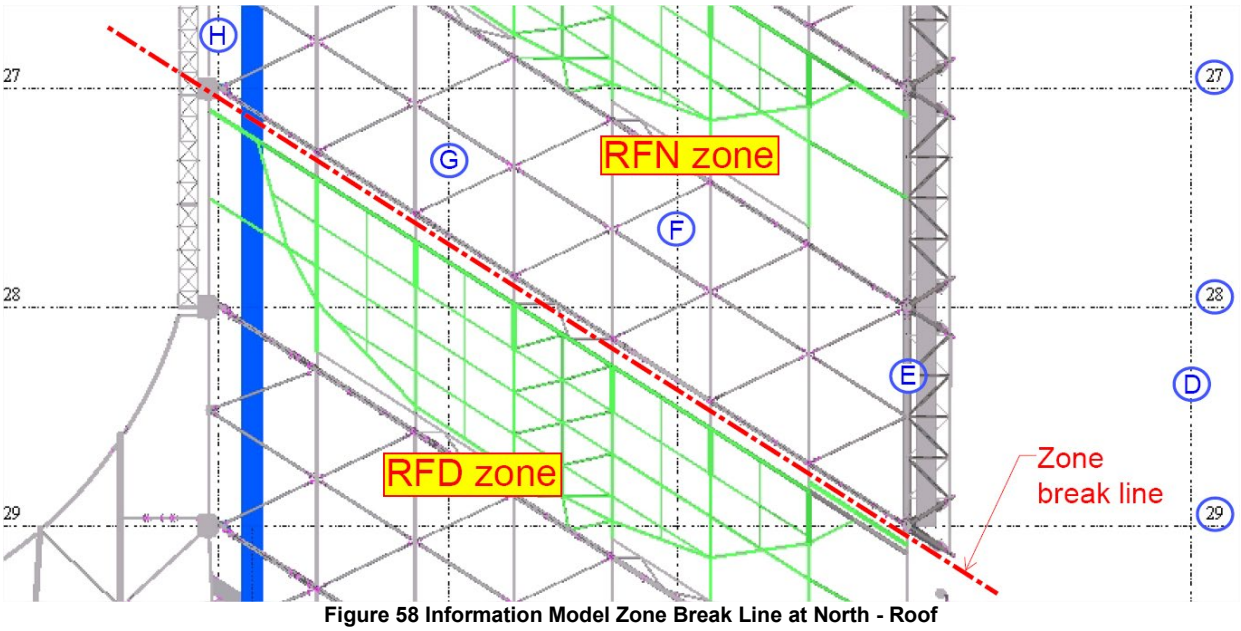


Figure 58 Information Model Zone Break Line at North - Roof

The match lines between the Concourse Node and APM Tunnel is as shown below:-

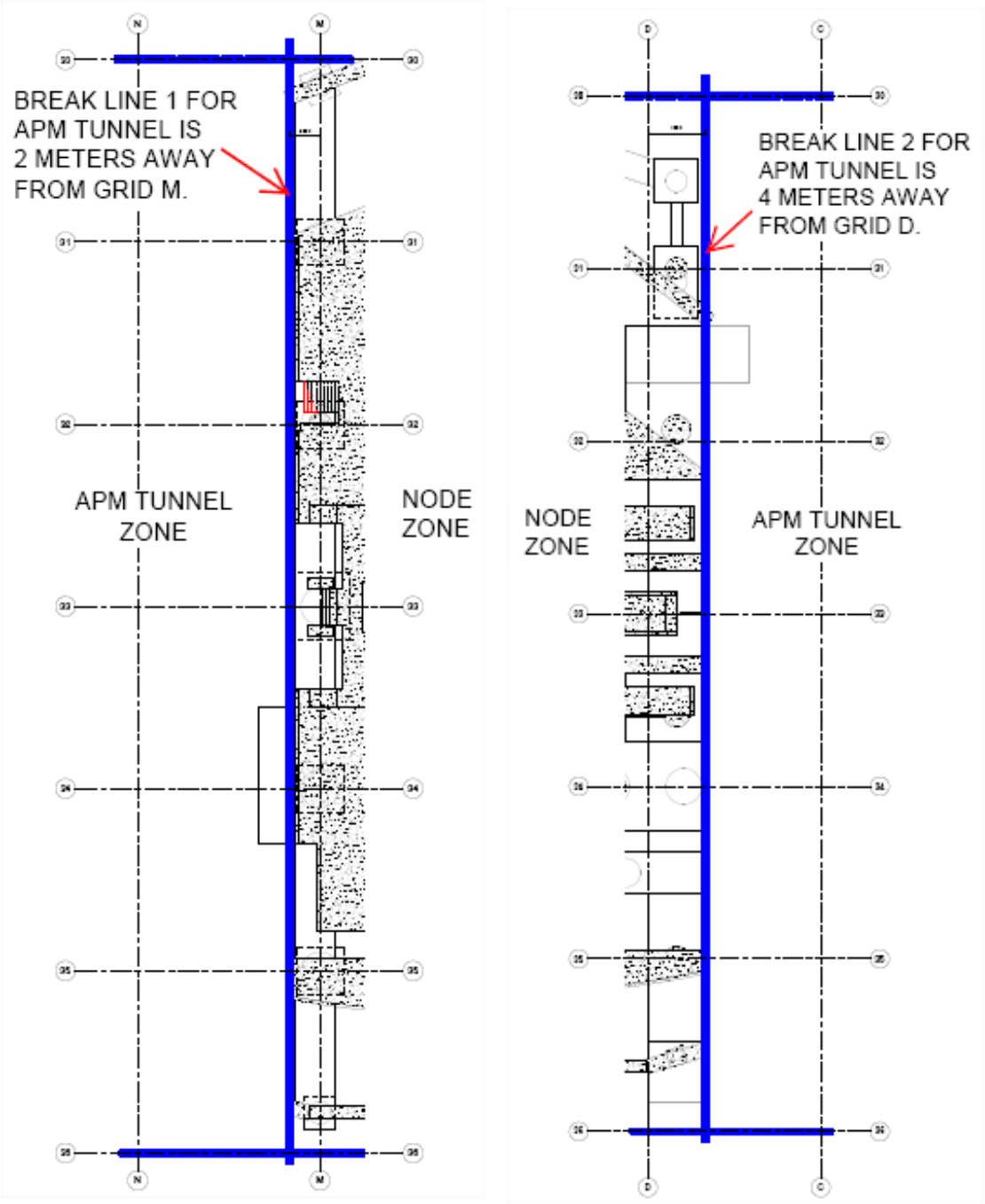


Figure 59 Information Model Zone Break Line at Node / APM

Appendix C

List of Figure

9 Reference

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21. 建築信息模型應用統一標準 2017

10 Committee on Building Information Modelling

The Task Force on BIM Standards

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- Buildings Department
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- Development Bureau
- Drainage Services Department
- Electrical and Mechanical Services Department
- Highways Department
- Hong Kong Housing Authority
- Hong Kong Institute of Utility Specialists and Building Services Operation
- Hospital Authority
- Lands Department
- Planning Department
- The Airport Authority Hong Kong
- The Association of Consulting Engineers of Hong Kong
- The Hong Kong Construction Association
- The Hong Kong Federation of Electrical & Mechanical Contractors Limited
- The Hong Kong Institute of Architects
- The Hong Kong Institute of Building Information Modelling
- The Hong Kong Institution of Engineers
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- Urban Renewal Authority
- Vircon Limited
- Water Supplies Department

The CIC thanks all stakeholders who have participated in the Stakeholders Consultation Seminars and/or Forums and offered opinions.

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CIC *Building Information Modelling Standards - General*

To improve future editions of this publication, we would be grateful to have your comments.

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