CONSTRUCTION INDUSTRY COUNCIL
建造業議會

CIC Beginner's Guide on Construction Digitalisation – **Adoption of Common Data Environment (CDE)**

for Information Management using BIM

2022

Disclaimer

Whilst reasonable efforts have been made to ensure the accuracy of the information contained in this publication of Reference Materials, the CIC nevertheless encourages readers to seek appropriate independent advice from their professional advisers where possible. Readers should not treat or rely on this publication of Reference Materials as a substitute for such professional advice.

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Table of Contents

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 given 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 provide standards or methodologies generally adopted and regarded by the industry as good practices. The CIC recommends the adoption of the standards or methodologies given in 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.

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

Definition of Abbreviations

Abbreviations	Definition
ABIM	As-Built Information Model
AIM	Asset Information Model
AIR	Asset Information Requirements
API	Application Programming Interface
BCF	BIM Collaboration Format
BEP	BIM Execution Plan (formerly known as PXP)
BIM	Building Information Modelling
BIM IP	BIM Implementation Plan
CAD	Computer Aided Drafting
CCBC	CIC-Certified BIM Coordinator
CCBM	CIC-Certified BIM Manager
CDE	Common Data Environment
CIC	Construction Industry Council, Hong Kong
CICBIMS	Construction Industry Council Building Information Modelling Standards – General
CQMS	Construction Quality Management System
DEVB	Development Bureau, The Government of the HKSAR
DOC	Level of Documentation
DfMA	Design for Manufacture and Assembly
EDMS	Electronic Document Management Systems
EIR	Exchange Information Requirements
GIS	Geographic Information System
IFC	Industry Foundation Classes
IoT	Internet of Things
IT	Information Technology
LOD-G	Level of Graphics
LOD-I	Level of Information
LOIN	Level of Information Need
MEP	Mechanical, Electrical and Plumbing
MIDP	Master Information Delivery Plan
MiC	Modular Integrated Construction
OIR	Organisational Information Requirements
PIM	Project Information Model
QR Code	Quick Response Code
ROI	Return on Investment
SME	Small and Medium Enterprise
WIP	Work in Progress
XML	Extensible Markup Language

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

Executive Summary

Common Data Environment (CDE) is a digital solution for the management and storage of shared information for any given project or asset. It allows integrated and cross-disciplinary access to federated Building Information Modelling (BIM) (building data from built asset lifecycles), Geographic Information System (spatial and geographic data), construction works information and possible integration with various technologies, such as sensors and Internet of Things (IoTs), to provide the extended functions. Data in CDE are exchanged and coordinated through an agreed and standardised protocol, under the control of the respective owners.

CDE is regarded as an effective tool to further enhancing the effective use of BIM. The adoption of CDE in the workflow helps ensure that the BIM model so developed can serve as a single source of truth for collaboration throughout the whole project lifecycle.

This Guide is developed for Clients (Appointing Parties), Lead Consultants and Main Contractors (Lead Appointed Parties) who have no or mere experience in the CDE adoption. It aims to provide practical advice on the general considerations when selecting a CDE as an information management and collaboration tool for BIM, as stated in the CIC BIM Standards – General (CICBIMS) and ISO 19650. The considerations are applicable to any type of CDE to be used in any project stage. It is understood that the requirements and expectations on CDE for different projects may vary. This Guide will focus only on the most essential areas that any CDE must include.

The Need for CDE in Construction Industry

- CDE is regarded as an essential Information Technology (IT) infrastructure to support BIM adoption in construction industry.
- BIM adoption was made mandatory for the Development Bureau (DEVB) capital works projects with project estimates more than $30 Million since 2018.
- CDE is a digital solution for the management and storage of project information for any given project or asset that can facilitate BIM collaborative working among the project parties.
- Adoption of CDE in construction projects was supported by the Construction Innovation and Technology Fund (CITF) since 2018.
- CDE is one of the main pillars of the construction digitalisation of Hong Kong.
- CDE can be adopted in an enterprise with different levels of CDE adoption as shown below:

Enterprise CDE	This is used in complete integration with the business, workflows, and existing systems (e.g. IT, procurement, asset management, etc.) of the enterprise.
Departmental CDE	In a large organisation, different departments/offices may have different departmental CDEs to suit their individual business needs (e.g. civil, building, facility management, etc.).
Project CDE	For a specific project or built asset, it is used for single, multiple project stages or full project lifecycle of the built asset. Typically, a Project Information Model (PIM) CDE or Asset Information Model (AIM) CDE is often regarded as a project CDE.

Essential functions of CDE

Electronic document management systems (EDMS)				
Cloud options	Data storage capacity	Data backup	Data security	Anti-virus
Document archive	Document management	Access security	Access options	
Workflow Management				
Workflow for	Workflow for document	Dashboard &	Audit trail	

managing information process	submission and approval	Reporting		
2D & 3D coordination				
3D viewer	2D viewer	Issue tracking		

Benefits of adopting CDE

- Facilitate collaborative working
- Improve project coordination efficiency
- Provide reliable shared information
- Offer full audit trail for information traceability
- Enhance BIM project management

General Considerations when selecting a CDE

Section 2 provides practical advice on the general consideration in selecting a CDE:

Introduction

The CIC Beginner's Guide on Construction Digitalisation – Adoption of Common Data Environment (CDE) for Information Management using BIM is developed with an aim to provide practical advice on the general considerations when selecting a CDE as an information management and collaboration tool for Building Information Modelling (BIM), as stated in the CIC BIM Standards – General (CICBIMS) and ISO 19650. It is developed for Clients (Appointing Parties), Lead Consultant and Main Contractors (Lead Appointed Parties) who have no or mere experience in the CDE adoption. The Guide shall be used in conjunction with the CIC BIM Standards - General (Version 2.1 – 2021), which contains major enhancements to align with the ISO 19650's Information Management principles, workflows and requirements, as well as the Hong Kong Local Annex of ISO 19650-2:2018.

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 & 12/2021 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.

In response to demands from the industry, a Task Force on BIM Specifications and Agreement under the ambit of Committee on BIM was established on 23 October 2019. The Task Force is co-chaired by Committee on BIM and Committee on Construction Business Development, and underpinned by two Task Groups, namely Task Group 1 (BIM Specifications) and Task Group 2 (BIM Special Conditions of Contract & Services Agreement). The Task Force developed CIC BIM Exchange Information Requirements (EIR) Template (BIM Specifications), CIC BIM Special Conditions of Contract, and CIC BIM Services Agreements.

As at September 2022, 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).
xii. CIC Beginner's Guide on Construction Digitalisation – Adoption of Common Data Environment (CDE) for Information Management using BIM (2022)
xiii. CIC Beginner's Guide on Construction Digitalisation – Adoption of BIM in Small and Medium Enterprises (SMEs) (2022)
xiv. CIC Beginner's Guide on Construction Digitalisation – Smart Site Digital Platform (2022)
xv. CIC Beginner's Guide on Construction Digitalisation – Cybersecurity Awareness (2023)

The CIC BIM Standards – General (CICBIMS)

The objective of the CIC BIM Standards – General (CICBIMS) is to provide the 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.

In Section 4 of CICBIMS (version 2.0 and onwards), the principles of CDE that aligned with ISO 19650 are given. It covers Project Information Requirements, the CDE and Gateways, the CDE Functional Requirements, the CDE Process Requirements, CDE Security, Storage and Technology Specification and the CDE Handover Procedures.

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)
- ISO 19650-4:2022, Part 4: Information exchange (First Edition, 2022); and
- ISO 19650-5:2020, Part 5: Security-minded approach to information management (First Edition, 2020).

ISO 19650 provides a high-level functional view of the CDE as shown in Fig. a. A CDE should have four information containers, namely Work in Progress (WIP), Shared, Published and Archive to support the information management workflow for managing information during asset management and project delivery.

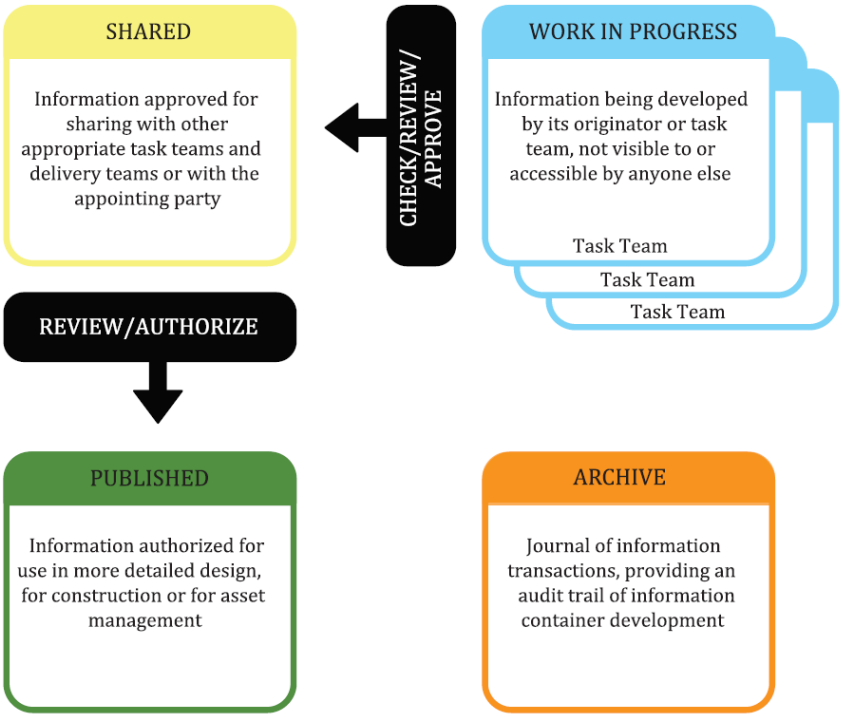


Fig. a – Common data environment (CDE) concept from ISO 19650-1

The CICBIMS takes on board the principles of the above published ISO standards (Part 1-3 and 5), 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.

1.The needs of CDE in the construction industry

1.1. Overview

In 2018, the Government of the Hong Kong Special Administrative Region (HKSAR) published the "Construction 2.0 – Time to Change" with initiatives to reform and upgrade the construction industry, to enhance its capacity and sustainability, increase productivity, promote regulation and quality assurance, improve site safety and reduce environmental impact, through " innovation", "professionalisation" and "revitalisation"[1]. Building Information Modelling (BIM) has been identified as one of the Innovations and should be uplifted the utilisation rate of BIM [2].

With the release of the Technical Circular (Works) Nos. 7/2017, 18/2018, 9/2019, 12/2020 & 12/2021 by the Development Bureau (DEVB) of the HKSAR, capital works projects with project estimates more than $30 Million are mandated to use BIM from 1st January 2018 onwards.

Since then, BIM has been adopted widely in the industry with proven benefits. Common Data Environment (CDE) is known as a technology solution with workflow that works closely with BIM. It is regarded as one of the pillars of the construction digitalisation.

From the government point of view, "To reap the full benefits of BIM, project teams should re-engineer the workflow for the whole project delivery cycle to ensure that the BIM models are properly developed at the design stage for facilitating their utilisation in the subsequent stages and the whole project lifecycle, and make good use of the BIM data/model for collaboration among project team members with an aim to improve productivity, reduce abortive works, enhance construction safety and/or optimise operational efficiency"[3]. However, such BIM uses and benefits could not be effectively achieved without an effective information management and collaboration tool for BIM model and information in a project. "**CDE is an effective tool to further enhancing the effective use of BIM, the adoption of CDE in the workflow helps ensure that the BIM model so developed can serve as a single source of truth for collaboration throughout the whole project lifecycle."[3].** It has emphasised the importance of CDE as an information management and collaboration tool for BIM model and information, as well as for whole project lifecycle of any built asset.

[1] Project Strategy and Governance Office (2022) https://www.psgo.gov.hk/en/c20.html
[2] Construction 2.0 – Time to Change, 2018, DEVB
[3] DEVB TC(W) No. 2/2021, Adoption of Building Information Modelling for Capital Works Projects in Hong Kong

1.2. What is CDE?

In a nutshell, CDE is a digital solution for the management and storage of shared information for any given project or asset. It provides appropriate and secure access to all project team members or parties who are required to produce, use and maintain that information[4].

CDE should be a combination of workflow and information storage solutions, to support the information management process for the asset(s)[5].

One of the major deliverables of CDE are information models (e.g. Project Information Model, PIM and Asset Information Model, AIM) which containing federated information deliverables are produced as a result of the CDE workflow to address the perspectives of all interested parties.[4]

Essentially, CDE is composed of three major components: (Fig. 1)

- Electronic document management systems (EDMS)
- Workflow management
- 2D & 3D coordination

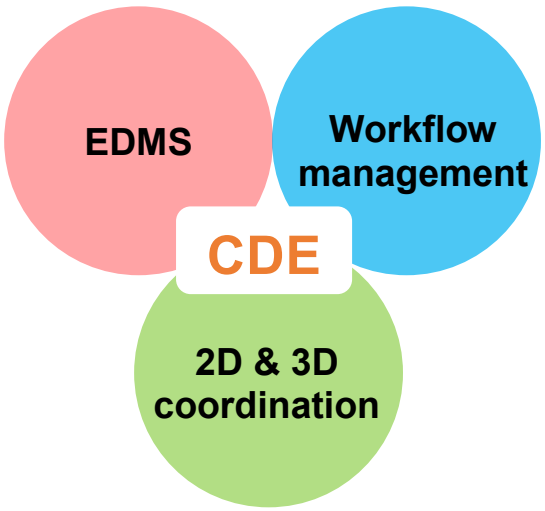


Fig. 1 – Three major components of a CDE

Electronic document management systems (EDMS)	A system provides secured storage, access and management for electronic documents, e.g. Google Drive, One Drive, etc. (EDMS alone is not considered as a CDE)
Workflow management	The CDE workflow supports collaborative production, management, sharing and exchange of all information during operational and delivery phases[4]. For details, please refer to Section 4 of CICBIMS.
2D & 3D coordination	CDE allows 2D & 3D coordination by providing viewer to illustrate the 2D & 3D contents of the digital files (e.g. documents, drawings and BIM models). It also allows review and markup on those contents, supported by an issue tracking system.

[4] ISO 19650-1:2018
[5] ISO 19650-3:2020

1.3. BIM, CDE and collaborative working

BIM is the process of generating and managing building data during its design, construction and during the building or assets lifecycle. Typically, the process uses three-dimensional building modelling software to increase productivity of consultants and contractors during the whole asset lifecycle.

The process produces the building information model database, which encompasses building geometry, spatial relationships, geographic information, quantities and properties of building elements. It is a new way of working using new technology to facilitate project management, better construction process control, cross-disciplinary collaboration, communication with external stakeholders, decision support and risk management[6].

With BIM, organisations are increasingly working in new collaborative environments to achieve better quality and greater re-use of existing knowledge and experience. A significant outcome of these collaborative environments is the potential to communicate, re-use and share information efficiently, and to reduce the risk of loss, contradiction or misinterpretation[4].

CDE can be regarded as an information management infrastructure of BIM, to provide a common platform for collaborative working and information management in a controlled environment for all project members (Fig. 2).

Collaborative working and open standards

Collaborative working involves information exchange by sharing and coordination of information through a CDE, using open standards (e.g. jpg, pdf, dxf, ifc, bcf, xml), whenever possible, and clearly defined operating procedures to enable a consistent approach by all organisations involved[4].

Traditional Information Sharing VS Information Sharing in a CDE

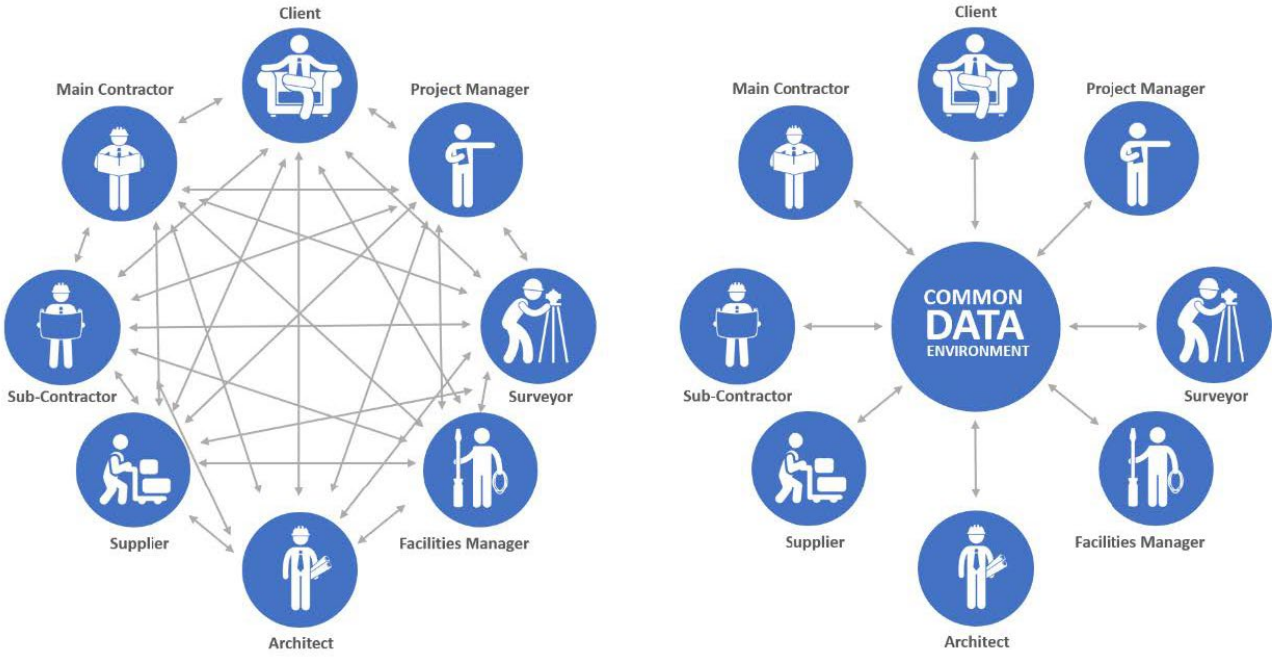


Fig. 2 - CDE Concept[7]

[6] What is BIM?, CIC BIM 2022, https://www.bim.cic.hk/en/bim_in_hk/what_is_bim

[7] Implementation of a Common Data Environment - The Benefits, Challenges & Considerations (2018), The BIM Delivery Group for Scotland, Scottish Future Trust (SFT)

1.4. CDE for PIM and AIM

A CDE solution and workflow should be used for managing information during asset management and project delivery. During the delivery phase, the CDE solution and workflow support the information management processes in the development of PIM and AIM[4].

In project delivery phase such as design and construction stage, CDE is developed as a project specific solution to meet the common criteria for delivering the PIM. 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 lifecycle data approach[8]. For more details on CDE handover procedures, please refer to Section 4.6 of the CICBIMS.

1.4.1. Project Information Model (PIM)

The Project Information Model (PIM) is the collection of the graphical information, nongraphical information and the documentation (DOC) required to support the delivery of the project. Consisting of design and construction stage models developed as a response to the Level of Information Need (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 CDE.[8]

1.4.2. Asset Information Model (AIM)

The AIM supports the strategic and day-to-day asset management processes established by the appointing party. It can also provide information at the start of the project delivery process. For example, the AIM can contain equipment registers, cumulative maintenance costs, records of installation and maintenance dates, property ownership details and other details that the appointing party regards as valuable and wishes to manage in a systematic way[4].

At the point of handling over from the construction phase, the AIM will duplicate the data from the As-Built Information Model (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 Organisational

[8] CIC BIM Standards - General (Version 2.1 - 2021), CIC 2021

Information Requirements (OIR) for the assets' alteration and addition; or for the organisation's next project for continuous improvement. [8]

For more details on BIM and CDE for operational phase of the assets, please refer to ISO 19650-3.

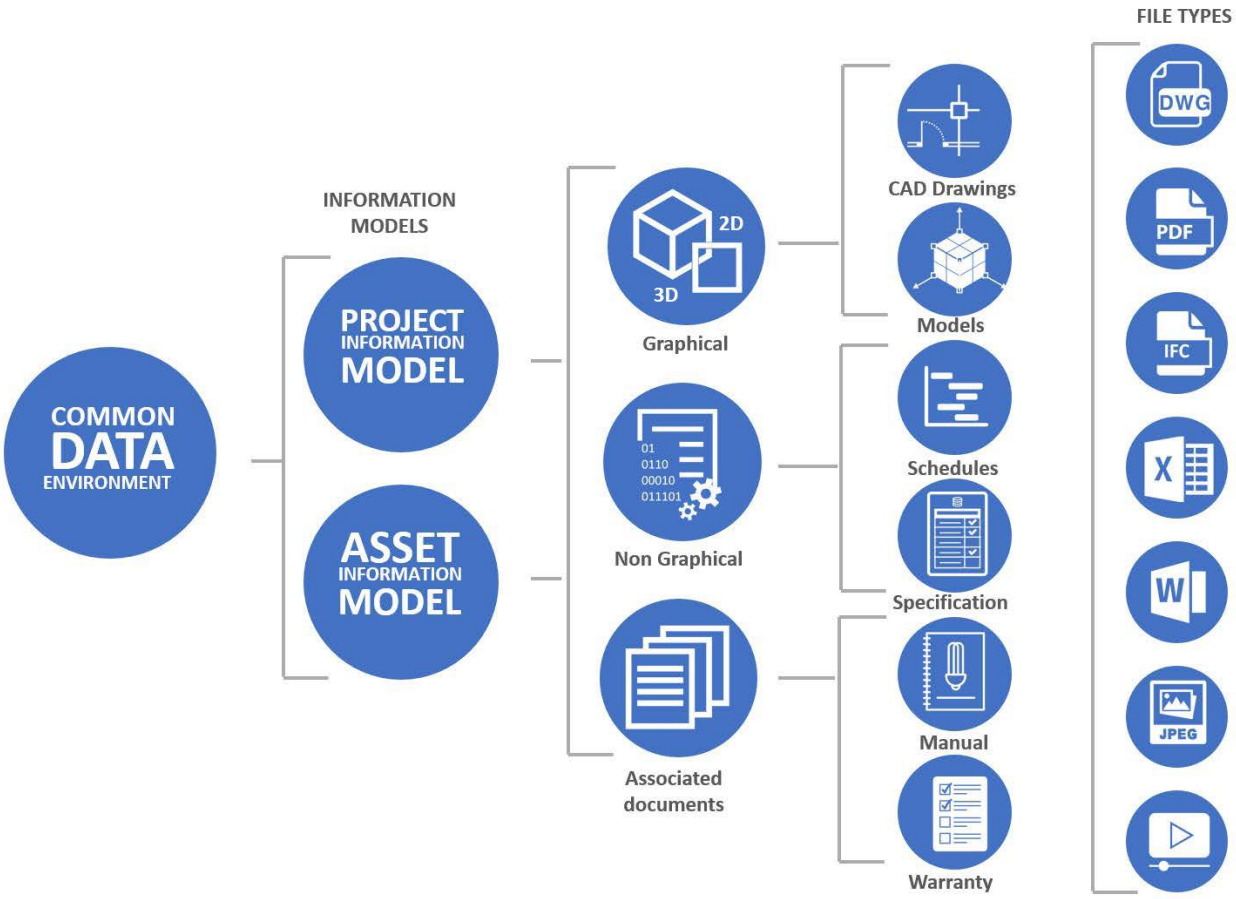


Fig. 3 – Content summary of types of information being stored, shared and coordinated in a CDE[7]

1.5. Level of CDE for an enterprise

The level of CDE adoption for an enterprise depends on the overall organisational strategy and specific project goals. CDE can be used as a long-term organisational-wide infrastructure for information management, or a short-term project CDE for a specific project. For example, a PIM CDE is used only during the project delivery stage.

There are mainly three levels of CDE for an enterprise to adopt:

Enterprise CDE	An organisational-wide CDE that is completely integrated with the business, workflows, and existing systems (e.g. IT, procurement, asset management, etc) of the enterprise. As an organisational-wide infrastructural system, it requires extensive resources, studies and efforts so that the development and adoption of the enterprise CDE can be successful.
Departmental CDE	In a large organisation, different departments/offices may have different departmental CDEs to suit their individual business needs (e.g. civil, building, facility management, etc.). Depending on the business nature and needs of the department, the departmental CDE could be established and adopted more towards an enterprise CDE or in the opposite, more towards a project based CDE.
Project CDE	A project CDE is a CDE being used in a specific project or built asset. Comparing with enterprise and departmental CDE, it has a lower entry level, and is more simple and flexible, in terms of the CDE setup and adoption (refer to Section 1.6). Typically, a PIM CDE or AIM CDE is often regarded as a project CDE. For companies that have no or mere experience in the adoption of CDE, it is a good starting point for their individual department or office to try to adopt a project CDE from a pilot project, preferably in a smaller project scale and simpler project scope. For mega size projects (e.g. civil works or new town development), multiple project CDEs from different work contracts may be used. In such cases, communication and collaboration between those project CDEs will be a big concern (Fig. 4). More efforts will be needed for the clients and the project management teams to establish and maintain a smooth CDE communication and information exchange workflow.

From the perspective of information management, it is very important to have seamless information exchange and good communication between CDEs at different levels. This is still a relatively new area that needs further exploration from the industry.

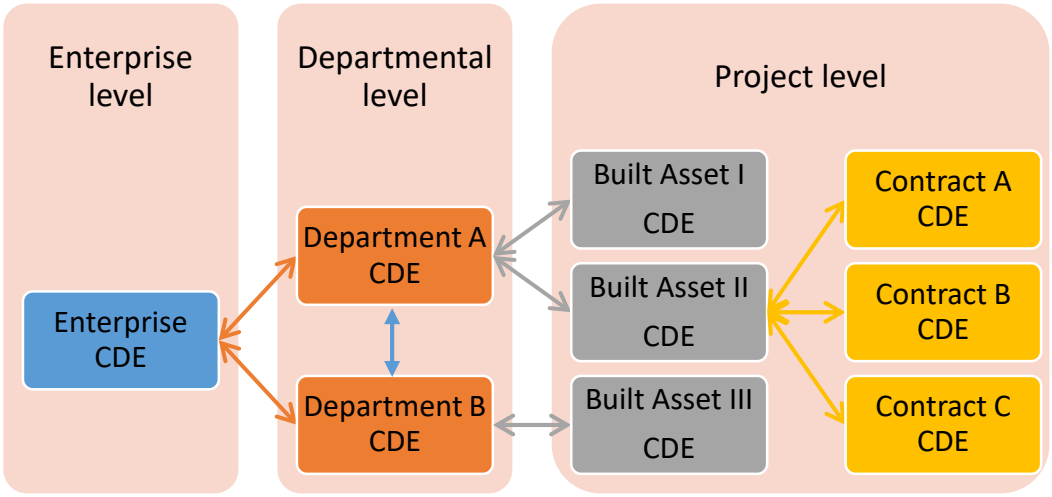
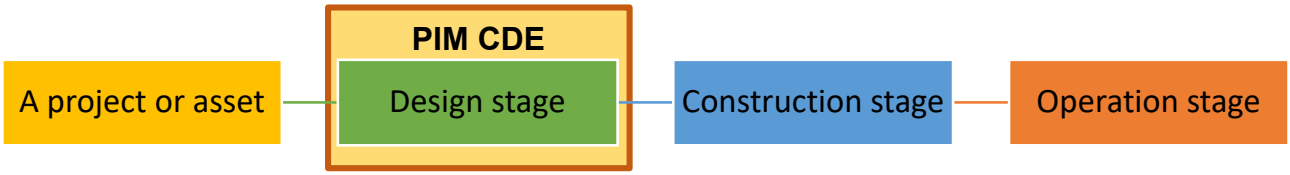


Fig. 4 – Diagram to show the level of CDE

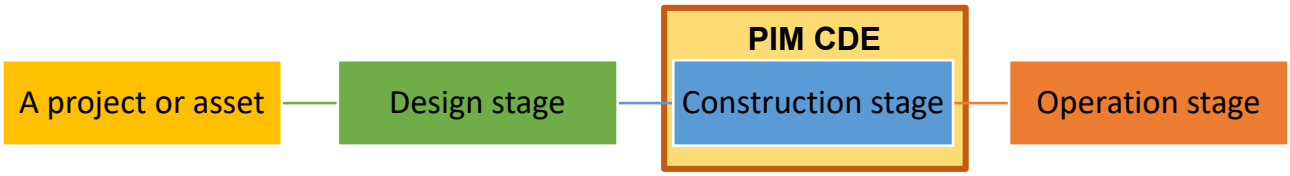
1.6. When project CDE is used? Who owns or operates it?

As a principle, CDE should be adopted in as early project stage as possible, with a means to provide well-orgainsed project data and information that can be reused in the later stages. Client is playing the most vital role for promoting the adoption of CDE in a project and to maximise CDE and BIM's benefits by including them in the project specifications. Nevertheless, Lead Consultants or Main Contractors (as the Appointing Parties for their supply chains) can require their supply chains to use CDE in the project even it has not been specified by the client.

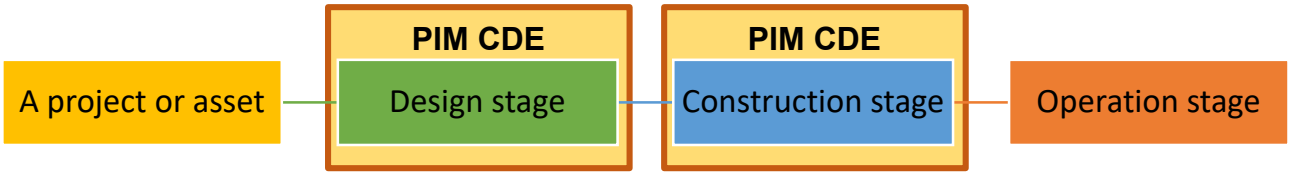
CDE should be used in a project when there is a need to perform BIM information exchange and collaboration works between two or more parties. Some examples are shown below:



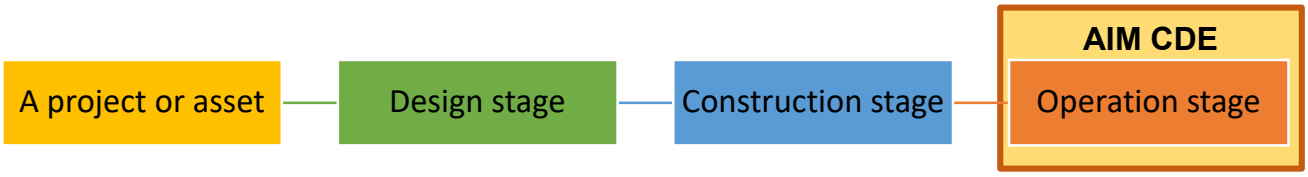
(A) A PIM CDE is used only in the design stage and is provided by the Lead Consultant.



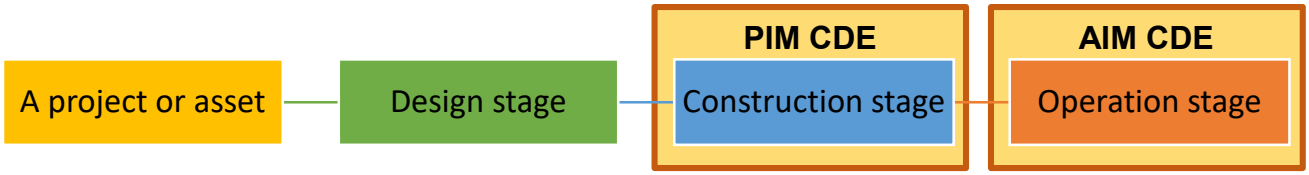
(B) A PIM CDE is used only in the construction stage and is provided by the Main Contractor. For mega size project such as a mega size civil and infrastructure project, there may be more than one work contracts running in parallel and interfacing of multiple brands of CDEs will be a big concern.



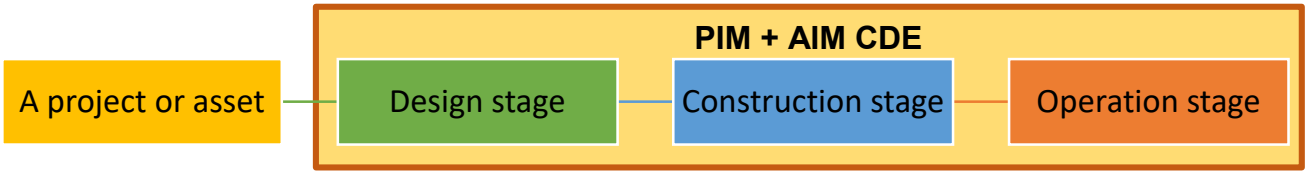
(C) Same PIM CDE is used in both design and construction stage of the project. It is likely to happen in a design and build project. Nevertheless, the brand of PIM CDE in design stage can be different from that used in the construction stage. (In such case, the handover of PIM CDE from one project stage to another stage should be considered.)



(D) An AIM CDE is used only in the operation stage. It could happen for an existing building or built asset for which BIM for AM/FM is adopted in future. The AIM CDE could be provided by the BIM AM/FM consultant, which is then handed over to the Client upon project completion.



(E) A PIM+AIM CDE is used in both construction and operation stage. It is likely to happen in a new built building or built-asset in which BIM is adopted in the construction stage and BIM for AM/FM in the operation stage. It is less common but it is possible that the brand of PIM CDE is different from that of AIM CDE. (In such case, the handover of PIM CDE to AIM CDE of different brands should be considered.)



(F) A PIM+AIM CDE is used in the early design stage to the operation stage. It will be the most efficient way to adopt CDE in a project across multiple stages, if a capable PIM+AIM CDE has been identified and chosen in the early project stage and adopted throughout the project stages.

In reality, irrespective of the stage(s) that the Client will adopt BIM and CDE for a specific project, there will be many considerations. Discussion on this topic is outside the scope of this Guide.

The need for open data and open CDE for the handover of CDE

Depending on the project requirements, the content and data of CDE may be requested to be archived in the Client's preferred formats or handed over to the Client's preferred systems upon the end of the project stage. The data interoperability and data structure of CDE should be considered in the early project stage so that a feasible and smooth workflow on data exchange and data handover can be achieved. Currently, there are issues on CDE data interoperability and data structure. For example, some of the data from a CDE solution can be difficult to be extracted or to be recognised by other digital systems during the handover of CDE. Hence, it is suggested that an open data standard for CDE shall be developed in future. Ultimately, there will be open CDE solutions that can read and write open data of CDE across various CDE solutions/platforms in future.

1.7. Essential functions of CDE

The CIC BIM Standards - General (Version 2.1 - 2021) has stipulated the essential functional requirements of a CDE (Section 4.3 of CICBIMS). This section summaries the CDE functional requirements in terms of the three major components of a CDE as mentioned in Section 1.2.

CICBIMS Functional Requirements of CDE		
	Type	**Functional Requirements**
EDMS	Cloud options	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;
	Data storage capacity	k) Provide sufficient capacity to store all files throughout the project stages and operate properly as requested by the Appointing Party / Client;
	Data backup	o) Provide off-site backup of all project files including Information Models, documents and data;
	Data security	j) Contained encryption for data security;
	Anti-virus	l) Installed with anti-virus software and maintained with updated security patches by the operating system or environment that the CDE resides on.;
	Document archive	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);
	Document management	c) Provide a user-customisable sectional / categorisable structure;
	Document management	f) Support uploading, downloading, Information Models and documentation to facilitate retrieval of documents attributes to support the CDE processes, including as a minimum the document identifier (number), title, revision, version, and status codes (suitability);
	Access security	b) Provide a user-customisable security access right control and management system;
	Access options	i) Allow access from portable devices and web applications;

CICBIMS Functional Requirements of CDE		
	Type	**Functional Requirements**
Workflow Management	Workflow	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)*;
	Workflow	e) Provide a user-customisable workflow for document submission and approval;
	Dashboard & Reporting	m) Provide dashboards for presenting the BIM progress information to the different levels of users;
	Audit trail	q) Provide a full audit trail of the information stored in the CDE;
2D & 3D coordination	3D viewer	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 BIM Execution Plan (BEP);
	2D viewer	h) Support review, comment, and mark-up procedures for Documentation formats and versions as documented in the BIM Project Execution Plan;
	Issue tracking	n) Provide an issue tracking system, including the issue registration, logging, update, and email notification to the selected user account.

1.8. Benefit of adopting CDE

CDE is an integrated systems of EDMS, workflow management and 2D & 3D coordination that can improve productivity, reduce abortive works, enhance construction safety and/or optimise operational efficiency. Below are some of the key benefits that CDE can directly or indirectly help to achieve them:

Benefit	How
Facilitate collaborative working	CDE as an integrated system for EDMS, workflow management and 2D & 3D coordination can provide an integrated and common platform for all project members to collaborate and communicate effectively.
More efficient project coordination	The 2D & 3D viewers enable CDE users to review, markup and raise issue on documents, drawings, BIM models in a common platform with convenience.
Reliable shared information	CDE is a “single source of truth” for the storage of project information to facilitate information exchange. The information shared by each party is well categorised and guided by rigorous CDE workflows – the information shared is with appropriate status and validation.
Full audit trail	CDE provides full audit trail such as user activities, approval records and issue history.
Better BIM project management	CDE provides a common platform for management staff to manage and monitor the progress of BIM, such as submission, approval and issue status of the drawings, BIM models and information.
Flexible setup	The infrastructure of CDE (e.g. data storage capacity, numbers of user) is scalable on-demand. The setup and configuration of CDE are highly customisable to suit specific project needs.
Wide price range	There are many CDE products available in the market with wide price range and with various features for companies to consider.

1.9. Funding support on adoption of CDE

The Construction Innovation and Technology Fund (CITF), with an approved allocation of HK$1 billion, was established by the Development Bureau (DEVB) of the Government of the Hong Kong Special Administrative Region in October 2018. The Construction Industry Council (CIC) is commissioned by the DEVB to be the implementation partner. In 2022, another $1.2 billion was injected for its ongoing operation and implementation of enhancement measures launched recently, including expanding the funding scope and increasing the funding ceiling[9].

The CITF is established to encourage wider adoption of innovative constructive methods and new technologies in the construction industry with a view to promoting productivity, uplifting built quality, improving site safety and enhancing environmental performance. The CITF is dedicated to:

A. encourage wider adoption of innovative construction methods and technology in the construction industry (in short, technology adoption), and
B. build up the capacity of industry practitioners (ranging from skilled workers to professionals) and tertiary students of construction-related disciplines to build an innovative culture and foster the mind-set to espouse new technology for the continuous improvement of the industry (in short, manpower development).

Eligible Applications

a. Levy-paying Contractors

Levy-paying contractors which have paid levy for construction works under the Construction Industry Council Ordinance (Cap. 587) to the CIC in the 24 months preceding the time of application

b. Registered Specialist Trade Contractors Scheme and Registered Subcontractors

Specialist Trade Contractors and Subcontractors who are registered under the Registered Specialist Trade Contractors Scheme (RSTCS) and the Subcontractor Registration Scheme (SRS) operated by the CIC.

c. Consultants

Consultants on the lists maintained by Government and professional bodies, including

i. the Engineering and Associated Consultants Selection Board;
ii. the Architectural and Associated Consultants Selection Board;
iii. the Band 3 Architectural Consultants and the list of Registered Practices maintained by the Hong Kong Institute of Architects;
iv. the Band 3 Architectural Consultants maintained by the Association of Architectural Practices Ltd;
v. member companies of the Association of Consultant Quantity Surveyors;
vi. member companies of the Hong Kong Institute of Surveyors;
vii. member companies of the Association of Consulting Engineers of Hong Kong; or
viii. member companies of the Association of Registered Engineering Consultants

d. Other players in the construction process may be considered on a case-by-case basis

[9] The 2022-23 Budget Speech, https://www.budget.gov.hk/2022/eng/budget65.html

Remarks: For related enterprises i.e. enterprises with different business registration certificates but having the same individual(s) holding 30% or more ownership, they would be treated as one single enterprise in counting the funding ceiling per company)

CDE in CITF

CDE falls into the category of the Advanced Construction Technologies (ACT) of the CITF. CDE vendors or developers can help their CDE related products to apply for CITF Pre-Approved List or Non-pre-approved List. The CITF ACT Pre-Approved List can be found at https://www.citf.cic.hk/?route=search. Type the keyword "CDE" in the Technologies field to search for CDE related products that have been approved by CITF.

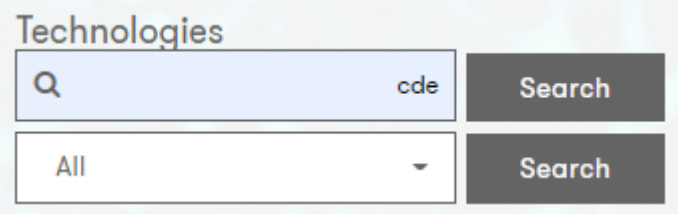


Fig. 5 – Type CDE as keyword to search CDE related products that have been approved by CITF in the CITF website

Apart from CITF ACT list, there are also many CDE products available in the market. It is suggested that interested parties shall contact CDE vendors or seek for relevant professional advice.

1.10.Integrated CDE

Integrated Common Data Environment (CDE) allows integrated and cross-disciplinary access to federated BIM (building data from built asset lifecycles), GIS (spatial and geographic data) and other data. It enables the data to be stored, accessed, reviewed, monitored, analysed and shared across the full asset lift-cycle and connect the full information management potentials of an enterprise.

The key concepts of CDE are ‘integration’ and ‘single source of truth’. ‘Integration’ can break down data silos and allows users to get the holistic picture. ‘Single source of information’ allows source tracing which ensures information reliability.

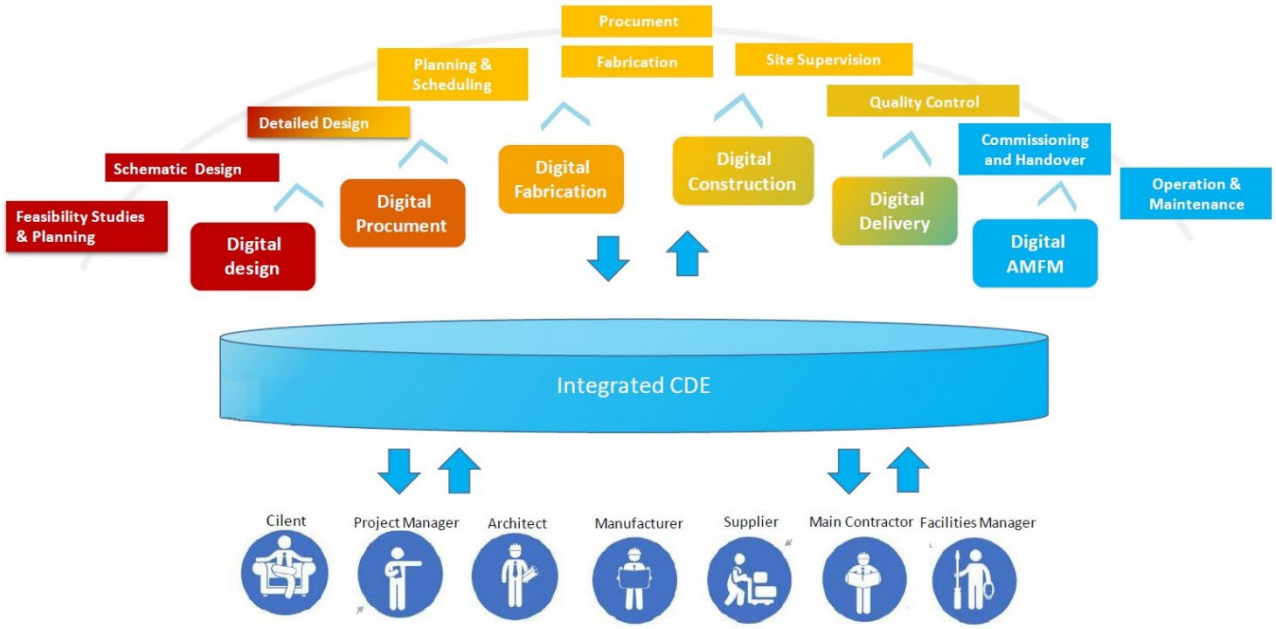


Fig. 6 – An Integrated CDE to be the common platform for a built asset covering the full asset lifecycle

The CIC Construction Digitalisation Roadmap (2021) has identified six high-value digital application areas (DAs). They can be the conceivable future for some of the key applications from Integrated CDE. Among the DAs, Smart Data Sharing is the “core” of construction digitalisation. Both Common Spatial Data Infrastructure (CSDI) and Common Data Environment (CDE) can facilitate collaboration among all stakeholders on a city or project level. Every stakeholder can contribute information to and extract information from the central portal. By enabling a seamless flow of information among stakeholders across the built asset lifecycle, Hong Kong’s construction industry will transition to a new digital era and the industry know-how will be continuously built up[10].

[10] The CIC Construction Digitalisation Roadmap for Hong Kong 2021

The six high-value digital application areas (DAs):

DA 1 – Smart Data Sharing

DA 2 – Smart Planning and Design

DA 3 – Smart Submission with BIM

DA 4 – Smart Offsite Fabrication and Delivery

DA 5 – Smart Site Management

DA 6 – Smart Asset and Facility Management (Smart AM/FM)

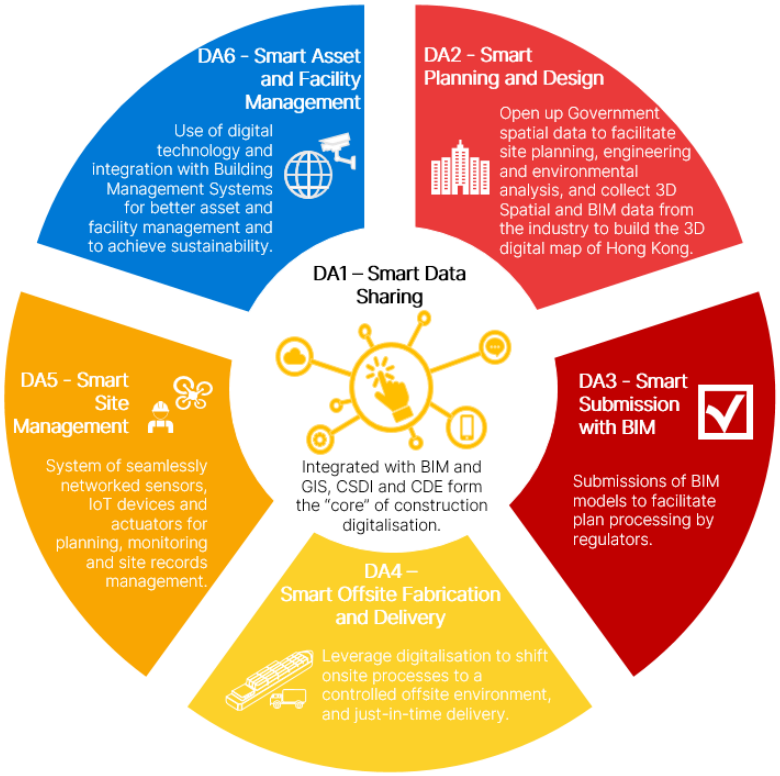


Fig. 7 – Six high-value digital application areas (DAs) as identified in the CIC Construction Digitalisation Roadmap for Hong Kong (2021)

2.Advice in selection of a CDE

As a rule of thumb, the Common Data Environment (CDE) should be able to manage project information and asset information (e.g. BIM models, drawings, documents) in accordance with CIC BIM Standards – General (CICBIMS) and ISO 19650.

This section provides practical advice on the general consideration when selecting a CDE. The advice is applicable to any CDE to be used in any project stage. It is understood that the requirements and expectations on a CDE for different projects may vary. This Guide will only focus on the most essential areas that any CDE must include.

It is suggested that this Guide should be used in conjunction with the CICBIMS. This Guide provides holistic and general considerations when selecting a CDE for any given project and asset in any stage of the built asset lifecycle, whereas the CICBIMS provides detailed explanations on the topics such as CDE Gateways, CDE Process Requirements and Information Management Workflow which are important when considering the information requirements and implementation of CDE. This section can act as supplementary information to Section 4.3 – The CDE Functional Requirements of the CICBIMS.

This Guide and the CICBIMS together stipulate the general principles, workflows, requirements and considerations of CDE as an information management tool for BIM. It is strongly recommended that companies examine and assess the CDE solutions thoroughly, or obtain professional advice from CIC-Certified BIM Managers (CCBM), CDE or IT-related professionals to ensure the chosen CDE solutions can meet the goals and expectations as required.

2.1. General area

(A) Advice on general area		
1.	IT security	The CDE solution provider should have sound information security management practices and controls, e.g. globally recognised industry security standards such as ISO 27001 or ISO 27017.
2.	Data security	The CDE should contain encryption function for data security.
3.	Anti-virus	The CDE should be installed with anti-virus software and maintained with updated security patches for all software. It is preferable to have initial virus scanning of files whenever they are uploaded to the CDE.
4.	Data storage	The CDE should support data storage for file uploading, downloading, sharing, publishing, archiving, etc. It is preferable that the CDE solution can provide direct plugin or equivalent feature that can facilitate uploading of BIM files from a local computer to the CDE.
5.	Data backup and recovery	The CDE should have back-up system in the event of failure or outage of the existing system to avoid interruption of services, e.g. daily backup and off-site backup for the project information in which the backup media should be stored securely away from the working office.

(A) Advice on general area		
		The CDE should have effective data backup and disaster recovery arrangements, e.g. Tier 4 Disaster Recovery
6.	Data archive	The CDE should provide a feature of project archive for all project files and information. For project files, consideration should be taken if the archived file format and folder structure are user-customisable to meet the Appointing Party's / Client's requirements. For audit trail, please refer to Section 2.5.
7.	Data / folder structure	The CDE should provide a user-customisable sectional / categorisable data or folder structure.
		Remarks: Some CDE products claim that they can provide data/folder structure templates that are compliant with the relevant ISO standards (e.g. ISO 19650). Companies should thoroughly examine if such folder/data templates can truly follow those standards and suit the project's needs.
8.	Hardware and software requirements	In general, most CDEs rely heavily on web browser or mobile devices on launching the CDE system/solution. As such, hardware and software requirements on running a CDE are insignificant as compared with those for BIM, CAD or 3D design authoring software.
		Remarks: If the CDE is setup on-premises, the additional cost (e.g. setup and maintenance) of hardware and software should be taken into account.
9.	Technical and customer support	The CDE vendors or solution developers should be able to provide efficient technical and customer support (e.g. email, phone and online ticketing system).
		Remarks: **There have been various issues regarding the disruption of service of a CDE, such as cloud server delay, suspension, backup failure and server down which cannot be fixed by the project team. Such service interruption may have undesirable impact on the progress of the project depending on the severity and duration of the interruption. Hence, good local technical, customer and training supports, and service agreement are particularly important for a CDE.**
10.	User friendliness	The interface and setup of a CDE should be user-friendly and intuitive to encourage and facilitate the CDE users to use it. Complicated interface and settings will have a deterring effect on users, especially inexperienced computer or mobile app users.
11.	API	The CDE should provide Application Programming Interfaces (API)s for communication or integration with other potential technologies/system, e.g. Geographic Information System (GIS), Internet of Things (IoT), site supervision system, etc.

2.2. CDE hosted in the cloud environment

CDE can be hosted in the cloud or on-premises environment. In practice, most CDE products are hosted in the cloud environment. There are mainly four types of cloud model for CDE as shown in Fig. 8. In general, public cloud for CDE is more economical than others as the IT infrastructure of the public cloud is provided and maintained by external Cloud Service Provider.

A discussion of the selection of cloud service provider is outside the scope of this Guide. It is suggested that companies should obtain professional advice from IT-related professionals on this area.

Aspects	Public cloud	Private cloud	Community Cloud	Hybrid cloud
Description	Publicly available cloud service provider.	Also called internal or corporate cloud, is defined as computing service offered either over the Internet or a private internal network and only to selected users instead of the general public.	For exclusive use by a specific community of consumers from organisations that have common goals, interests and/or shared concerns	A combination of public and private cloud services, maintained by both internal and external providers and with coordination between the two.
Service Delivery	Delivered over the Internet	Delivered via a (virtual) private network	Delivered via a (virtual) private network	Combination of Internet and private networks
Service Level Agreement (SLA)	SLA defined by Cloud Service Provider	SLA defined by the organisation	Shared SLA by participating organisations	Mix of different SLAs
Is it common as a host for CDE?	Common	Less common	Rare	Rare
Initial setup cost	Lower	Higher	Depends	Higher
Examples	CDE hosted in Alibaba Cloud, HUAWEI Cloud, Microsoft Azure and Amazon AWS	Internal government CDE hosted in infrastructure provisioned for exclusive use by the Government departments.	CDE for community of the Government and Non-Government Organisations with shared business needs	A private cloud CDE connected to a public cloud service for capacity needs that cannot be met by the private cloud.

Fig. 8 – Four possible types of cloud models for CDE

2.2.1. Advice on selection of CDE in public or private cloud environment

(B) Advice on selection of CDE in public or private cloud environment				
No.	**Item**	**Answer**	**Advice on CDE**	
1.	Does the project involve any sensitive project information that is not allowed to be stored in public cloud?	Yes	Private cloud	
		No	Public cloud	
Remark: Companies should conduct any required internal or external Information Technology (IT) security risk assessment to ensure any sensitive project information can be stored in public cloud.				
Remark: For government projects, it is suggested that the CDE should be configured and managed to comply with the latest relevant Office of the Government Chief Information Officer (OGCIO)'s Information Technology (IT) security requirements, such as Practice Guide for Cloud Computing Security (ISPG-SM04) and the prevailing Security Regulations of the Security Bureau. [11] For details, please refer to https://www.ogcio.gov.hk/en/our_work/information_cyber_security/government/				
2.	Does the project involve any sensitive project information that data sovereignty is a concern?	Yes	Private cloud or public cloud (that allows buyer to choose cloud service provider and location of the data center for the data storage and hosting of the CDE)	
		No	Public cloud	
Remark: Data sovereignty (sometimes known as data residency) refers to the location(s) where the data is to be physically stored. Security concern on data sovereignty can be associated with geopolitical risk that may have influence on the governance and operation of the data centre and the cloud service provider, which may cause undesirable service delay, disruption or data leakage. For more information, please refer to Practice Guide for Cloud Computing Security [ISPG-SM04], Version 1.2, OGCIO.				
Remark: Some CDE products do not allow customer to have choice of the public cloud service providers.				
3.	Is there any overseas consultant or production team stationed outside HK that needs to access the CDE frequently?	Yes	CDE with appropriate Cloud Data Center location.	
		No	Any CDE solution is fine	
Remark: "Appropriate" here refers to the data center location for the storage and hosting of CDE. Some countries may have limitations on network accessibility and speed outside their regions (e.g. BIM production teams from China that need to access the CDE hosted in Singapore data center).				

[11] DEVB(W) 430/80/01, Information Security of Project Data, Development Bureau Technical Circular (Works) No. 12/2020 Adoption of Building Information Modelling for Capital Works Projects in Hong Kong

2.3. User Licences in CDE

There are several items that will affect the price of CDE solution (excluding the CDE features). Fig. 9 shows a simple price example of CDE for reference.

2.3.1. Subscription/Perpetual

Subscription

Many CDE products offer subscription period for the use of CDE. This means the buyer of the CDE "does not" really own the CDE system/solution. A 1-year, 2-year or 3-year subscription period is usually provided.

Users will not be able to access the CDE system/solution and the associated data if the subscription period is expired. It is suggested that the operator of the CDE shall perform project archive in certain stages of the project. Otherwise, data stored in the CDE will be erased within several months after the end of CDE subscription.

Perpetual

Some CDE products can be procured with perpetual licence, which means that the full CDE system/solution is owned by the buyers. In general, the CDE system/solution will be installed on-premises, such as in the company server or preferred data centre. CDE with perpetual and on-premises installation will likely involve initiation setup fee and annual maintenance fee (after the first year).

Some CDE products provide both pricing options for customer's need. For example, a subscription is used during the construction stage and a perpetual licence is used for the operation stage of built asset with the information stored in client's server or data centre.

2.3.2. Number of users

The number of users with access to the CDE is directly proportional to the cost of CDE products. In common, most CDE products only charge a single user level on the user account type. There are very few CDE products with user accounts categorised into full user or viewer user (e.g. user only with viewing rights in the CDE) which will have different price. Credit should be given to those CDE vendors with scalable flexibility on numbers of user.

2.3.3. Data storage capacity

CDE products commonly come with unlimited data storage capacity. Some CDE products offer options on the volume of data storage capacity but the costs are generally insignificant. It is often scalable on-demand and can be expanded easily upon request.

CDE	Storage Type	Storage	Subscription Period	Number of User	Price per year (HKD)
Product A	Public Cloud	Unlimited	3 years	25	$390,000
Product A	Public Cloud	Unlimited	3 years	100	$460,000
Product B	Public Cloud	Unlimited	1 year	100	$200,000
Product C	Public Cloud	300GB	1 year	Unlimited	$340,000
Product D	Public Cloud/On-premises	Unlimited	1 year	20	$260,000
Product D	Public Cloud/On-premises	Unlimited	1 year	150	$770,000
Product E	Public Cloud/On-premises	Unlimited	Perpetual	Unlimited	$440,000 *(one-off price)* + $100,000 *(Optional annual maintenance fee*
Product F	Public Cloud/On-premises	1TB	1 year	25	$120,000
Product G	Public Cloud/On-premises	Unlimited	1 year	25	$300,000
Product H	Public Cloud/On-premises	1TB	1 year	Unlimited	$50,000

Fig. 9 – Price example of CDE related products (2021)

2.3.4. Advice on licence consideration

(C) Subscription/Perpetual (2.2.1.)
In general, subscription licence provides more flexibility to users. Users can discontinue the subscription if they do not need it anymore. This arrangement is good for the Lead Appointed Parties (Lead Consultants or Main Contractors) who are likely to provide PIM CDE only in the project delivery stage.
Perpetual licence is in general more costly as an initial expense. Also, it may involve on-premises setup fee and optional annual maintenance fee as a long run. It is more suitable for: a. Large Lead Appointed Parties (Lead Consultants or Main Contractors) that have constant supply of new projects, such that a perpetual licence CDE can be setup as a long-term investment of the companies. b. Client (Appointing Parties) that require an enterprise/departmental CDE or AIM CDE for long-term use.

(D) Number of users (2.2.2.)	
Not all project members need a CDE user account. The BIM Manager should decide the parties/personnel to be provided with the CDE user accounts.	
Some examples for reference:	
Project Type	No. of user needed
A single block of building development	<25 CDE users
A mixed-use residential and retail development	<50 CDE users
A large client or developer that has internal AM/FM team for the use of an AIM CDE	>100 CDE users

(E) Data storage capacity (2.2.3.)
For those CDE products with limitation on data storage capacity, the BIM Manager should estimate the need of storage capacity of CDE for the project. The need for storing extra-large files (e.g. 300MB above), such as for BIM models and 3D scanning point cloud files, should be taken into consideration.

2.4. Network access to project data

CDE shall provide a user-customisable security access right control and management system. Advice on the network access to project data is shown below:

2.4.1. Advice on network access of CDE

(F) Advice on network access of CDE		
No.	Item	Example
1.	Setup of users with companies in the CDE and assign users to their respective companies;	Allow company names to be created under clients, consultants, contractors, other specialists, etc.
2.	Setup of users with groups, which determine their roles and permissions to execute certain actions and access certain information in the CDE;	Allow user roles created under Viewer, Editor, Reviewer, Approver, Administrator, etc.
3.	Provide password-protected admin and user logon;	Customisable rule on the setup of password for admin. E.g. password compositions with capital and small letters and special characters (Notes: It should support a password with no less than eight digits).
4.	Control file and folder permissions to prevent any unauthorised access;	Forbid the Client to enter the information stored in the Work in Progress (WIP) information container.
5.	Provide access right control according to ownership and roles at both individual and company level	Allow the user role “Viewer” granted with access right to view the BIM models in the “Shared” information container only.
6.	Provide user management on their own details and user access credentials;	Allow users to change, such as password or basic user information.
7.	Allow access from portable devices and web applications	Suggest to have two-factor authentication (2FA), such as One-Time Passwords, biometrics and digital certificates.
8.		Prefer not to only rely on any plugins but to give support working flawlessly on web browser, such as Google Chrome, Microsoft Edge, Apple Safari, and native browsers on iOS, Android or Harmony OS devices.
9.	Provide secured file access and sharing to public / guest users	Provide password protected link / time-limited file access

2.5. Project coordination in CDE

The CDE should include built-in or less preferable 3rd party web viewer to review 2D CAD drawings and 3D BIM models for project coordination. The viewer should be supported with a comprehensive issue management systems as described below:

2D content coordination

Support review, comment, and mark-up procedures for **documentation formats** and versions (e.g. jpeg, pdf, 2D CAD drawings).

3D content coordination

Support collaborative review, comment, and mark-up procedures for **information models** and versions (e.g. ifc, gbxml, bcf).

Issue management systems

Provide an issue tracking system, including the issue registration, logging, update, and email notification to the selected user account, or as assigned in the issue workflows.

2.5.1. Advice on project coordination in CDE

(G) Advice on project coordination in CDE		
1.	Interoperability between the CDE and the major BIM design authoring software in the project	The selected BIM design authoring software in the project can have big influence on the selection of the project CDE, especially for the PIM. In general, CDE solution and BIM design software that are both developed by the same software company will have better interoperability and more intuitive BIM coordination features (e.g. In-app 3D spatial coordination and reporting) in the CDE.
2.	2D viewer	No specific advice as most CDE products perform well in this area.
		Remarks: Some CDE can provide auto-compare feature on document files (e.g. pdf) with different version/revision. It can improve the efficiency and reduce the time on reviewing latest documents shared in the CDE. Note that the performance of the auto-compare feature may be varied among different CDE products.
3.	3D viewer	The display features of CDE should enable user to navigate around a model in 3D, search for any information or objects, click on objects and see associated data, information and documents.
4.	Display scalability on BIM models	The CDE should have adaptive display capability to display BIM models effectively with optimised loading time, e.g. able to instantly display BIM models for project coordination purpose without loading the full BIM models in the CDE
		Remarks: Loading time of BIM models in the CDE is crucial. Although the loading time could be affected by many factors, it is suggested that companies should perform certain tests before procuring the CDE solution. For example, a check of the streaming performance of a BIM model in CDE

(G) Advice on project coordination in CDE		
		and cache download features of files from CDE to various devices should be carried out.
5.	Display filters	The CDE should have various display filters to support review of BIM models, e.g. display filter by file, level, discipline and category.
6.	Display of federated BIM models	The CDE should be able to display single or federated (multi-discipline) BIM models in the 3D web viewer of the CDE to facilitate project coordination.
		Remarks: Some CDE products can select and display multiple BIM files as federated BIM models directly in the CDE. Such feature is recommended as it facilitates CDE users with higher flexibility to review the BIM models instantly in CDE without uploading/downloading files for BIM model federation.
7.	Issue management	The issue system in CDE should be user-friendly and with intuitive interface.
8.		Issues should contain spatial information for the users to refer to in the BIM models. It is more preferable if issues raised in the CDE can be directly associated with the BIM models/objects in the 3D view, to facilitate 3D coordination.
		Remarks: Some CDE products support the use of open BIM Collaboration Format (BCF) to facilitate BIM coordination across different CDE and it is recommended.
9.		It is preferable to have customisable issue management systems in the CDE to suit specific project needs.
10.		The issue logs and histories should be secured and cannot be tampered. It should be easily traced or searched to facilitate communication and audit trail.

2.6. Workflow management in CDE

In principle, the CDE should support the information/collaboration management processes as stipulated in the CICBIMS (Section 4.2 and 4.4) and support user-configurable customisation.

On the other hand, it should also support uploading, downloading, information models and documentation, and 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). Note that the level of metadata interoperability between BIM models/documents (native or open format) and CDE varies among different CDE products in the market. Apparently, the industry is still in the early development stage in this area and there is still plenty of room for improvement.

Audit Trail refers to a chronological record that reconstructs and examines the sequence of activities surrounding or leading to a specific operation, procedure, or event in a security relevant transaction from inception to final result[12]. In CDE, a full audit trail of information production should be made available for use during and after each project delivery and asset management activity. For example, a full track record of the approval/review/check log of a BIM model stored in the CDE throughout the construction stage of a project should be made available during or after the project delivery.

The CDE is just a tool to provide workflow management. The definition of workflows of specific projects would depend on the company standards and needs. For more details about setup of information management workflow, please refer to CICBIMS.

2.6.1. Advice on workflow management in CDE

(H) Advice on workflow management in CDE		
1.	CDE Gateway in CICBIMS *(Section 4.2 and 4.4.1)*	The CDE should be able to create user-customisable setup of the essential CDE gateway and information containers in the CDE workflow setting. There should be a facility for the information/file to update its status of information container automatically along its progression in the designated workflow.
		Remarks: Some CDE products can only change the information/file's information container status by manually moving or copying the information/file to those information containers, which is not recommended.
2.	Status Code, Revision Code and Authorisation Code in CICBIMS *(Section 4.4.2 – 4.4.4, 4.4.8-4.4.9, LA.4)*	The CDE should be able to create user-customisable setup of the essential information containers, such as Status Code, Revision Code and Authorisation Code in the CDE workflow setting. Ideally, there should be a facility for information/file to update its status of information container automatically along its progression in the designated workflow.
		Remarks: Status Code, Revision Code and Authorisation Code are suggested in the form attributed metadata in the CDE. Some CDE products do not have automatic update features for the

[12] National Information Assurance (IA) Glossary, Committee on National Security Systems 2010

		abovementioned information containers. As such, those metadata can only be input and updated manually along the progression of the designated workflow.
3.	Version control in CICBIMS *(Section 4.4.9)*	Most CDE products have automatic version control and the iteration development of file during WIP can be grouped and stored in the CDE.
4.	File naming	The CDE should provide user-customisable file naming feature. It is recommended that this file naming feature is automatic or with auto-checking feature that will alert users if the uploaded file does not comply with the file naming rules setup in the CDE.
		Remarks: Some CDE products have provided preset naming rule templates compliant with ISO 19650.
5.	Audit trail	The CDE should be able to provide full traceability which include, but are not limited to, tracking the events uploaded, issued, accessed, read, edited, moved, downloaded, status changed and distributed information and shall include date of action and the person making the action should also be provided. There are mainly two ways for a CDE product to maintain the audit trail after the project delivery: • To export the files and audit trail away from the CDE. • To maintain the virtual project environment (preferably read-only interface) of the CDE after project completion (e.g. read-only status) so that all files and audit trail are kept intact.
		Remarks: There is great variance in the performance of the CDE products in the market in providing the audit trail (e.g. completeness, readability and format of the audit trail). Companies should examine if the output of audit trail from the CDE products can fulfil the project's or company's standards.
6.	Dashboard & Reporting	The CDE should be able to extract and utilise project data to perform various data analysis and reporting. It is preferred that the CDE can provide flexible and user-customisable dashboard and report module to CDE users (e.g. executives, senior managers, middle managers, designers, etc) to allow them to create their customised dashboard and reporting to suit their own needs. The CDE should be able to provide real-time dashboard on reporting the status of document(s) submission, review, approval, pending actions, etc., for quality performance analysis. Dashboard interface should be provided to alert users of any updates or changes to information and a summary of incoming and outgoing tasks.

3.Annex A – Checklist on major features of a CDE

(A) General Area			Yes	No
1.	IT security	The CDE solution provider/developer has sound information security management practices and controls, e.g. globally recognised industry security standards such as ISO 27001 or ISO 27017, or other, please specify:_____		
2.	Data security	The CDE solution has encryption function for data security.		
3.	Anti-virus	The CDE solution has been installed with anti-virus software.		
4.		The CDE solution has been regularly maintained and updated with the latest security patches for all software.		
5.		The CDE solution has initial virus scanning features for files uploaded to it.		
6.	Data storage	The CDE solution can provide data storage for, such as file uploading, downloading, sharing, publishing and archiving.		
7.		The CDE solution has direct plugin or equivalent feature that can facilitate uploading of BIM files in local computer, e.g. one-click plugin in BIM software to upload working BIM files to the CDE.		
8.	Data backup and recovery	The CDE solution has off-site back-up system in the event of failure or outage of the existing system to avoid any interruption of services.		
9.		The CDE solution has daily backup capability in which the backup media should be stored securely away from the working office. Or please specify if there are other time intervals required:_____		
10.		The CDE solution has an effective data backup and disaster recovery arrangements, e.g. Tier 4 Disaster Recovery, or other, please specify:_____		
11.	Data archive	The CDE solution provides a feature of project archive for all project files, information and audit trail.		
		The CDE solution can provide user-customisable file format and folder structure for project file archive. Please specify the required file formats for project archive:_____		

(A) General Area			Yes	No
12.	Data / folder structure	The CDE solution can provide a user-customisable sectional / categorisable data or folder structure.		
13.		The CDE solution can provide data/folder structure templates that are compliant with any global or local standards (e.g. ISO 19650), or others, please specify:_____		
14.	Hardware and software requirements	The CDE solution can be ran smoothly with the computers, laptops and tablets for normal office uses that it has no special requirement on the hardware and software for the captioned devices.		
15.		If the CDE solution to be setup in premises, please list out the specifications of hardware and software required.		
16.	Technical, customer and support of CDE	The CDE solution has an efficient local/non-local customer support (e.g. email, phone and online ticketing system). Please specify:_____		
17.		The CDE solution has an efficient local/non-local technical support (e.g. email, phone and online ticketing system). Please specify:_____		
18.	User friendliness	The setup and interface of the CDE solution are user-friendly and intuitive.		
19.		The interface of the CDE solution is suitable for all levels of CDE user as stated below: - Client Representative - Project Director - Project Manager - Discipline Lead - Contractor - Project Coordinator - Others, please specify:_____		
20.	API	The CDE solution provides Application Programming Interfaces (API)s for communication or integration with other potential technologies/system, e.g. GIS, IoT, site supervision system, or others, please specify:_____		

(B) Hosting of the CDE solution						
1.	Cloud environment	The CDE solution and the data can be hosted and stored in a secure cloud-based or on-premises environment. (Please tick as appropriate). Or other, please specify:_____ _____		Please name the cloud service providers for below options:		
				Public cloud		
				Private cloud		
				Community cloud		
				Hybrid cloud		
2.	Data sovereignty	The CDE solution can provide options on choosing the cloud service providers and location of their associated data centers. Please specify:_____			Yes	No

(C) Licence model of CDE					
1.	The CDE solution provides subscription and/or perpetual licence model for the procurement of CDE. (Please tick as appropriate)		Subscription	Period	Price
			Perpetual	Please list out the costs:	

(D) Number of CDE users			Yes	No
1.	No. of users	The CDE solution provides options on the number of CDE users. Please specify the options :_____		
2.		The number of CDE users is expandable during the service period.		
(E) Data storage capacity of CDE			Yes	No
1.	Data storage capacity	The CDE solution provides unlimited data storage capacity during the service period		
2.		The CDE solution provides scalable data storage capacity during the service period. Please specify the scalable option:_____		
(F) Network access of CDE			Yes	No
1.	Setup of users with companies in the CDE and assign users to their respective companies;			
2.	Setup of users with groups, which determine their roles and permissions to execute certain actions and access certain information in the CDE;			
3.	Provide password-protected admin and user logon;			
4.	File and folder permissions should be controlled to prevent any unauthorised access;			
5.	Access right control according to ownership and roles at both individual and company level			

(F) Network access of CDE			Yes	No
6.	Users management on their own details and user access credentials;			
7.	Allow access from portable devices and web applications, provide two-factor authentication (2FA) such as One-Time Passwords, biometrics and digital certificates.			
8.	The CDE solution can be ran not to rely on any plugins but also support working flawlessly on most common web browser. Or please specify the required systems:_____			
9.	Secured file access and sharing to public / guest users such as password protected link / time-limited file access			
(G) Project coordination in CDE			Yes	No
1.	Interoperability between the CDE and the major BIM design authoring software in the project	The CDE solution has direct BIM coordination features or plugin with any proprietary BIM design authoring software that makes it distinctive from others. Please specify:_____		
2.	2D viewer	The CDE solution provides 2D viewer feature on common digital document file format (e.g. pdf). Please specify other 2D viewer features: _____		
3.	3D viewer	The CDE solution provides 3D viewer feature that enable user to navigate around a model in 3D, search for any information or objects, click on objects and see associated data, information and documents.		
4.	Display scalability on BIM models	The CDE solution has adaptive display capability to display BIM models effectively with optimised loading time, e.g. to instantly display BIM models for project coordination purpose without loading the full BIM models in the CDE.		
5.	Display filters	The CDE solution has display filters to support review of BIM models, such as display filter by file, level, discipline and category. Or other similar features, please specify:_____		
6.	Display of federated BIM models	The CDE solution can display single or federated (multi-discipline) BIM models in the 3D web viewer of CDE to facilitate project coordination.		
7.	Issue management	The CDE solution has an user-friendly and intuitive interface for the issue system, including viewing, making, editing, tracking and management of the issues.		

(G) Project coordination in CDE			Yes	No
8.	Issue management	Issues should contain spatial information for the users to refer to in the BIM models. It is more preferable if issues raised in the CDE can be directly associated with the BIM models/objects in the 3D view, to facilitate 3D coordination, e.g. support the use of BCF.		
9.		The CDE solution can provide customisable (preferable) issue management systems to suit specific project needs.		
10.		The issue logs and histories should be secured and cannot be tampered. It should be easily traced or searched to facilitate communication and audit trail.		
(H) Advice on workflow management in CDE			Yes	No
1.	CDE Gateway in CICBIMS	The CDE solution can create user-customisable setup on the essential CDE gateway and information containers in the CDE workflow setting. There should be a facility for the information/file to update its status of information container automatically along its progression in the designated workflow.		
2.	Status Code, Revision Code and Authorisation Code	The CDE solution can create user-customisable setup on the essential information containers such as Status Code, Revision Code and Authorisation Code in the CDE workflow setting. Ideally, there should be a facility for the information/file to update its status of information container automatically along its progression in the designated workflow.		
3.	Version control	The CDE solution has automatic version control which iteration development of file during WIP can be grouped and stored in the CDE.		
4.	File naming	The CDE solution can provide user-customisable file naming feature.		
5.		The CDE solution can provide an automatic or auto-checking feature (preferable) to alert users if the uploaded file does not comply with the file naming rules setup in CDE.		
6.	Audit trail	The CDE solution can provide full traceability which include, but not be limited to, tracking the events upload, issue, accessed, read, edited, moved, downloaded, status changed and distributed information and shall include date and by whom the action was carried out.		
7.	Dashboard & Reporting	The CDE solution can provide flexible and user-customisable dashboard & reporting features to extract and utilise project data to perform various data analysis and reporting.		

(H) Advice on workflow management in CDE			Yes	No
8.		The CDE solution can provide real-time dashboard on reporting the status of document(s) submission, review, approval, pending actions, etc. for quality performance analysis. Dashboard interface should be provided to alert users of any updates or changes to information and a summary of incoming and outgoing tasks.		

4.Annex B – Checklist on digital site management

Common Smart applications enabled by CDE during Construction stages:

Area	Application	Function
Data Management	Data compatibility	Photo, video, CAD, BIM, point cloud, sensor data and document support and viewing
	Data processing	Photo, video, CAD, BIM, point cloud, sensor data and document processing/ conversion
	Data Analysis and Workflow	Data analytic
		Dashboard
		Command centre visualisation (e.g. digital twins 3D rendering of site, visualisation of alert and notification location)
		Geo-referencing of data
		Geotechnical analysis
		Manual/ automatic report generation
		Manual/ automated workflow
		Mobile App or Digital platform web portal
		Task handling (e.g. Task assignment)
		Checklist and report compilation
Progress Monitoring	Site Record	Request for Inspection/ Survey Check (RISC) Form
		Site Diary/Site Record Book
		Labour Return Record
	Inspection Checklist	Site Safety Inspection Records
		Cleansing Inspection Checklists
		Quality Inspection Checklist

Area	Application	Function
		Environmental Inspection Checklist
	Defect/ Outstanding Work Monitoring	Site Defect / Outstanding Work Inspection
		Automatic comparison of site image and design
		Drone for external inspection
Safety Monitoring	Personal Protective Equipment (PPE) Checking	Safety Helmet
		Reflective Vest
		Life jacket
		Safety shoes
		Wrist band / smart watch
	Well-being Monitoring	Workers' location tracking
		Body temperature
		Heartbeat
		Blood pressure
		Sudden fall
		Motionless
	Workers' Behaviour Monitoring	Smoking
		Driver sleeping
		Driver using mobile phone
		Driver motionless
		People count based on different vests and helmets
	Hazardous Area Zoning/ Access Control	Truck licence plate detection
		Truck delivery and analytics

Area	Application	Function
		Face recognition for access control
		Anti-collision / Machinery safety distance - Sensor-based
		Anti-collision / Machinery safety distance - AI-based
		Restricted zone / Danger zone - Sensor-based
		Restricted zone / Danger zone - AI- based
		Fall from height prevention
		Fire hazard detection and alarming
		Crane for working platform and crane operation CCTV
Site Monitoring	Site Environment Condition Monitoring	Noise
		Vibration (e.g. crane vibration)
		Titling / Inclination
		Displacement
		Settlement
		External sensor compatibility
		Dust/ Air quality (e.g. underground and confined space IAQ)
		Harmful gas (e.g. ad hoc welding location, storage location)
		Fire
		Water level and/or leakage
		Gas leakage
		Electricity leakage (e.g. at MCB box)
	Building Element Monitoring	Loading

Area	Application	Function
		Concrete maturity
		Drainage piping assessment
	Equipment Status Monitoring	Equipment data
		Equipment location tracking
		Equipment operating data
		Fuel consumption
		Power system fault

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6.Committee on Building Information Modelling

The Task Force on BIM Standards

Membership List

Member	Representing Organisation / Remarks
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- Buildings Department
- Civil Engineering and Development Department
- Development Bureau
- Drainage Services Department
- Electrical and Mechanical Services Department
- Highways Department
- Hong Kong Housing Authority
- Hong Kong Institute of Utility Specialists
- Hospital Authority
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- 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
- The Hong Kong Institute of Surveyors
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- The Real Estate Developers Association of Hong Kong
- The West Kowloon Cultural District
- Urban Renewal Authority
- Water Supplies Department

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Feedback Form

CIC Beginner's Guide on Construction Digitalisation – Adoption of Common Data Environment (CDE) for Information Management using BIM

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

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2. **Does the publication enable you to understand more about the subject?**	Yes		No		No Comment
	❑		❑		❑
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	❑		❑		❑
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	❑	❑	❑	❑	❑
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