Department of Municipalities and Transport

Municipality of Abu Dhabi City

Municipal Infrastructure and Assets Sector

BUILDING INFORMATION MODELLING (BIM) DOCUMENTATION

BIM Documentation Guidelines for Infrastructure

Version 1.0

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Contents

BIM Glossary of Terms:

2D	Two-dimensional geometric representation (x, y)
3D	Three-dimensional geometric representation (x, y, z)
4D	The combination of three-dimensional geometric representation and time, including the construction sequencing, scheduling of resources, and quantities information, creates the fourth construction dimension.
5D	The analysis and estimation of the cost. Including the generation of bills of quantities and derivation of productivity rates and labour costs.
Appointed party/lead appointed party	The party who has signed an agreement or a contract to provide information concerning work or services with the appointing party/ The Employer. A lead appointed party shall be identified for each delivery team, such as the lead consultant and sub-consultants, the main contractor, and sub-contractors.
Appointing party	The provider of the information which will always be the Employer.
Appointment	Contract or agreement for involvement in information production concerning work or services.
Asset Information Requirements (AIR)	Data and information requirements of the organization in relation to the asset(s) it is responsible for.
Asset Information Model (AIM)	A Model developed to manage, maintain, and operate the asset(s) of which the project had comprised during the production to the Completion.
Author	The originator of model files, drawings, and/or documents.
BIM Execution Plan (BEP)	Defines the methodology to be adopted by the Project Team Member in respect of the production, sharing, and publication of the BIM Material.
Building Information Modelling (BIM)	An integrated collaboration process of designing, constructing, and/or operating a building or infrastructure asset using electronic object-oriented information throughout all project stages.
Clash Detection / Interference Check.	A process where software functionality allows for identification of spatial conflicts among BIM objects deriving from various interrelated building and infrastructure elements
Collaboration Site	A BIM management and collaboration platform that connects all involved parties through digital access to the Federated Model and data, as well as streamlining the BIM workflows during the entire lifecycle of a project.
Common Data Environment (CDE)	The single source of information used to collect, manage, and disseminate Project Information. It consists of the four states (Work-in-progress (WIP), Shared, Published, Archive) representing different stages of collaboration and three main gateways for approval and quality control QC.
BIM Submissions	Information on a particular format and level of detail issued to the Client at various project stages.

Delivery Phase	Stage of the life cycle where an asset to be developed. Such as concept phase, construction phase, and commissioning.
Element Level of Development (LOD)	The level of development of the information, including the structure and unstructured information.
Element Level of Detail (LOD)	The level of details of a model element.
Employer	The party is named as Employer under the Contract (Usually - Municipality).
Exchange Information Requirements (EIR)	A document that sets out the information to be delivered, the standards, and processes to be adopted by the Project Team Member as part of the project delivery process in relation to an appointment.
Facilities Management (FM)	The interdisciplinary process is devoted to the management and operation of buildings, structural objects, or infrastructure installations.
Federated Model	A Federated Model is a BIM model that links (does not merge), several single discipline models, into one. As opposed to an Integrated Model, Federated models do not merge the properties of individual models into a single database. They are linked as a reference. A Federated Model is primarily used for coordination, clash detection, design, and construction development.
File Naming Conventions	A set of rules for constructing unique and descriptive names for digital files. The rules specify the order and the length of words, phrases, or abbreviations used in the name.
Information Level of Detail (LOI)	The relevant level of information of a model element.
Integrated Model	An Integrated Model is a BIM model that aggregates several single discipline models into one. As opposed to the Federated Model, an Integrated Model merges all properties of individual models into a single database. Integrated models are deemed coordinated, clash-free, and contain all required deliverables as agreed and stated within the Project BIM Execution Plan.
ISO 19650	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) published by the International Standards organization ISO.
Life Cycle	Life of an asset from the day it is required and defined to the day it is demolished or terminated, passing through all phases of conception, detailing, construction, operation, maintenance and demolish
Material Quality Manager	Assure delivery of Material selection and information exchange, confirm material specification, Accept/reject materials information exchange within the common data environment.

Master Information Delivery Plan (MIDP)	The primary plan for when Project Information is to be prepared and by whom, as is produced by the Lead Consultant gathering all Task Information Delivery Plans (TIDP's)
Master Format	Master Format is a standard used for organizing specifications and other written information to assist the user in organizing design/ construction specifications into distinct groups.
Model Production and Delivery Table	Identifies the responsibilities for the production and delivery of Models in relation to the project.
Employer's LOD Matrix	The matrix identifying the applicable Levels of Detail/ Information to be used on the project as is approved by the appointing party (Employer).
Organizational Information Requirements (OIR)	Data and information required to achieve the organization's needs, necessities, and objectives
Object ID	Unique identity code that every element/ object is assigned in a Building Information Model for seamless data transfer between various applications.
PAS1192-2:2013	Specification for information management for the capital/delivery phase of construction projects using building information modelling and published by The British Standards Institution BSI. ISO 19650 is the equivalent International Standards.
Project BIM Execution Plan (BEP)	The BIM execution plan prepared by the lead appointed party post Contract award. Which defines the methodology it will adopt in respect of the production, sharing, and publication of the BIM Material, and how the requirements set in Exchange Information Requirements will be implemented.
Pre-appointment BIM Execution Plan (Pre-contract BEP)	Prepared by the appointed party during the tender response process to demonstrate their proposed approach, capability, and competence of bidder's firm and supply chain to meet the Exchange Information Requirements.
Project Information Model (PIM)	PIM is the term for the information (structured and unstructured information), which is developed during the design/construction phase of the project.
Project Information Requirements (PIR)	Information requirement in relation to the delivery of an asset as it defines the project BIM brief and project requirements to form an essential part of the EIR.
Project Team Members	The consultant is entering into the Contract with the Employer.
Property set	A property set is the content and advancement of any BIM Material (or part thereof) carrying all the element attributes.
Published state	Approved and uploaded or issued into the 'Published" state of the Common Data Environment (CDE).

Shared state	The information which has been issued with a status code identifying the Permitted Purpose for sharing with other project team members and uploaded or issued into the “shared” state of the (CDE).
Stakeholders	Consultants, Main contractor, and supply chain
Start Model	The initial project developed model containing the project coordinates and orientation. Typically developed by the design consultant and is shared with all project-related disciplines as a model of coordination reference.
Status Code	The code allocated to BIM Material identifying the Permitted Purpose of the information therein and describing the suitability of its contents.
Structured Information	Referring to geometrical models, material schedules, project schedules and databases.
Task Information Delivery Plan (TIDP)	Federated lists of information deliverables by each task, including format, date, and responsibilities. TIDP is expected to be compiled by individual project task teams and project suppliers for their scope of works and to be populated into the overall Master Information Delivery Plan (MIDP).
Task Information Manager	Task Information Manager is responsible for directing the production of task information in compliance with the project BIM standards and methods, using agreed systems within their project team, and verification of outputs to be submitted on the SmartHub/PMWeb.
Task Teams	Individuals assembled to perform a specific task within a delivery team.
UniFormat ll	UniFormat ll is an elemental classification system used for building specifications, cost estimating, and cost analysis.
Unstructured Information	Referring to documentation, video clips, and sound recording (e.g. rendering and work simulation developed with 3D Model)

1. Introduction

This document sets out the Digital Engineering Policy for Municipal Infrastructure and Asset Sector (MIAS). It provides an overview of the implementation plan of Building Information Modelling (BIM) processes and methodology in the delivery of infrastructure projects. This policy to be reviewed on a regular basis for continued suitability and circulated to all stakeholders.

This document outlines a new strategic direction by the Employer for the planning, investment, and delivery of Assets of infrastructure projects.

To achieve that, all stakeholders, designers, and constructors need first to embrace the processes outlined in this guideline and use it to maximize the efficiency and effectiveness of their particular part in the industry.

1.1. The purpose of this guideline

The guideline promotes the use of BIM throughout the delivery of Municipal Infrastructure and Assets Sector projects and improves the standards, Methods and Procedures for all stakeholders. The aim has been to create a centric document that follows the normal progression of the project, keeping the Employer's business, as usual, introducing new strategies and best practices for the following.

- Promotes the use of BIM throughout the project life cycle.
- Creates a common language for the industry to use.
- Clarifies the briefing process for designers and constructors.
- Clarifies the handover deliverables for designers and constructors.
- Improves the level of coordination in the design and construction phases.
- Promotes a more proactive approach to Asset Management.
- Creates a clear path for the future development of the industry.

The guideline does not cover every aspect of BIM in detail. Its primary focus is on the information management processes, standards, methods and procedures for BIM documentation and production of information throughout the project life cycle and asset delivery.

To realize the maximum benefits of BIM, the information/data created during the design, construction and handing over phases must be fed into ADM asset management systems using defined standards, methods, and procedures.

This guideline aims to reach Stage 2 maturity which is also identified as "BIM according to the ISO 19650 series", where a mixture of manual and automated information management processes is used to generate a federated information model.

1.2. The guideline contents

Adding to the Introduction above. The second section will demonstrate the BIM uses intended by the Municipal Infrastructure and Asset Sector implementing these standards.

The third section will explain the BIM information management processes and procedure for the BIM workflow throughout the design and construction phases for the Employer's capital projects and outlines the same process for all stakeholders in the development projects.

The fourth section will be a list of newly introduced documents supporting the BIM information processes.

The fifth section will highlight the BIM management requirements, roles and responsibilities and submissions procedures through the Employer's Common Data Environment (CDE) and to explain the BIM measures to confirm the stakeholders' BIM capability and capacity to be certified for carrying out projects under BIM.

The sixth section will focus on standards introduced for BIM management of the information to be delivered during the project life cycle.

1.3. What is BIM

There are many definitions of BIM (Building Information Modelling) that can be found in research documentation, all of which have a common theme that BIM is a process focused on information management using shared digital representation of a built asset to facilitate design, construction and operation processes to form a reliable basis for decisions.

"BIM is a digital representation of the physical and functional characteristics of a building. As such, it serves as a shared knowledge resource for information about a building, forming a reliable basis for decisions during its life cycle from inception onward." The definition by Building Smart International.

BIM is defined as the use of a shared digital representation of a built asset to facilitate design, construction, and operation processes to form a reliable basis of decisions. Where built assets include, but not limited to, buildings, bridges, roads, process plants. (The definition by Iso 19650)

Municipal Infrastructure and Asset Sector is committed to the implementation of Digital Engineering and fully supports the collaborative working approach for the design, construction, operation, and management of all assets and will work with all stakeholders including Consultants, Contractors, and Service providers to achieve the benefits of an integrated Digital Engineering framework.

The Digital Engineering Framework, incorporating BIM, is a comprehensive approach involving the generation and management of infrastructure assets using 3D digital representations of their physical and functional characteristics. Digital Engineering includes the implementation of BIM technology and processes throughout the Infrastructure acquisition, management, and operations lifecycle. Which can be achieved through building 3D intelligent models for the various disciplines, construction simulation, virtual and augmented reality, 3D scan, digital fabrication, O&M digital applications and more. All new technologies are developing and enhancing the processes of collaboration and coordination between design and construction teams and the way of design, construction, and operations of assets.

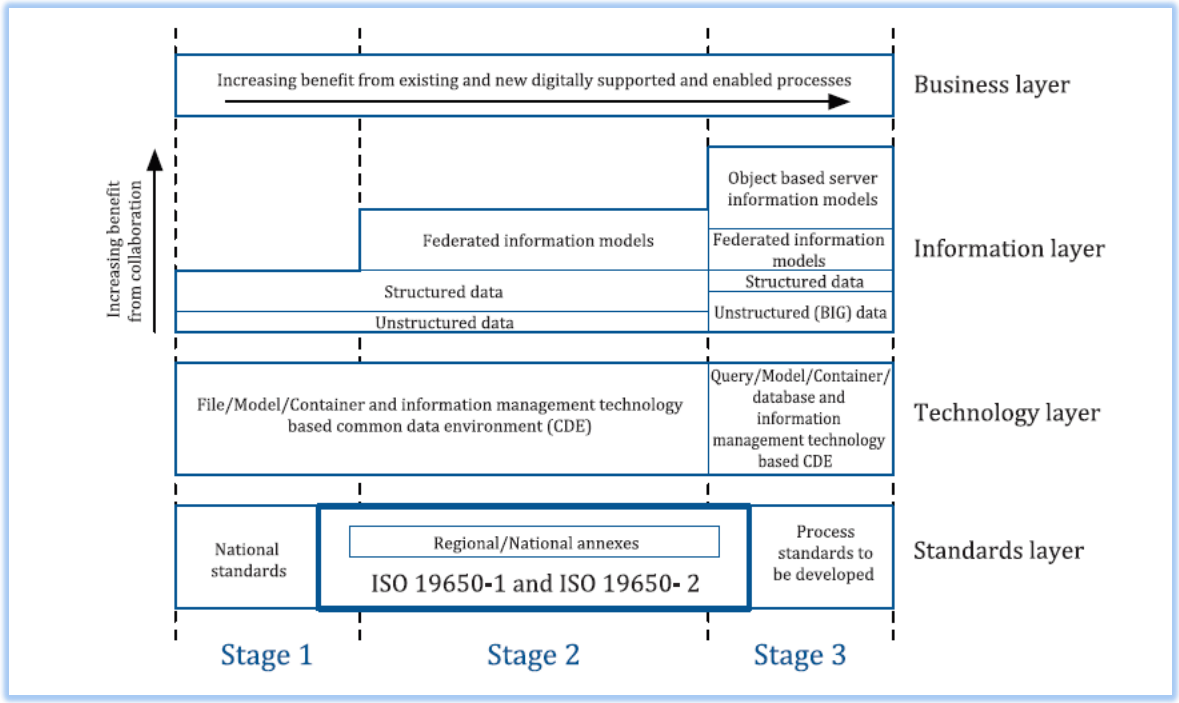
BIM is the process of creating digital data sets consisting of structured information such as (graphical (3D models), schedules and database) and unstructured information such as (non-graphical information documents, videos, recording audios and screenshots) in a shared digital space known as a Common Data Environment (CDE).

The non-graphical information is linked to the graphical 3D Model. When you explore and click on different parts of the 3D representation, you will be able to access the information about it. Clicking on an object, for example, might give you information on its material type, quantity, cost, and spatial location, just to name a few of the attributes that can be assigned to the object. This information is known as a "data set" or "information model".

The key principle is that BIM is not any single act or process. It is not creating a 3D model in isolation from others or utilizing the computer-based design. It is aware of the information needs of others as you undertake your part of the process.

Information management according to ISO 19650 series

Information management can be represented as a sequence of maturity stages, shown as stage 1, 2, and 3 in Diagram 01. This diagram shows the development of standards, advances in the technology and more sophisticated forms of information management all combine to deliver increased business benefit.



@ ISO 19650- Diagram 01- A perspective on stages of maturity of analogue and digital information management.

1.4. Benefits of BIM

BIM delivers benefits throughout the entire project life cycle. These benefits below are enhanced when the process is considered as a whole, and the information/data requirements are coordinated. The table below shows the most direct benefits can be achieved throughout the project life cycle.

Cost savings		
Improved design process	Reduced construction cost	Reduced operations and maintenance cost with more efficient design
Clear requirements identified by the Client and enhanced clash detection identification in the design phase.	Increased efficiency, improved scheduling, increased offsite prefabrication and reduced rework.	Better tracking of maintenance and reduced maintenance requirements.
Better data/information capturing – Asset Database enhancement		
Existing conditions modelling	Coordinated drawing production	As-constructed model delivery
Improved capture of site-specific conditions and provides access to	Improved 2D drawing production from 3D coordinated models	Improved Asset Management Database information

data at any stage of the project's lifecycle.	avoiding miss coordination in the construction phase	
Less rework – through the elimination of errors/omissions/process		
Improved design process	Reduced construction cost	Reduced operations and maintenance cost
Design reviews, visualization, and coordinated approach to discipline-specific model development.	Improved project coordination and construction schedule.	Access to improved Asset Database for maintenance activities.
Improved productivity – reduction of working hours to achieve an output		
Improved design process	Improved construction process	Improved handing over process and asset management
Reduced resource needs to achieve design outputs and 3D modelling with enriched object/attribute information.	Reduced resource needs to achieve technical design outputs and manufacturing drawings by developing a ready 3D model with enriched object/attribute information.	Reduced resource needs to Handover the project at the final stages as all outputs are coming from one single federated source.

Table 01 - Benefits of implementing BIM.

1.5. BIM in Infrastructure

The Infrastructure industry had been progressively moving towards documenting in 3D over the past two decades. This has been driven primarily by a desire to improve the quality of design and deliver projects more efficiently as advancements in 3D CAD modelling software became more readily available. The advancements in the tools to efficiently design and document in 3D have accelerated in recent years to a point where the current systems, processes and policies are falling behind in terms of accuracy and relevance. In some cases, the current processes hinder our ability to adapt/utilize the new tools, systems, processes, and practices.

BIM implementation from design into construction and handing over would provide better data for Asset Management which is managed as well at a network level via a suite of internal asset management systems. All design task teams are working and documenting in a 3D environment where the most benefits of improved coordination would be achieved.

The design coordinated Model is not the only aspect of the BIM process. It will also allow the contractors to maintain the BIM model throughout the construction phase and provide an "As-Built" model at the handing over.

This guideline aims to aid the development of BIM implementation process by:

- increasing the stakeholders' project managers understanding of the benefits of BIM so that they can better brief their design teams.
- creating a common language so that the internal and external designers and constructors understand what they are being asked to provide
- outlining the process that should be followed to efficiently implement BIM on a project with the end in mind
- providing a framework so that those new to BIM can understand what is involved and decide if / how they could benefit from adopting BIM.

2. BIM Uses

The BIM Uses to be tailored for each project based on the Project needs.

2.1. The existing condition modelling

Geo-Technical Model:

A visual Model of the geo-technical analysis report. A process in which BIM tools are used to evaluate the existing properties in a given area and to determine the most optimal design for a future project. For instance, the intent and requirement for a topographic laser scan survey can be as following:

the scanner to digitize all the 3D information concerned with a real-world object such as buildings, trees, and terrain down to millimetre detail. Adding to capture all existing ground conditions, with a high-level accuracy of utility tracing, boundary mapping, existing surface, and existing structures

Infrastructure:

Roads, bridges, airfields, tunnels, transportation, and underground utilities are required to be developed as separate discipline models coordinated with the most up-to-date existing site survey data and underground utilities. The intent and requirement for existing infrastructure surveying are to capture and detect the location, positioning and identification of existing underground utilities and structures coordinated with a corresponding topographical survey. A chosen survey methodology shall be agreed as per project-specific requirements, and the critical nature of existing utilities are to be accurately located and recorded.

2.2. Site analyses

BIM/GIS tools are used to evaluate the condition properties in a given area to determine the most optimal site location design for a future project. The site data collected is used first to select the site and then to locate and align (or position) the Infrastructure project based on the engineering requirements of its components (geometric, geo-technical, structural, etc.).

2.3. Design Authoring

3D BIM is the process of creating the structured and unstructured information required for the project information model PIM. This Model is the basis for the extraction of all technical documentation and the base for all other BIM uses, the authoring tools and the modelling standards will be mentioned in the EIR (Exchange Information Requirement) for each project.

3D models are used to calculate the environmental impact of a new construction project or an existing Facility. These calculations may include Carbon Footprint, Life Cycle Assessment, Embodied Energy, and other sustainability metrics.

2.4. Phase Planning (4D Modelling)

Phase planning adds an extra dimension of information to a project information model in the form of scheduling data. This data is added to components which will build in detail as the project progresses. This information will be used to obtain accurate program information and visualizations for the mobilization, logistics and construction phases, showing how your project will develop sequentially, the authoring tools and the standards will be mentioned in the EIR (Exchange Information Requirement).

2.5. Cost Estimation (Quantity Take-off)

5D BIM is the process to produce accurate quantities take off to support the cost estimates from the components of the information model. This is extremely helpful in reducing excessive budget overruns caused by design modifications and for value engineering proposals. The use of BIM in this area is most useful in the early stages of a project.

2.6. Design Technical Review

The main procedure of work will remain as business as usual but to be done using BIM, The list of deliverables at each stage will not change but BIM Models to be submitted along with all submissions, The Consultant / Contractors to submit the drawings in DWG and PDF as business as usual but to be extracted from coordinated BIM models.

The technical design review to be conducted directly on the BIM Software native files at each design and construction phase, the PDF copies will remain the reference for the approvals along with the federated Model in NWD and IFC models.

Submissions will come through the SmartHub/ PMWeb, which will be integrated with the Employer's (On-premises) CDE shared and published folder.

Employer's templates and central libraries will be shared with the lead appointed party during the appointment phase, This template with the central libraries to be followed in the information production and submissions, a project to project exceptions or exclusions to be allowed for concept and pre-concept stages. This is to be confirmed in the Project BEP (BIM Execution Plan).

The BIM review for quality and compliance with the EIR and BEP during the design phases will be carried out by the ADM team and authorization of information for tender. During the construction stages, the supervision consultant to carry out the BIM review and ADM team to authorize the BIM information.

2.7. Material Technical Review

All submissions to the Material Quality Section during design phases or even the material approvals on-site will require to follow the modelling guideline which will be highlighted in this document and provided for each project through the EIR (Exchange Information Requirement) and confirmed in the BEP (BIM Execution Plan). Using the pre-defined template and Central library (shared ADM resources) in the information production will allow for smooth review and approval of materials. That can be achieved through a pre-defined list of data sets and attributes to be checked when applying for material approval for use in Infrastructure projects, as well as at project handing over phase and asset delivery.

2.8. Drawing production

BIM is used to create drawings and project documentation. This includes Concept, Preliminary Design, Draft Final/Final Design, Construction, Shop Drawing, and As-Built. Views are automatically generated by the authoring software and benefit the Project Team Members coordination and development of drawings due to its bi-directional link to the Model. The information and data inputs in the Model will be exported in forms of schedules and table lists.

2.9. Site logistic planning

BIM is used to graphically represent both permanent and temporary structures on-site during multiple phases of the site planning and construction process. Integrating the project site logistics, materials and equipment

use, vehicles, load and delivery planning schedule data with BIM provides a means to see, prevent and resolve conflicts

2.10. Digital Fabrication

A process that uses digitized information to facilitate the fabrication of construction systems or assemblies. Some uses of digital fabrication can be seen in but not limited to, sheet metal fabrication, structural steel fabrication, pipe cutting, prototyping for design intent reviews. Digital model visualizations and simulations shall be utilized to support decision making processes for on-site erection and logistics.

2.11. Asset Information Delivery

BIM Models are a repository for structured and unstructured information and will be the core submission of the final Asset information submission and handing over the project. However, the Employer's Asset Information Manager will be involved through the workflow of the project in all phases to make sure that during the progression of design and construction, all information is in the right place and procedure.

2.12. Permit Review

It will be mandatory for all BIM submissions at all design stages to follow this guideline in terms of submission procedures and documentation. This will be explained in the fourth and fifth sections. The deliverables strategy for each design phase is to be mentioned in the project EIR (Exchange Information Requirement), the lead appointed party (The main consultant in the design phases, the Main contractor in the construction phases) will list all BIM deliverables in his BEP (BIM Execution Plan) in the form of MIDP (Master Information Development plan).

A BIM quality check will be conducted on each BIM submission. This check to certify the submission to pass to technical team review. A list of QA/QC checklists to be submitted during the appointment phase by the lead appointed party and to be approved by ADM.

This BIM documentation is for Capital projects only. The Permit review processes and submissions for development projects will be as business as usual and will remain through the Smart Hub/ PMWeb. A code of practice can be found here *the ADM website* for developers as a guideline of Employer's BIM requirement in submissions of design, construction phases, and assets delivery. The submission will follow this BIM guideline in deliverables standards and quality management.

3. BIM information management processes

To explain the project information management process, we must define the management functions, project delivery teams, task teams and parties involved in the production of the information.

3.1. Management functions

Clarity of functions, responsibility, authority, and the scope of any task are essential aspects of effective information management.

Functions should be embedded into appointments, either through a specific schedule of services or by referring to more general obligations.

BIM Information has three main distinct functions integrated to generate the information throughout the whole project life cycle from project initiation, procurement phase and appointment to the production of PIM (Project Information Model) ending with the AIM (Asset Information Model) at the project handing over phase.

Functions should be allocated to one or more capable individual, and that will be explained further in the roles and responsibilities section.

Asset Information Management Functions	Includes Tasks related to the operation of an asset
Project Information Management Functions	Includes Tasks related to the delivery of an asset
Task Information Management Functions	Includes Tasks related to the production of information

Table 02 - The three main management functions.

3.2. Project Team definitions

Appointing party	The receiver of information from a lead appointed party and is responsible for the project initiation or appointing another party on behalf of him to carry out the activity. The appointing party will always be the Municipal Infrastructure and Asset Sector.
Appointed party	The information provider which usually will be the awarded tenderer and having an appointment with the appointing party, the appointed party will be responsible for the production of information and may consist of more than one delivery teams.
Lead appointed party	The lead appointed party should be identified for each delivery team. The Lead appointed party can be in the same organization as one of the task teams.
Delivery team	based on the project delivery activity scale and complexity the size of the delivery team to be sized and the number of task team individuals to be adjusted.
Task Team	Individuals are qualified to perform a task and to generate information.

Table 03 - Definition of BIM information management teams and responsibilities.

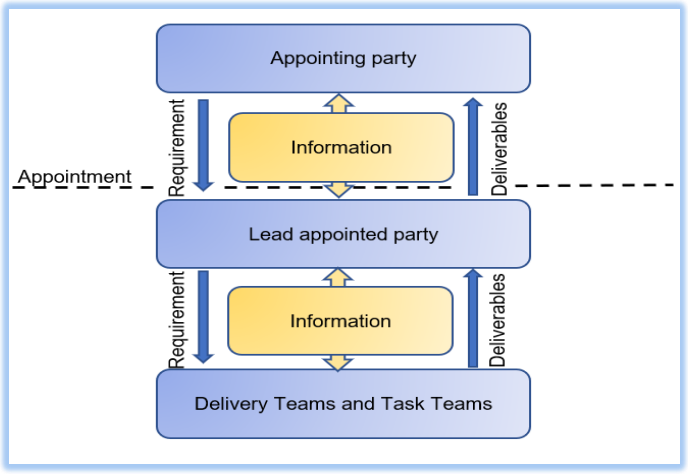
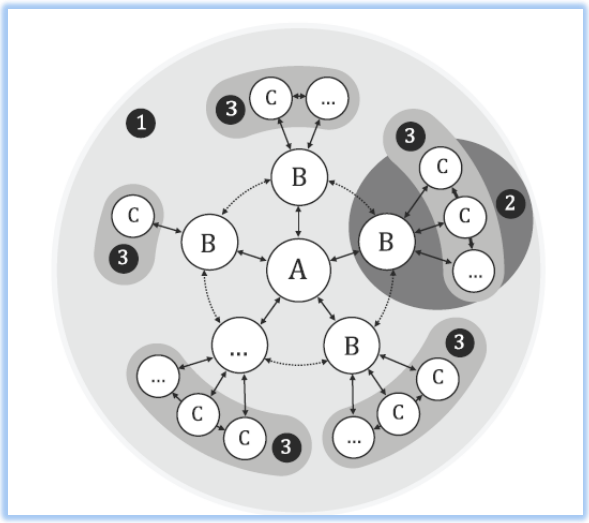


Diagram 02- The Appointing party Vs appointed party



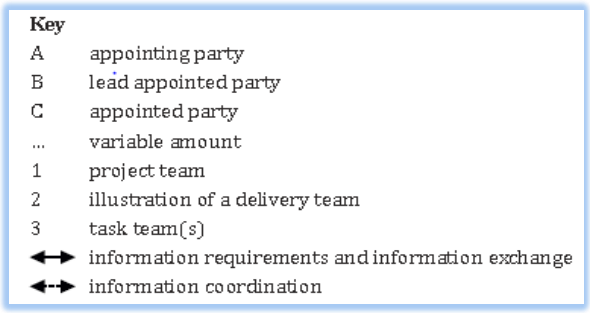


Diagram 03- Interface between parties and teams for the purpose of information management (@ ISO 19650-2)

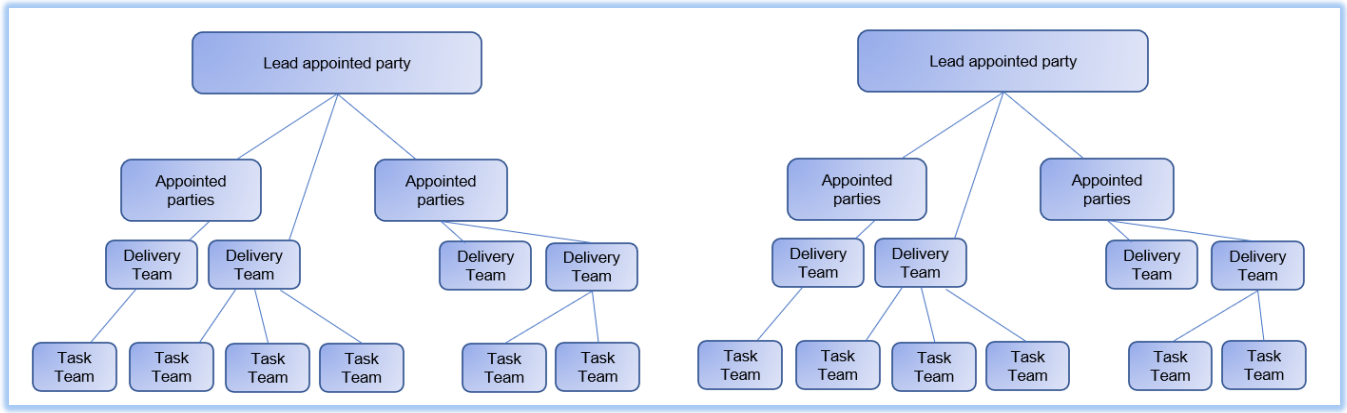
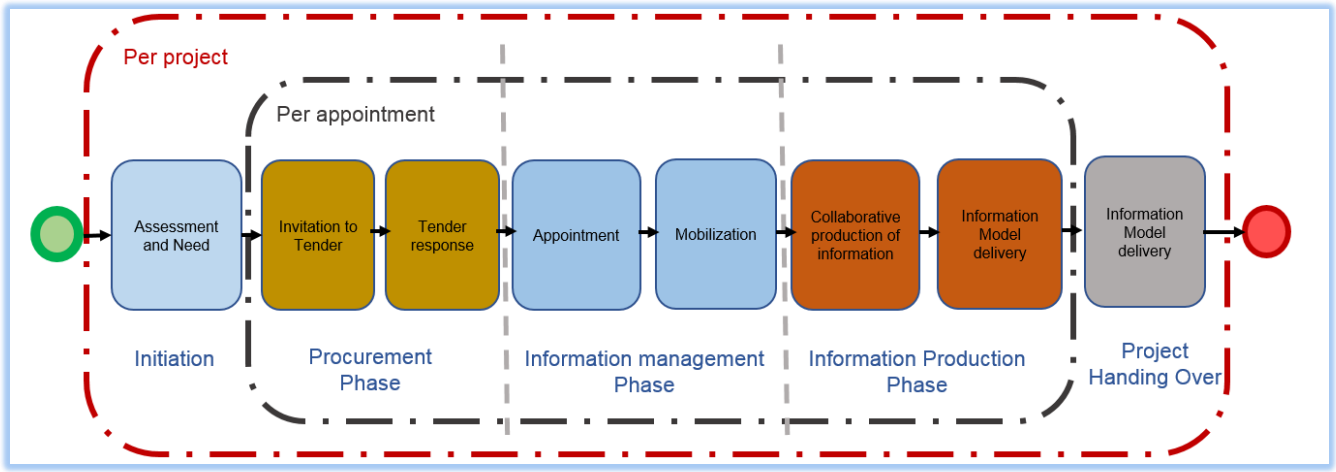


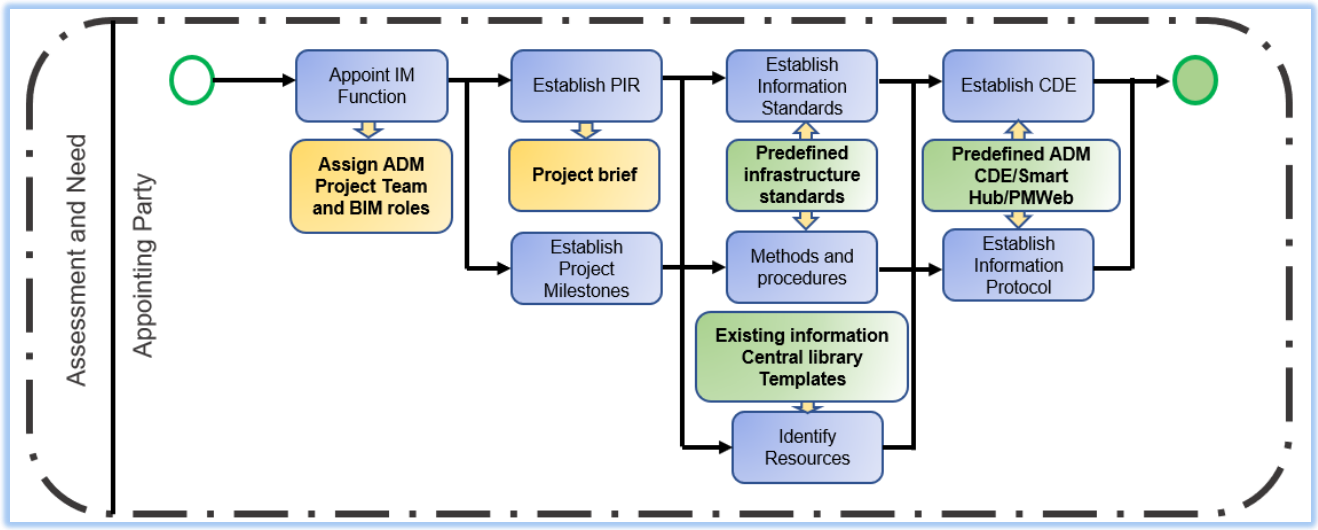
Diagram 04- The hierarchy of delivery, task teams and appointed parties and lead appointed parties

3.3. Information management processes during the delivery phase of assets

The information management processes to be applied throughout each appointment regardless of the project stage (Design or construction). The order in which activities are presented in flow chart 01 reflects the order in which they are undertaken.

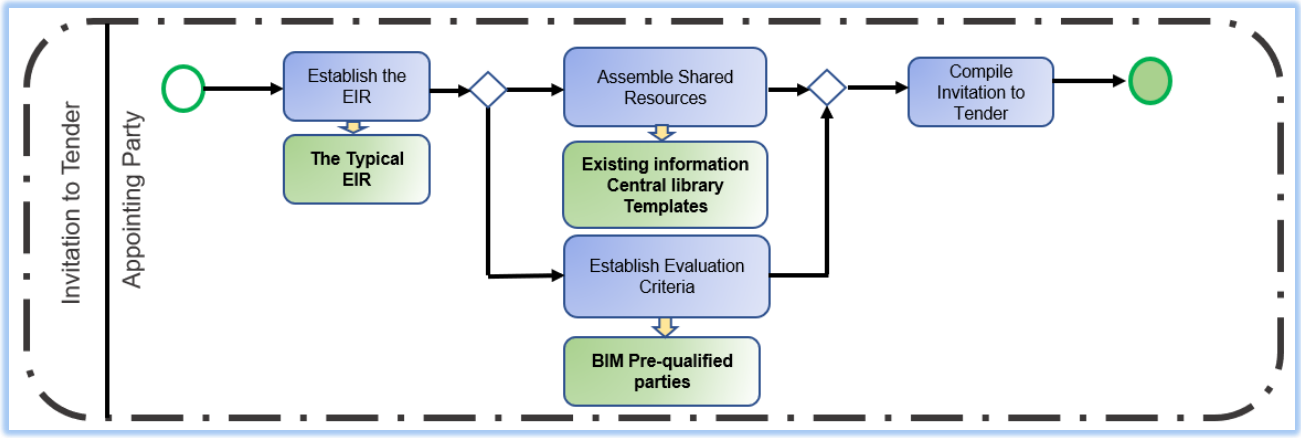


3.3.1 Initiation / Assessment and need



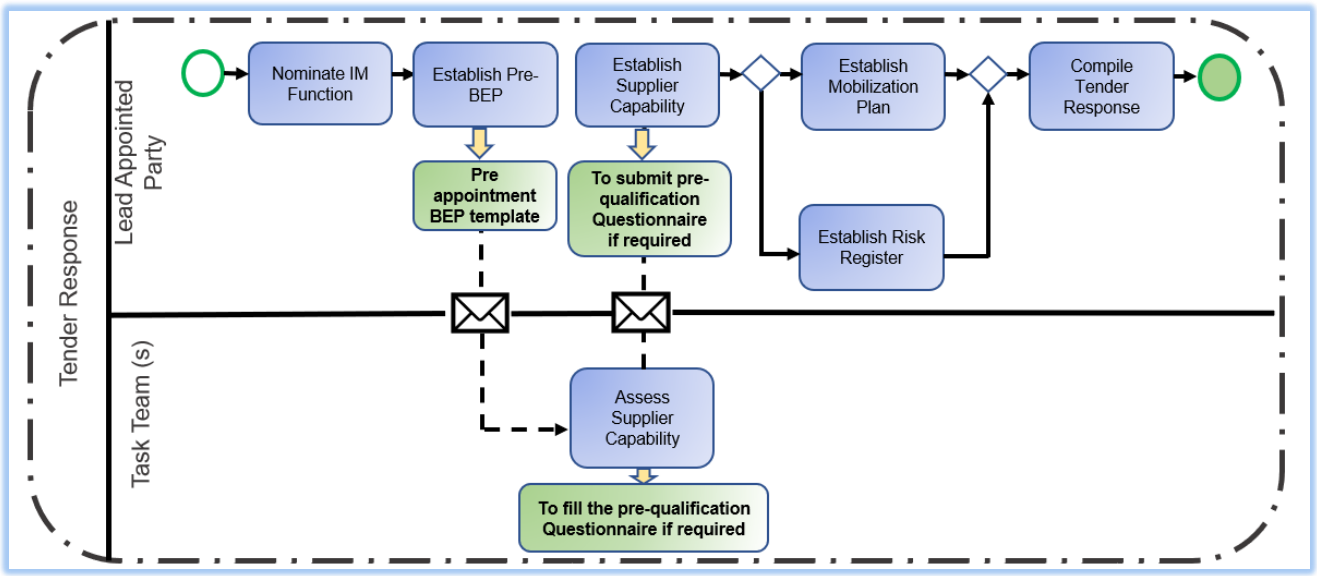
During the first activity Assessment and need the project initiated, the tasks exclusively related to the appointing party (Municipality/ Employer) during this activity the appointing party to establish several key items related to the project information management process including the PIR (Project information requirements), and project Milestone, standards, production methods and procedures. Through these items, the appointing party establishes how information to be planned, produced and delivered during the project. In addition, the appointing party should identify and request the consultant to arrange any resources to be shared with the delivery teams and how is the CDE (Common Data Environment) to be functioning across the entire project. Accordingly and once this task had been done, the appointing party then undertake the invitation to tender.

3.3.2 Invitation to Tender



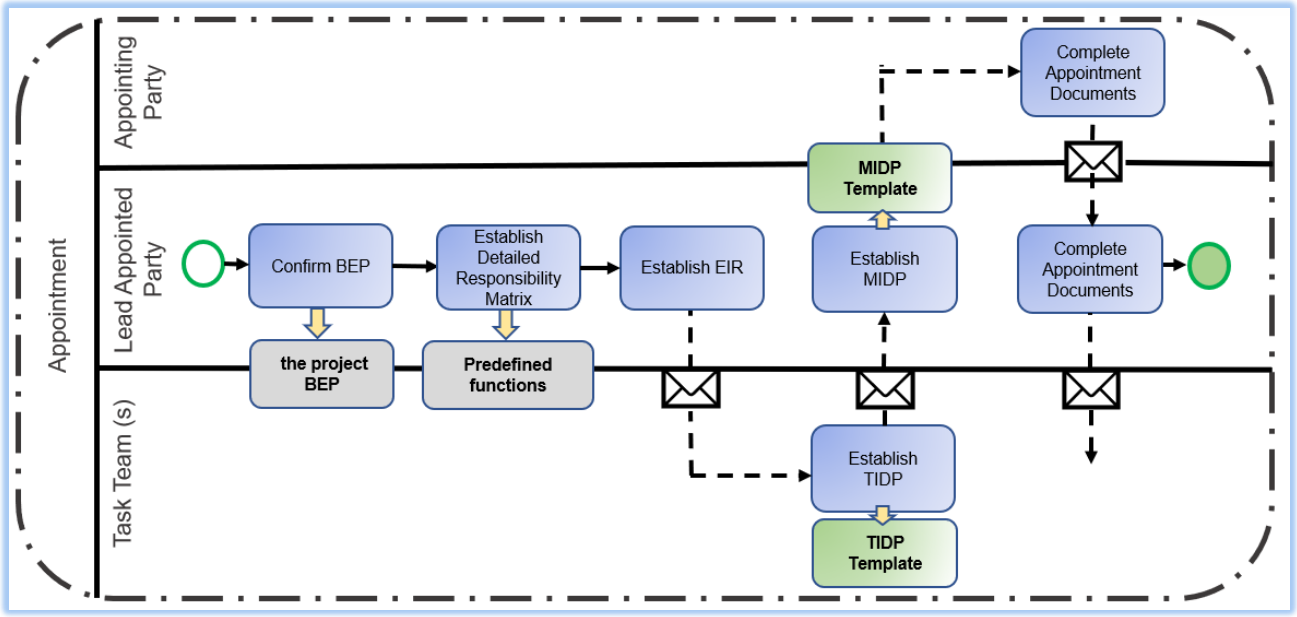
This activity tasks also related to the appointing party (Employer), during this activity the appointing party establishes the EIR (Exchange information requirements) using the previously completed PIR (Project Information Requirement) and pre-defined standards, confirming the reference information or shared resources identified during the project initiation, along with evaluation criteria for task and delivery teams (Supply chain and tenderers) to ensure that the information to be delivered during the project life cycle can be considered acceptable. Once these activities had been done, the appointing party compile the invitation to tender requirements and waiting for the tender response.

3.3.3 Tender response



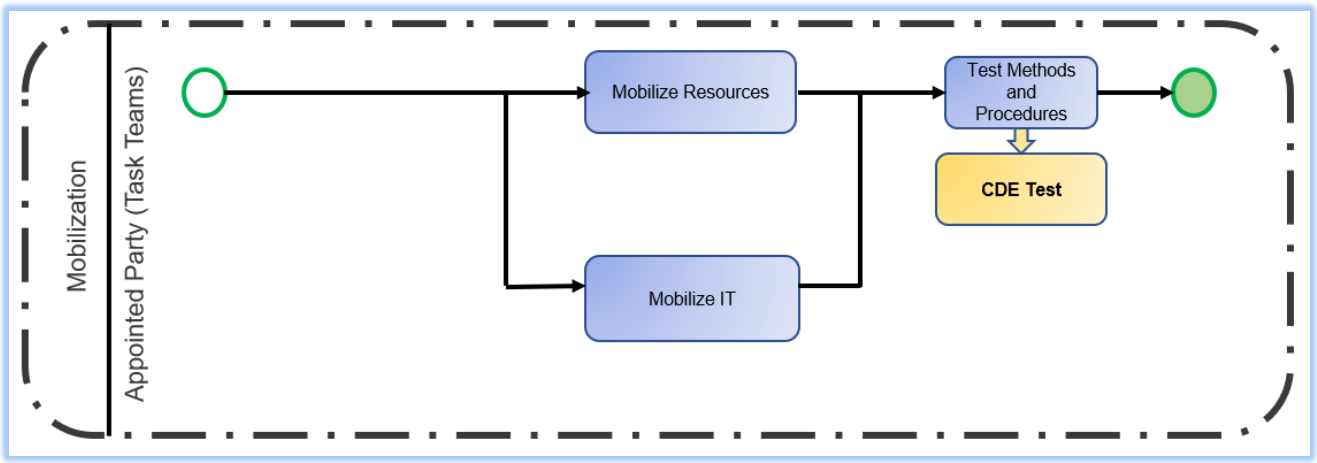
During this activity, the prospectively lead appointed party determined how he intended to respond to the invitation to tender to establish a Pre-appointment BEP (BIM Execution Plan), establishing the team capability, mobilization plan required and a risk register to ensure that BEP is achievable and complying with the EIR (Exchange information requirement). The lead appointed party or any of his supply chain can hire a BIM qualified third party to carry out the BIM production of information on his behalf, in this case, the appointed party to include the third-party pre-certification or the pre-qualification questionnaire to be filled by the third-party. Once this task had been completed, the lead appointed party compiles and submit the tender response.

3.3.4 Appointment



During this activity a preferred appointed party is selected, once selected the lead appointed party proceeds to confirm the BEP (BIM Execution plan), once confirmed the lead appointed party completes a detailed responsibility matrix and check the need of support of another organization if so the lead appointed party then establishes an EIR (Exchange Information Requirement for each task team they need to appoint, These task teams, in turn, established based on the scope of service the EIR provided, the TIDP (Task Information Delivery Plan) specifying the deliverables they intend to produce. To ensure that information is available prior to production of information the lead appointed party establishes the MIDP (Master Information Delivery Plan) which should consider all task information delivery plans and critical path of the delivery of information. Once this task had been completed, the appointing party can execute their appointment with the lead appointed party referencing the EIR, BEP and MIDP. In turn, the lead appointed party can execute their appointments with their task teams referencing their own EIR, BEP and TIDP

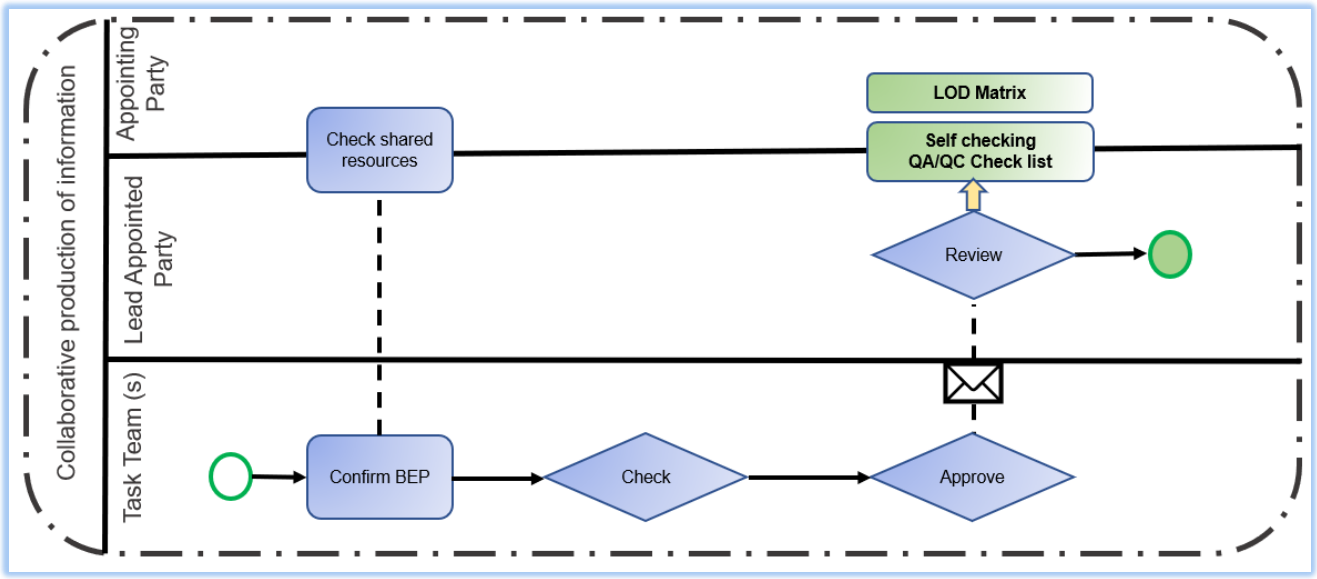
3.3.5 Mobilization



During this activity, the Lead appointed party ensures that the delivery team and associated task teams are fully prepared to produce the information. As shown the task identified related exclusively to the lead appointed party, as such the lead appointed party ensures that any resources and IT are mobilized, and the processes outlined within the information production methods and procedures are fully tested. Once this task

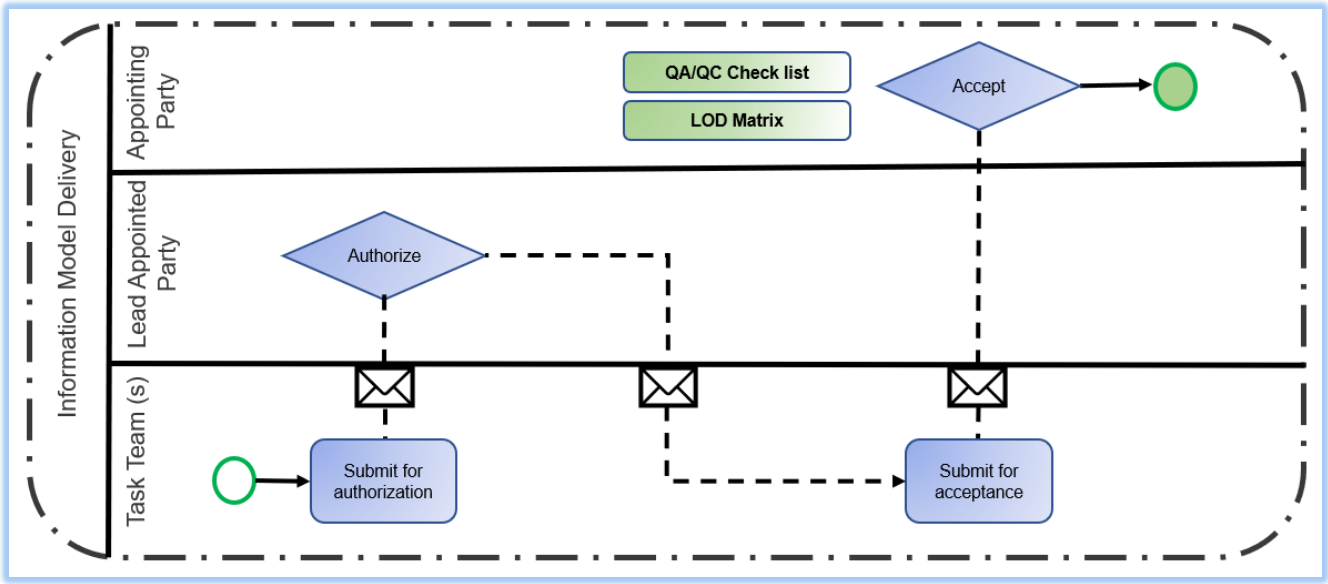
had been completed, and the lead appointed party is satisfied with the results of the testing, the delivery team can start the production of information.

3.3.6 Collaborative production of information



During this activity, the task teams produce information against the shared resources as well as the project's information standards and information production methods and procedures. In doing so, they ensure that the information is clear, complete, consistent, coordinated, and correct. By adhering to this requirement and referencing the information produced by other task teams were relevant, once this information had been produced it undergoes a quality assurance check (BIM QA/QC checklist to be used as an internal measure), review and approval before being shared with other members of the delivery team.

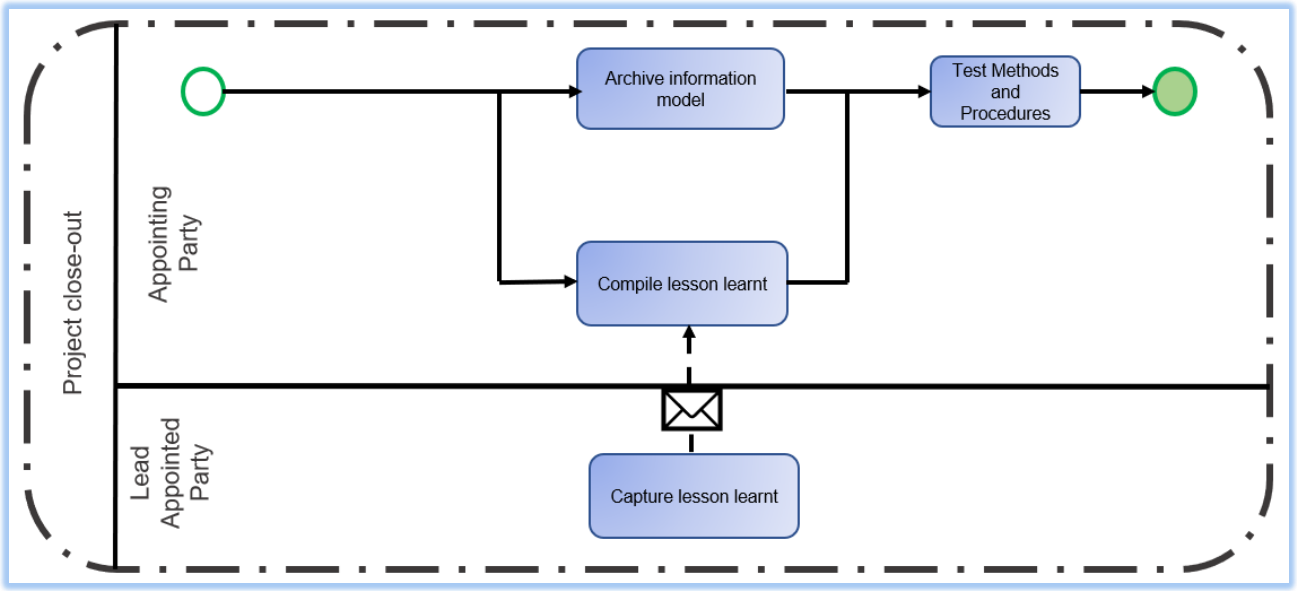
3.3.7 Information model delivery



During this activity which to be considered the final phase submission of an appointment before closing out the project, the Task teams submit their information for authorization and approval. During the authorization

and approval, the lead appointed party and the appointing party respectively review the information against their EIR (Exchange information requirement) and acceptance criteria to ensure that only verified information had been accepted. Once this task had been completed for all information being delivered a project phase can be considered complete. The cycle is to be repeated for all project phases.

3.3.8 Project close-out



During this final activity, the appointing party to archive all delivered information considering the reuse of information and future access requirements. The appointing party with the support of the lead appointed parties captures any lessons learned, the archived building information model then kept for record and relevant elements are used to generate or update the asset information model.

ADM Project life cycle and additional BIM documents/ actions in each process

During the project life cycle processes, the list of the newly introduced documents and actions related to the BIM implementation is to be used along with current used documents and procedures as business as usual. This list of documents can be found in sec 4 in this guideline. The following diagram explains the use of each document concerning each type of appointment and related processes.

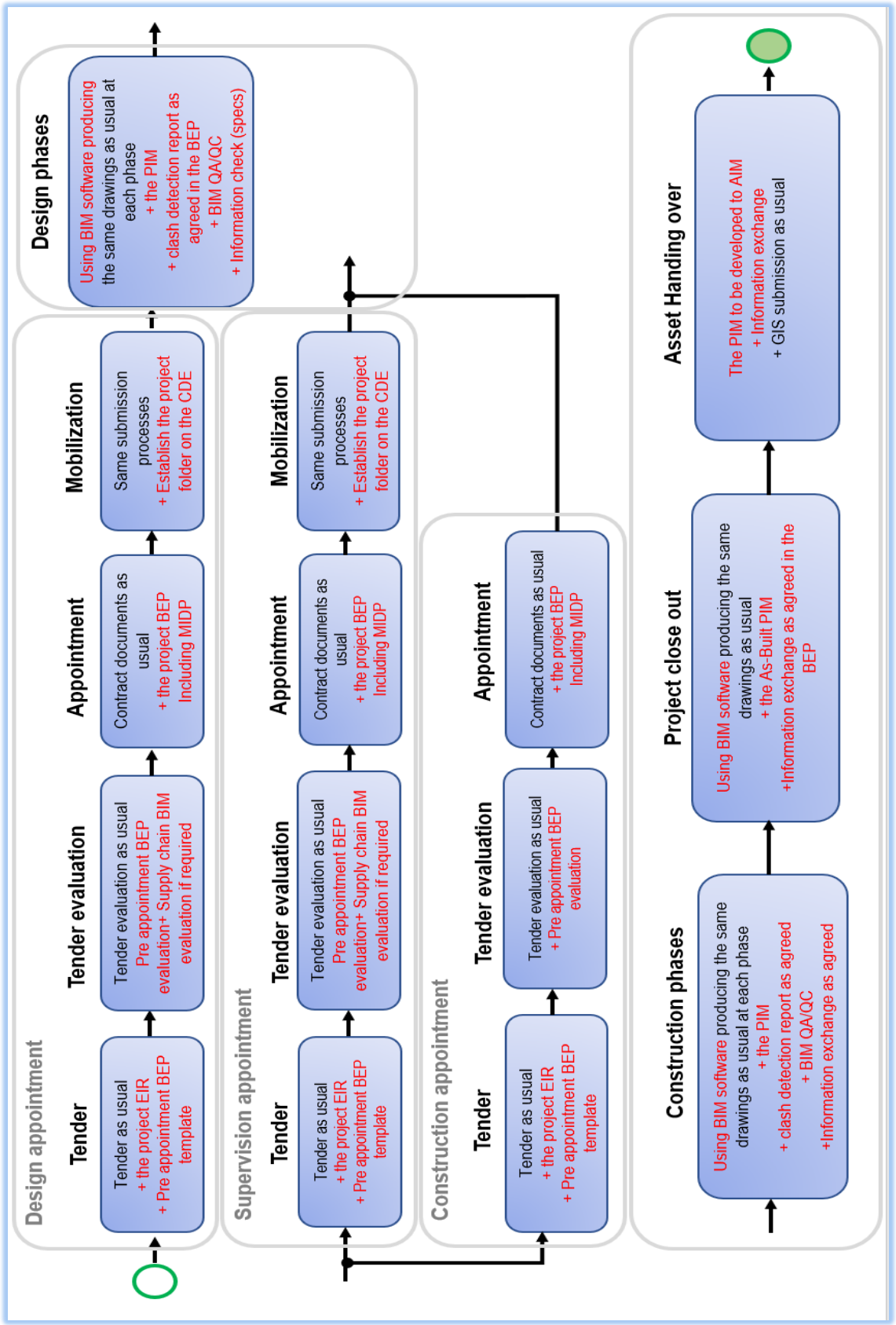


Diagram 05- project life cycle and additional BIM documents/ actions in each process

4. BIM Documentation

The BIM documents and actions required during the information management processes throughout the project lifecycle are related to the process it is required for. And in sequence with the pre-defined project phases as business as usual.

Initiation	Definition& Planning	Execution	Control& Monitoring	Closeout
				
Design ⟶		Construction ⟶		Handing over

BIM Process			Required documents / Deliverables
1	Assessment and need	Define information requirements and issue to potential appointed parties.	Exchange Information Requirement
2	Invitation to tender/ tender response	Review capability and initial plans for information delivery, confirm the appointment	Pre-Appointment BEP
3	appointment	Lead appointed party mobilizes and prepares a detailed plan for information delivery.	BEP, TIDP, MIDP.
4	Collaborative production of information	Production of information during the project.	CDE test, establish the folders mapping, modelling breakdown structure and production of the PIM.
5	Information model delivery	Production and maintenance of information during asset management.	AIM and Assets management delivery
6	Project closeout	Assessment of asset performance.	Project closeout and operations Lesson learned

Table 04 - BIM documentation and deliverables list throughout the information management processes

4.1. Exchange information requirement / BIM Specification (Code of Practice)

- The BIM process had been built on the principle of beginning with the end in mind. Identifying the downstream uses of information to ensure that the information can be used throughout the project and life of the asset.
- The Municipal Infra Structure and Asset Sector's EIR (Exchange Information Requirements) is a pre-tender document setting out the information to be delivered, the standards and processes to be adopted by the supplier as part of the project delivery process.

- The process is to start with defining the PIR (project information requirement) and project milestones which to be issued to potential appointed parties.
- The appointing party (Employer) shall determine his AIR (Asset Information Requirement) information requirements to support its assets, asset management system and the achievement of its organizational Information Requirements and objectives (OIR).
- The appointing party (Employer) to define his collaborative working requirements ensuring to be smart and to define the decision points for the requirements.

The EIR (Exchange Information Requirement) will be specifically for the Employer's capital projects. A separate BIM Specification (or Code of Practice) document will take the place of the EIR for permitting developers' projects. This document will be defining the BIM submissions requirements, provide detail on the BIM uses of the Sector and is to be a prerequisite to comply within development infrastructure projects.

4.2. Pre-Appointment BIM Execution Plan

The prospectively lead appointed party (supply chain and tenderers) to respond to the EIR in the form of BEP (BIM Execution Plan) as part of the procurement process and a vital element of this process. The BEP is to be submitted as Pre-Appointment BEP (BIM Execution Plan) in the tender response and to be developed and completed in the form of Project BEP (BIM Execution Plan).

The Pre-Appointment BEP (BIM Execution Plan) shall set out the lead appointed party's delivery teams and supply chain approach, capability, and competence to meet the appointing party (Municipality / Employer) information requirements.

The pre-Appointment BEP (BIM Execution Plan) contents

- Project Information.
- Information required by the appointing party (Employer)
- Project implementation plan
- Project goals for collaboration and information modelling
- Major project milestone

Project information model (PIM) delivery strategy

Pre-Appointment BEP to show how did the lead appointed party demonstrate

- That the firm is capable of the job
- That the Exchange information requirement has been considered
- That the key dates/ Milestones and deliverables have been considered
- that sufficient information will be provided to allow the Employer to make informed decisions

The Pre-Appointment BEP (BIM Execution Plan) is a static document, to be submitted along with the tender response and in case of the project been awarded the BEP to be developed with further information and master information delivery plan to be added.

4.3. Project BIM Execution Plan

Further information is required to the Pre-Appointment BEP (BIM Execution Plan) in order to provide sufficient information to allow for project team mobilization. This stands for the development of the Project BEP (BIM Execution Plan) which include additional documents describes TIDP (Task Information Delivery Plan and MIDP (Master Information Delivery Plan), It shall be submitted along with the responsibility matrix and will include but not be limited to the following content:

The BEP (BIM Execution Plan) Main contents

- Project Information.
- Information required by the EIR.
- Information Management.
- Planning the Work and Data Segregation
    - Task Information Delivery Plan (TIDP)
    - Master Information Delivery Plan (MIDP)
    - Standards, methods, and procedures
    - IT Capabilities

The BEP (BIM Execution Plan) to define the BIM collaborative production of information through the appointment stages and the main contents to be agreed as standards, Methods, and procedures.

- Management (Who, What and When) producing, approving and authorize the Information by Task Team
- Planning and Documentation (Supply chain capability, responsibility, and delivery program
- Standards, Methods, and procedures SMPs (the standards should comply with Employer's standards as well as methods and procedures agreed to be used in the production of information.
- IT Solutions (Confirmation on what software and systems to be used to ensure the compatibility and usability of exchange information)

The BEP (BIM Execution Plan) is developed from the information already populated within the Pre-Appointment BEP (BIM Execution Plan) adding to other goals of collaboration which to be used as project standards, methods, and procedures.

The BEP (BIM Execution Plan) produced as a live document, to be submitted right after the tender award, confirmed by all task team members, and it is subject to change/develop in respect to the development during project information process production and project phases. Changes/ updates to be agreed and recorded as a revision of the document by all parties and to be repopulated to project teams.

4.4. BIM QA/QC checklist

As mentioned above in the permit review, a BIM quality check to be conducted on the submissions prior to upload to SmartHub- PMWeb and being shared on the (Common Data Environment) shared folder against the following:

- Guideline and standards.
- The project EIR
- The project approved BEP methods and procedures.
- The project approved MIDP Master information delivery plan.

The submission should meet a minimum BIM compliance prerequisite to be passed to technical review and to be returned if it did not meet this minimum requirement.

A list of QA/QC checklists to be submitted during the appointment phase by the lead appointed party and to be approved by ADM, the above-mentioned minimum requirement, and prerequisites to be mentioned clearly in the list.

The lead appointed parties to perform their internal review to ensure the information shared is meeting the minimum level of BIM and being consequently passed to the technical review.

4.5. As-built and Asset Information Model (AIM) delivery

The As-Built Models produced at the completion of the project contain all the information been generated throughout all BIM information processes as a continues development of the PIM (Project Information Model). To provide the best benefit for ongoing input into the Asset Management system. The lead appointed party and delivery teams to ensure that the information production throughout all production phases is

- Clear (produced with the recipient in mind)
- Complete (produced against the project's master information delivery plan)
- Consistent (produced in accordance with the project's information production methods and procedures
- Coordinated (produced spatially coordinated, sourcing approved information by others)
- Correct (produced in compliance with the project's information standard)

The AIM (Asset Information Model) to include design and construction information relevant to Asset Management, focused on the data needed to maintain and operate the asset. This information to be validated, verified and consistently structured throughout the project life cycle (following the Employer's ready template and central library) to allow for automated transition into the Sector's Asset Management systems.
The purpose of the asset information model (AIM) is to be the single source of approved and validated information related to the asset(s). This includes data and geometry describing the asset(s) and the spaces and items associated with it, data about the performance of the asset(s), supporting information about the asset(s) such as specifications, operation and maintenance manuals, and health and safety information.

All data and information related to or required for the operational phase of an asset shall be contained in or linked to the AIM. The AIM shall be a federated model consisting of parts which are aligned to the WBS (Work Breakdown Structure), as agreed within the Project BIM Execution Plan.

It is the responsibility of all BIM Model authors to ensure that the following parameter headings are attributed to the object being authored. This is to be undertaken irrespective of the data for that parameter field is required at that stage or not. This to enable data to be included at a pre-defined stage later in the project cycle.
The project team members shall establish processes and procedures to cover the following aspects of maintaining the AIM:

- Requirements for information and data maintenance, including version control, integrity checks, validation against the AIR (Asset Information Requirements) and other assurance activities.

- Requirements for the generation, capture or importing of the identified maintainable assets information and data.
- Requirements for the storage of information and data according to integrity, security, and confidentiality requirements

To maximize the likelihood of the above being achieved the concept of "starting with the end in mind," the following should be applied throughout the project.

The asset management requirements and the project BIM requirements mentioned in the EIR (Exchange Information Requirement) define all information required to be delivered at the project closeout/ asset handing over. The lead appointed party to define the strategies of partial review of the information production throughout the collaborative production phases. Ensuring that the information correctly and consistently placed.

Hence, the operational phase of the asset that has the most significant overall costs and offers the greatest possibilities for improvement, it is essential to be in mind in the early phases.

A list of categorized attributes to be extracted from the AIM (Asset Information Model) at the handing over and asset delivery phase. These attributes to be referring to the latest Employer's standards and specification for As-Built data submission (Version 1.7.3) *on the ADM website*.

5. BIM Management

5.1. Functions (Roles and Responsibilities)

Management functions shall be assigned and recorded for the project. The lead appointed party to submit DRM (Detailed Responsibility Matrix) showing the delivery teams and their assigned task teams. Task teams contact information shall be listed against each task in the BEP (BIM Execution Plan).

Information management functions should not refer or aligned to design or construction responsibility. However, it can be performed alongside with other function, such as design team leadership, project engineering or management. One person may deliver multiple tasks. A technical team member can take the responsibility of a BIM role. For instance, the Project Civil Engineer can take the role of task information manager, one more example that the task team manager can be the construction manager.

It is important not to confuse functions and responsibilities with the job titles; please refer to Appendix A for the BIM roles and responsibilities definitions.

As mentioned, in the (section 3 – 3.1) that the information management functions have three distinct functions.

Asset information management functions

Asset information management to be assigned to an individual from the appointing party (Employer) during As-Built and Handing over phases. This individual to take the leadership in validating information supplied by each appointed party against what had been planned for in the EIR (Exchange information Requirement). As a minimum of this requirement, there should be one function assigned for each project, and the number of individuals can be increased in respect to the project size and complexity.

- Asset Information manager (Authorize the delivery of an asset)

Project information management functions

The appointing party to allocate the delivery of information to individuals from his team in the design phases and the supervision consultant team in the construction phases. The three management functions to be assigned among the selected team to carry out the project deliverables authorization, the projects information compliance and efficiency at each submission, adding to the design leadership to be assigned to the Lead designer function.

The function is to be assigned directly to an individual or to be assigned to a delivery team in respect to the project size, complexity, federation strategy and number of disciplines are involved in the project.

As a minimum, there will be a Lead project delivery team assigned from the appointing party or the lead appointed party side.

- Project delivery manager (Lead appointed party individual or Employer's technical team)
- Project information manager (Lead appointed party individual or Employer's technical team)
- Lead Designer (Lead appointed party individual or Employer's technical team)

Task information management functions

Where delivery teams are sub-divided into task teams, defined management functions to be assigned for each task team, information management at a task team level is concerned both with the information associated with that task and with the requirement to coordinate information across multiple tasks. So, it is

advisable to consider the responsibility of the following function to be clearly assigned to an individual at each task team. As mentioned above, one person can carry two or three functions based on the capability and related to the task complexity and size.

- BIM Author — who generates the information
- Task information manager — who is responsible for information production consistency
- Task Team manager — who lead the task team and responsible for information sharing
- Interface manager — who is to responsible for the coordination of all information shared

(The interface manager to be from the lead appointed party)

Following are flow charts for how the newly introduced functions will be implemented in the Employer's projects at design and construction phases.

BIM Management functions during Design phases samples

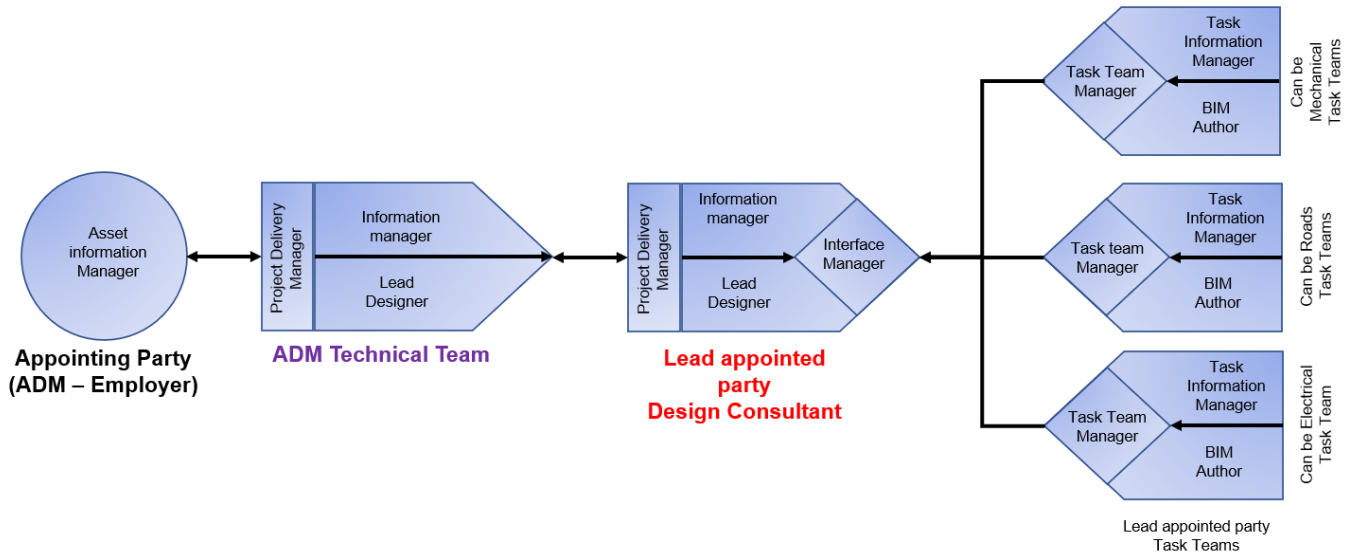
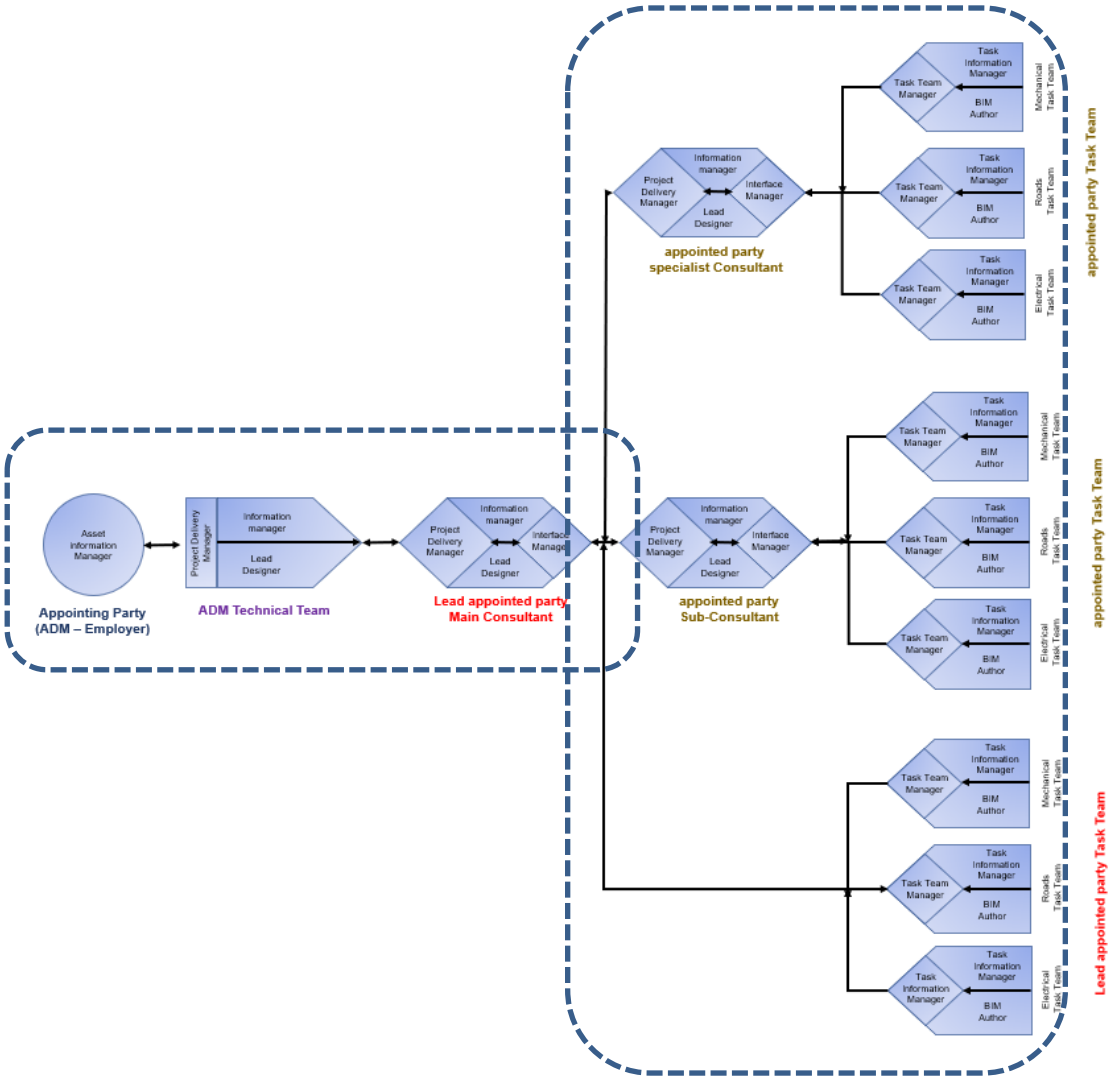
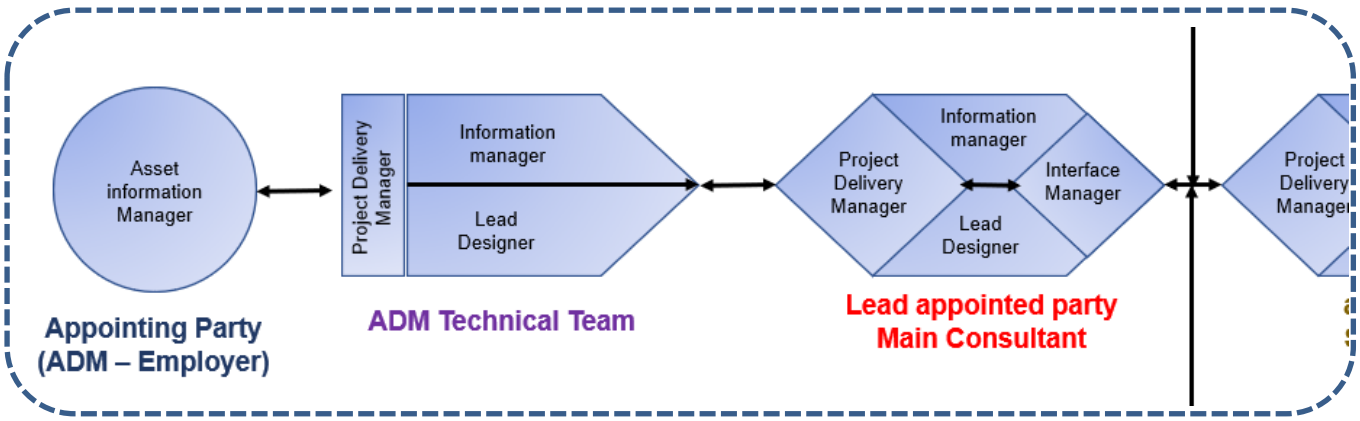


Diagram 05- Typical BIM management functions flow chart in design phases.


Asset Information Manager
Appointing Party (ADM – Employer)
Project Delivery Manager
Information manager
Lead Designer
ADM Technical Team
Lead appointed party Main Consultant
appointed party Sub-Consultant
appointed party specialist Consultant
Interface Manager
Task Team Manager
Task Information Manager
BIM Author
Mechanical Task Team
Roads Task Team
Electrical Task Team
appointed party Task Team
Lead appointed party Task Team


Asset information Manager
Appointing Party (ADM – Employer)
Project Delivery Manager
Information manager
Lead Designer
ADM Technical Team
Project Delivery Manager
Information manager
Interface Manager
Lead Designer
Lead appointed party Main Consultant
Project Delivery Manager

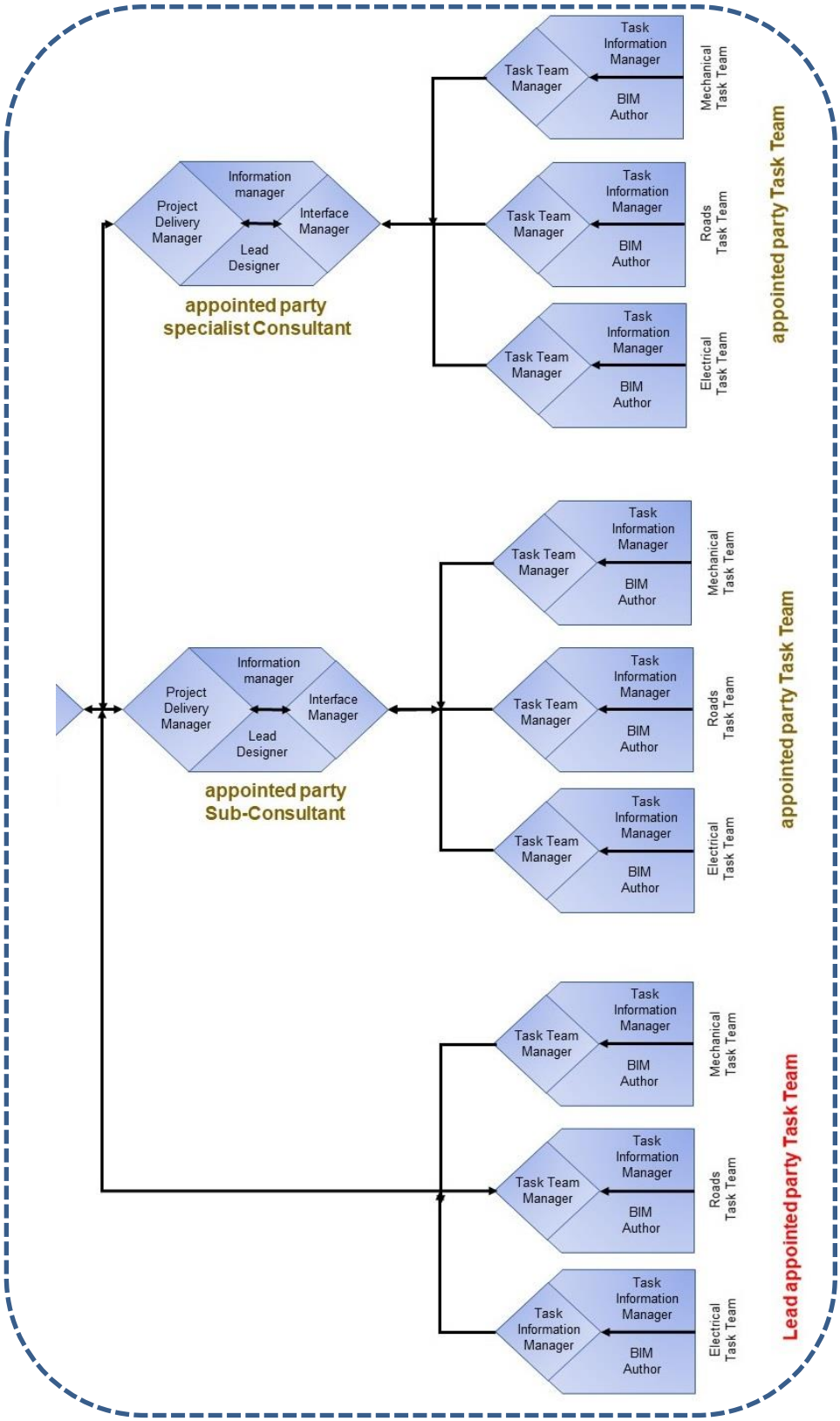
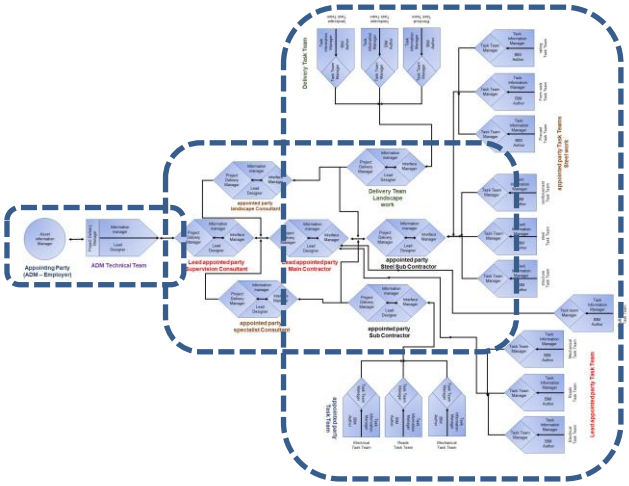
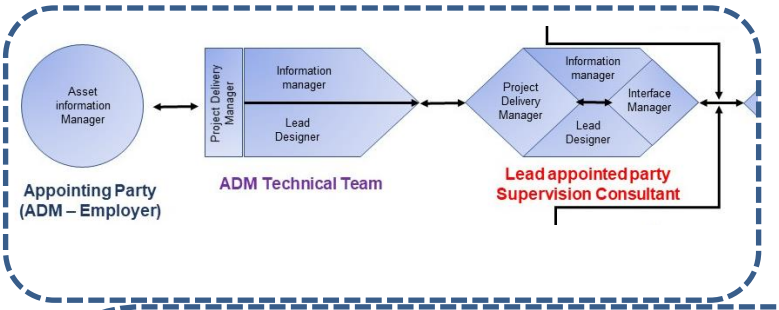
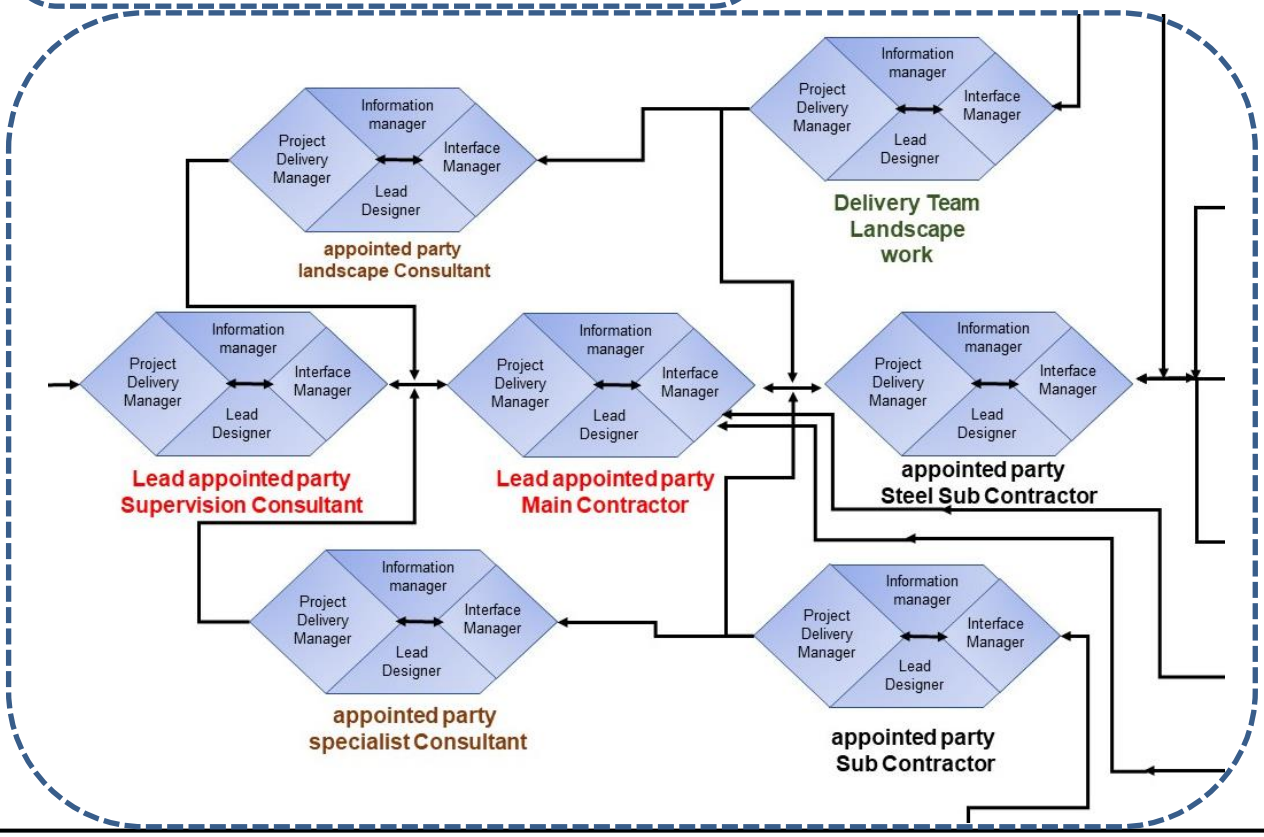


Diagram 06- BIM management functions flow chart in design phases for big scale projects.

BIM Management functions during construction phases







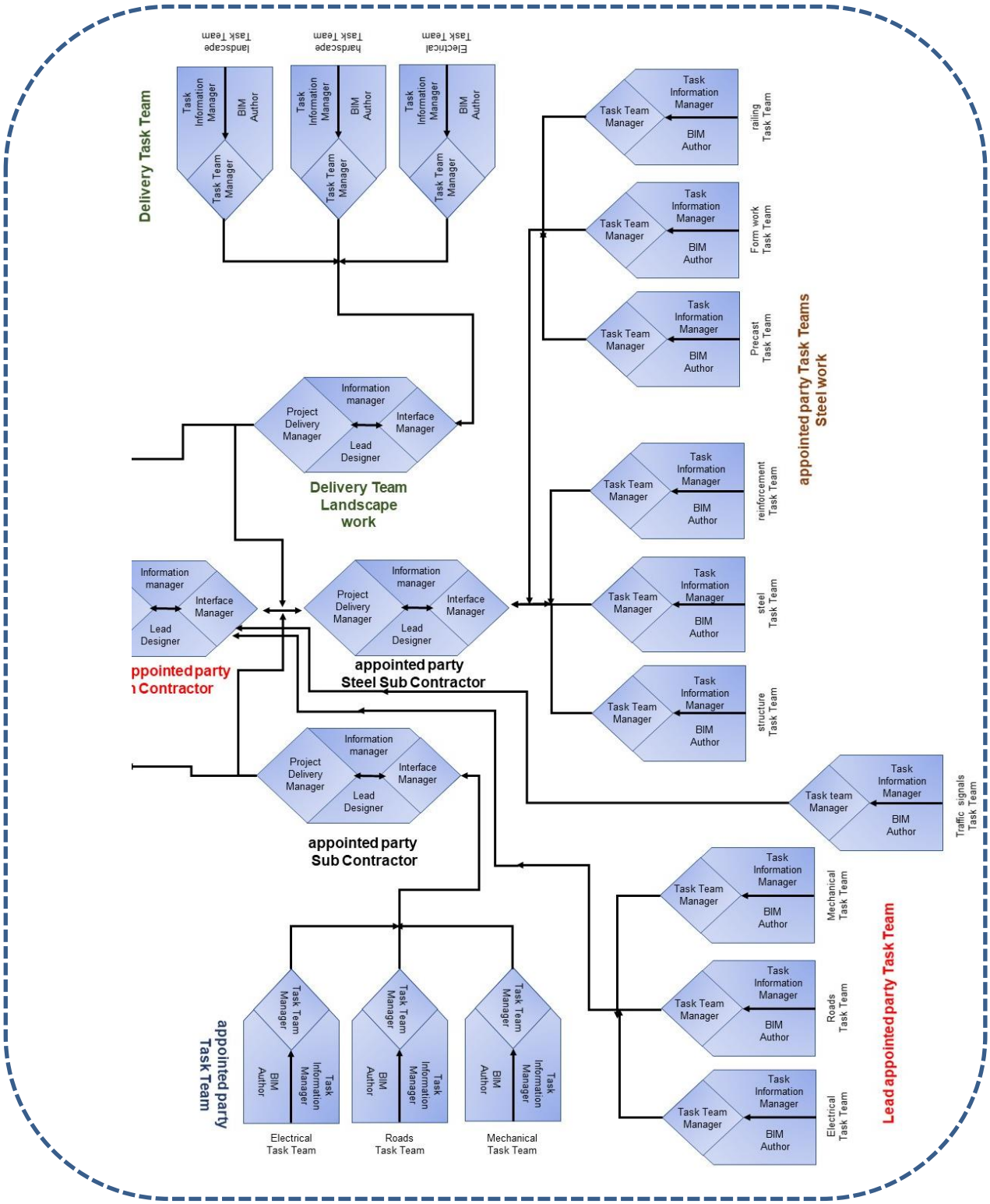


Diagram 07- BIM management functions flow chart in construction phases for more significant projects' Submissions.

5.2. BIM submissions

Project submissions will follow the schedule of submissions as business as usual for infrastructure projects in respect to design phases to tender through the smart HUB and construction phases as planned to be on the PMWeb.
All previous references remain with no changes, such as:

- ADM Consultant procedure manual for design consultancy services can be found *on the ADM website*.
- ADM QA QC Manual – 2011 Abu Dhabi can be found *on the ADM website*.
- All relevant Abu Dhabi-QCC Manuals, including Standard Drawings and Standard Specifications, can be found *on the ADQCC website.*

What newly introduced related to the submission is the internal CDE Common data environment for the Employer's team internal use. Where all BIM submissions to be reviewed and authorized. Once the submission delivered through the SmartHub or the PMWeb, it will be automatically mapped/ transferred to the CDE shared folder. This mapping will be controlled by correct file naming, submission status and revision code, which to be considered and carefully applied by all appointed parties allowed for upload submissions. Naming strategy to be followed carefully. However, the BIM quality check will not allow wrong named files.

Once the submission received on the Employer's CDE (Common Data Environment) shared folder. The submission will be firstly qualified as a correct BIM submission to be passed for technical review, as mentioned in section 4.4.

The Employer on-premises CDE (Autodesk-Vault), will allow for the work-sharing internally as well as externally. The CDE (Autodesk Vault) can be integrated easily with most common-used cloud-based CDE for design and construction collaboration with external stakeholders fully secured and safe.

BIM submission	Submission Code
Concept Design	**CD**
Preliminary Design	**PD**
Detailed Design	**DD**
For Tender	**FT**
Construction (Regular submissions of the PIM)	**PIM**
As-Built	**AB**
Asset –Handing over	**AIM**

Table 05 - BIM Submissions phases coding.

5.3. BIM Deliverables

BIM deliverables to use the newly introduced authoring tools in the design and construction phases, the production of drawings, the coordination procedures and approaches. However, the list of drawings will not change from what is currently running, but as the deliverables will vary project to project, the list of deliverables to be agreed for each project at the appointment phase in the form of TIDP (Task information delivery plan) and MIDP (Master information delivery plan).

The two plans had been introduced in section 3.3.4, and they will demonstrate the approved list of deliverables for each appointment.

The BIM deliverables are cumulative, apart from the concept stage and starting from Preliminary to As-Built all deliverables are to be versions of the PIM (Project Information Model). The AIM (Asset Information Model) is the final result of the cumulative and collaborative production of information.

In other words, the BIM Model to be developed phase to phase and not to be replaced by a new model mainly from the preliminary phase to As-Built then the Model to be developed as AIM

The PIM (Project Information Model)

The PIM supports the delivery of the project and contributes to the AIM to support asset management activities. The PIM should also be stored to provide a long-term archive of the project and for auditing purposes. For example, the PIM can contain details of project geometry, location of equipment, performance requirements during project design, method of construction, scheduling, costing and details of installed systems, components, and equipment, including maintenance requirements, during project construction.

As defined in -ISO 19650-1-

The AIM (Asset Information Model)

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.

As defined in -ISO 19650-1-

Accordingly, the PIM model to be developed from concept throughout all design and construction phases, the level of structured and unstructured information to be increased phase to phase. The level of information need and level of development of a modelled object at each design phase to be defined as LOD (Level of detail) for graphical information represented of an object and LOI (Level of information) for the information to be attached to this object.

The expected level of information and details Which to be used in all to project phases and development of design and construction can be found here *On the ADM website.* Appointed parties and delivery teams will use this to generate the required information for each phase and avoid over modelling. Appointed parties and delivery teams should consider the file sizes to be practical to upload and download and should not exceed IT managers provided allowable limit. In this case, the Model should be sub-divided.

A federation strategy/ model breakdown to be agreed and documented in the project BEP and to be updated as per any requirement raised during the project life cycle.

At each submission, the expected BIM deliverables can be as following but not limited to

- The PIM model/s in native format is respecting the project federation strategy and as per the MIDP.
- The PIM model/s in IFC format.
- The PIM federated model in NWD format.
- The model/s in NWC format.
- Clash report in spreadsheets or HTML format.

- Clash proposed resolutions to be discussed/ approved.
- Design or construction drawing sheets in correspondence to the models submitted.
- Schedules or quantities take off spreadsheets might be required for the submission.
- Analyses and calculations extracted from the BIM model.

Exclusions or additional deliverables in respect to the project size and criteria to be approved and agreed in the MIDP as mentioned above.

- All submissions as mentioned to be BIM qualified prior to being passed for the technical team.
- AIM and the final BIM submission (As-built Model) to have the spreadsheets for asset management information, as explained in section 4.5. and to be in excel sheets as extraction from the AIM.
- The concept design phases deliverables may vary from the design and technical submissions as the usage of special authoring tools with simulation or videos for the concept design may occur and on the other hand will require minor BIM quality checks.

5.4. CDE (Common Data Environment)

A CDE solution had been introduced for the Municipal infrastructure and Asset Sector for internal use, this CDE to be used in integration with the Smart-HUB and PMWeb. A recommended pre-defined workflow to be found here in this guideline *(Diagram 09)* to be as a guideline for appointed parties.

The workflow is used for managing information during asset management and throughout collaborative production of information phase. Mapping the two shared and published folders between the SmartHub/PMWeb and the on-premises ADM CDE to be tested during the procurement phase.

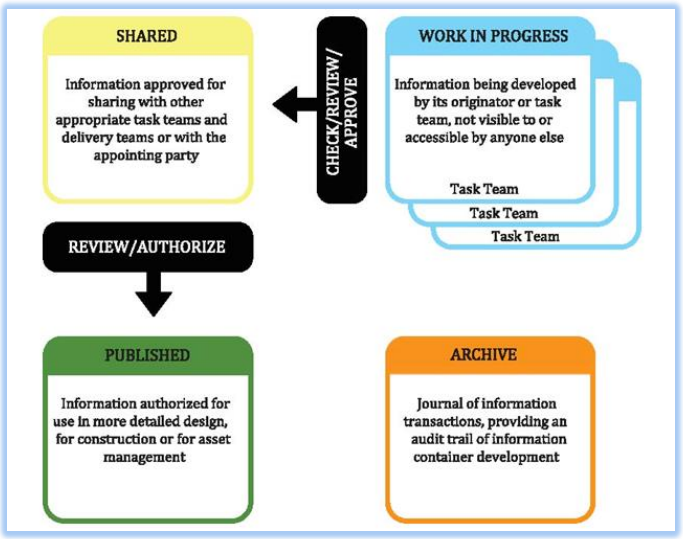


Diagram 08- @ ISO 19650-1 -the CDE Common data environment (CDE) concept

The submissions through the SmartHub/ PMWeb CDE should be in one of the following two states:

Shared Where files to be shared with other task teams

Published Where the file authorized for use

While **WIP** where each file created and developed on the appointed party CDE.

And in order of transition from a state to another, the information should pass through two main gates.

Check/ Review/ Approve transition

the transition should be made by the originating task team managers for information to be shared with other task teams (This to be done by the lead appointed party in collaboration with his supply chain).

Review/ Authorize transition

the Appointing party (Employer) to qualify/ approve the information to be published, information (in the published state) may be relied on for the next stage of project delivery or to be used to obtain authorities or external stakeholders approvals. The Authorized information to be sent back to SmartHub/ PMWeb simultaneously and to be as the submission response to the lead appointed party.

There should also be on the CDE an.

Archive state which providing a journal of all information transactions and an audit trail of their development. All shared and published submissions/ information will be copied to the Archive state.

At the end of a project, information required for asset management to be retained as a transition from PIM to the AIM and all unrelated information can be omitted to release the AIM for operations and maintenance. The AIM submission to follow the same procedure through PMWeb and CDE. Remaining project information including any in the archive state, to be retained as read-only in case of dispute and to help lessons to be learned. The timescale for retaining project information containers should be defined in the EIR.

Status Code / Revision Code

Each submission managed through the CDE should have metadata as a file attribute, which has no impact on the file naming at any phase:

Revision code to indicate the number of versions created from this file in both WIP and shared folder

Status code to indicate what is this file suitable for and the permitted use(s) of information.

Phase code to indicate the submission phase if applicable.

Metadata is initially indicated by its author and then amended by the approval and authorization processes.

The target of adopting the CDE solution and metadata for submissions is to keep the following:

- Responsibility of the information remains with the appointed party's task team who produced it, and although it is shared and reused, only the same task team is allowed to change it.
- Shared information which enhances the collaborative work and reduces the time and cost in producing coordinated information.
- A full audit trail of information production to be available for use during and after each project delivery and asset management activity.

The table below shows examples of submission status and revision codes in relation to the state where the submission exists.

Folder	Description	Status Code	Revision Code	Notes
WIP	Initial Model	**S0**	**P1**	initial
	Task Team Internal development	**S0**	**P1.01**	Internal
	Returned /Rejected	**S0**	**Pn**	New revision
	Task Team Internal development	**S0**	**Pn.0n**	Internal
	Task Team Internal development	**S0**	**Pn.0n**	Internal
	Task Team Internal development	**S0**	**Pn.0n**	Internal
Shared	For coordination only	**S1**	**Pn**	shared
	For Information	**S2**	**Pn**	shared
	For Internal review & comments	**S3**	**Pn**	shared
	For Stage approval	**S4**	**Pn**	Deliverable
	For PIM authorization	**S6**	**Pn**	Shared/Submission
	For AIM authorization	**S7**	**Pn**	Shared/Submission
	Costing	**D1**	**Pn**	Deliverable
	Tender	**D2**	**Pn**	Shared/Submission
	Obtain utility approval	**D3**	**Pn**	Deliverable
Published	Approved	**A1**	**Cn**	Commercial Doc
	Proceed with comments	**B**	**Cn**	Commercial Doc
	Costing	**D1**	**Cn**	Commercial Doc
	Tender	**D2**	**Cn**	Commercial Doc
	Obtain utility approval	**D3**	**Cn**	Commercial Doc
	Revision required	**C**	**Cn**	Commercial Doc
	As-Built	**AB**	**Cn**	Commercial Doc

*Table 0*6 - Examples for submission status and revision codes in relation to the state where the submission exists (n is integer serial number counting versions of the file).

All WIP state work will take S0 as a status code, revisions will start by P1... and to be P1 until reaching the level of approved to be shared by the task team manager, however internally it should take P1.01, P1.02, P1.03 as much it needed to reach the targeted level. The returned submissions to start the serial of P2 or P3 onward and consequently P2.01, P2.02 or P3.01, P3.02 onward.

Once the submission is ready and approved to be shared, the status code to be changed by the task team manager and to follow one of the examples above in respect to the submission suitability and the issuing purpose. However, the revision code will remain the same as it was in WIP state P1.

Returned submissions will have the same cycle again.

Authorized submissions by the appointing party team will be transferred to the published state and the status code to be changed to follow one of the examples above suitable for its condition, however, the revision code to be converted to C1, C2 in respect to the revisions of the same submission been issued.

At each transition from WIP to shared states or from Shared to published states an archived read-only copy to be in the archive state as mentioned earlier.

In the illustration and the submission map *(Table 07)* showing the information production throughout the WIP state on lead appointed party CDE and Employer's Vault CDE (On-premises Autodesk Vault). It will illustrate authoring the information by Task Teams in the WIP state, approval to be shared with other task teams on the shared state, then publishing the authorized information to the published state.

	Processes and information sharing
1	The WIP folder lays on the lead appointed party CDE.
2	The WIP is the live state (which means where the information generated, modified, and developed).
3	Task team BIM Author to create the assigned information related to his task and create the Model.
4	The task information manager to review the information, its suitability with respect to the phase submission and project LOI matrix and to approve it or to be revised.
5	The Task Team Manager of each Volume (i.e. Discipline) to confirm the LOD, model quality and compliance and the suitability of the submission, then to be transferred to the shared state with a new status code.
6	The Interface Manager (of the lead consultant or contractor) to receive other task teams shared models and perform a clash detection / create reports / discuss solutions with the Lead Designer/ Constructor. As a result of this coordination, the clash report, and proposed solutions to be compiled with the submission with the same status and revision code.
7	The lead appointed party's CDE shared state information is ready to be submitted as a submission through SmartHub/ PMWeb which mapped with the appointing party employer's CDE shared state. Hence, the submission is ready for review. BIM quality checks to be done, and the submission is to be passed for technical review or returned revised and resubmit.
8	Once the submission passed to the technical team, it is to be reviewed against its status code or as a revision. The submission to be authorized to publish state or returned to be revised and resubmit again through the SmartHub/ PMWeb to the lead appointed party.
9	The cycle is to be repeated for each design phase.
10	The same cycle can be repeated during the construction phases at pre-defined milestones.

Table 07 - Information workflow through Common Data Environment

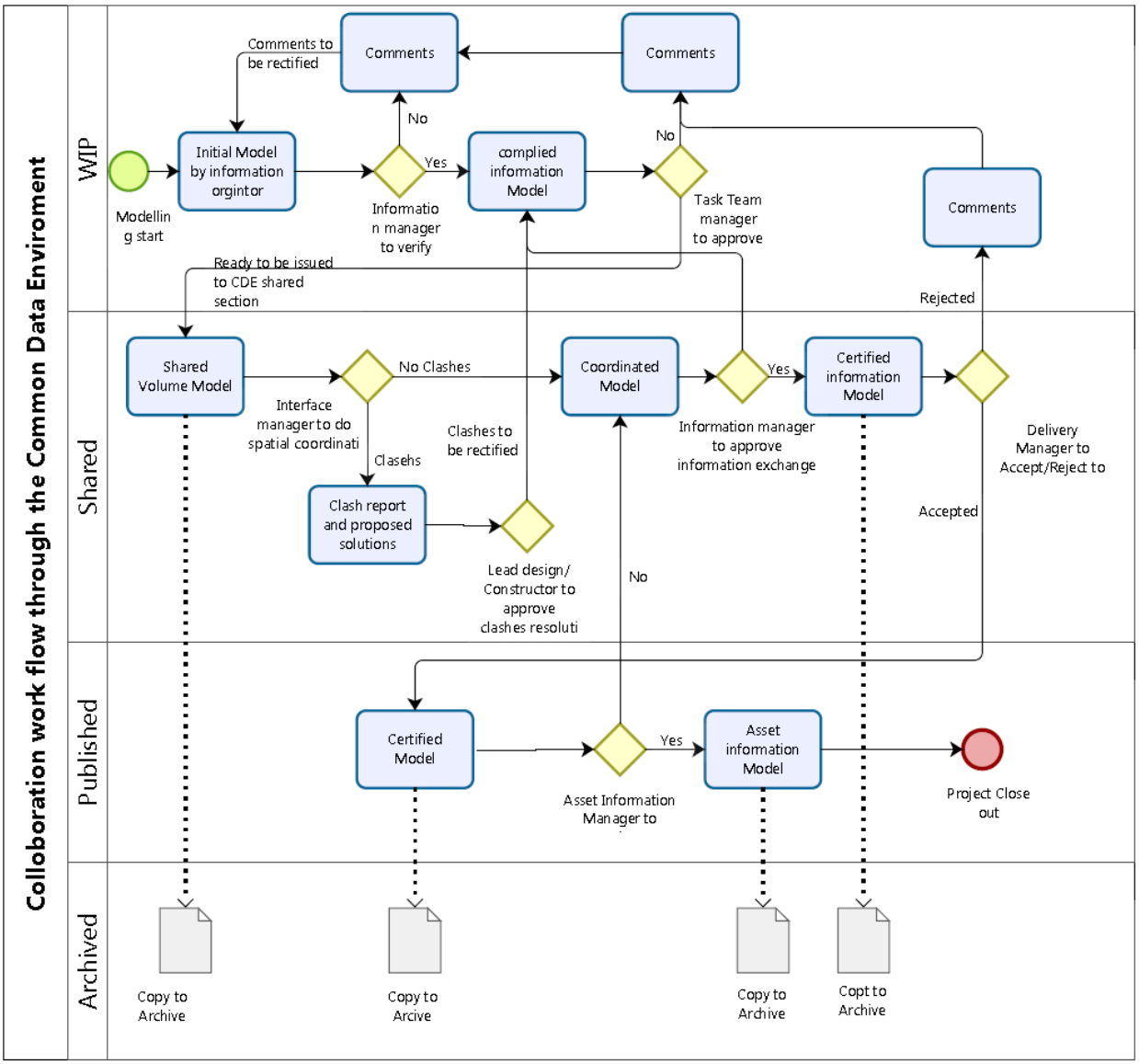


Diagram 09- the submission life cycle through the CDE

5.5. Appointed parties' capability and capacity assessment - (BIM Pre-qualification)

The lead appointed party should bean BIM qualified through the ADM Pre-qualification system which allows him to bid in the project.

The lead appointed party shall demonstrate his Supply chain BIM capabilities by asking them to fill and submit the pre-qualification questionnaire. That can be done during the tender response stage along with the pre-appointment BEP. Unless the supply chain is BIM certified (e.g. having ISO certification or already Pre-qualified by ADM through the same system). Or the organization is proposing a pre-qualified third party. The questionnaire is a series of questions for an organization (s) to answer regarding their level of BIM experience, BIM capability, BIM capacity, and availability of Information Technology (IT).

6. Standards, Methods and Procedures

6.1. Naming conventions and structures

The ability to efficiently reuse data throughout the life of the Model and the asset it relates to is one of the most significant benefits of BIM. In discussion with the Sector's BIM Team Lead and, Project Manager and other stakeholders, the BIM Management Plan should define:

- Objects naming convention
- Layer naming convention
- Specific attributes naming and requirements for elements
- File naming convention the granularity and naming conventions for elements, and as a minimum comply with the requirements of the Sector's Drafting and Design Presentation Manual, and
- specific parametric requirements for elements.

Even if the end-use of the model/data has not been confirmed, the data must be created in a structured and consistent way for future translation.

Project Number	Originator	Federation/ Breakdown / Zones	Location or Part	Type	Discipline/ Role	Number
1284-8	ADM	CVL	Sp3	3D	C	0001
S0244	PRS	RD	UG	3D	LS	0125
SW0129	ITech	PL	XX	BQ	RD	4001

Table 08 - File Naming strategy

Field	Obligation	Description
Project	Required	A unique number for the project to be used by all team members, this number is not subject to change and to be identified by the Employer in the EIR.
Originator	Required	Each organization is providing a code for their work, this code should not signify individual, but the organization has undertaken the work, these abbreviations to be listed down in the Project BEP.
Federation/ Breakdown / Zones	Required	A two-digit numerical code related to each agreed sub-division of the project, a table of codes to be provided in the Project BEP.
location	Required	A code for a specific segment/part of the project.
Type	Required	A two-digit code related to the type of the file being described. A schedule of allowable file types should be included as well as a description of what type of deliverable is associated with each. (Drawing, Model, BOQ...)
Discipline/ Role	Required	A code related to the Discipline/ subdivision authored the file
Number	Required	Sequential file number

Table 09 - Naming Information Fields Definitions.

Sample for Coding disciplines

Discipline Code		
1	**RG**	Road Geometry
2	**SM**	Signage and Marking
3	**RS**	Road Safety
4	**RP**	Road Pavement
5	**L**	Lighting
6	**SW**	Stormwater
7	**GS**	Geo-technical Study
8	**ST**	Structural
9	**LS**	Landscape
10	**IR**	Irrigation
11	**MT**	Materials
12	**EM**	Electro mechanic
13	**AD**	Addressing

Table 10 – Coding for the type of Drawings, Models, Documents, Roles and Disciplines guideline

Sample for Coding roles.

Role Code		
1	**A**	Architect
2	**B**	Building Surveyor
3	**C**	Civil Engineer
4	**D**	Drainage, Highways Engineer
5	**E**	Electrical Engineer
6	**F**	Facilities Manager
7	**G**	Geographical and Land Surveyor
8	**H**	Heating and Ventilation Designer
9	**I**	Interior Designer
10	**IR**	Irrigation Engineer
11	**K**	Client
12	**L**	Landscape Architect
13	**M**	Mechanical Engineer
14	**O**	Town and Country Planner
15	**P**	Public Health Engineer
16	**Q**	Quantity Surveyor
17	**S**	Structural Engineer
18	**TW**	Contractor
19	**U**	Utility Engineer
20	**X**	Subcontractor
21	**Y**	Specialist Designer
22	**Z**	General (non-disciplinary)

Table 11 – Coding for the type of Drawings, Models, Documents, Roles and Disciplines guideline

Sample for Coding types of information (Models and drawings)

Drawing Code		
1	**AF**	Animation file (of a model)
2	**CM**	Combined Model (Combined multidiscipline Model)
3	**CR**	Specific for the clash process
4	**DR**	2D Drawing
5	**M2**	2D Model file
6	**M3**	3D Model file
7	**MR**	Model rendition file for the other renditions, e.g. thermal analysis
8	**VS**	Visualization

Table 12 – Coding for the type of Drawings, Models, Documents, Roles and Disciplines guideline

Sample for Coding types of documents

Document Code		
1	**BQ**	Bill of Quantity
2	**CA**	Calculations
3	**CO**	Correspondence
4	**CP**	Cost plan
5	**DB**	Database
6	**FN**	File note
7	**HS**	Health and safety
8	**IE**	Information Exchange file
9	**MI**	Minutes / action notes
10	**MS**	Method statement
11	**PP**	Presentation
13	**PR**	Programme
14	**RI**	Request for Information
15	**RP**	Report
12	**SC**	Structural Calculation
16	**SH**	Schedule or table
17	**SN**	Snagging list
18	**SP**	Specification
19	**SU**	Survey

Table 13 – Coding for the type of Drawings, Models, Documents, Roles and Disciplines guideline

The document shall be read in conjunction with the project-specific requirements and Employer's relevant procedures and workflows. The File Naming needs to be implemented at the initial stage of BIM model development.

6.2. Federation strategies – Model break down structure

Federation strategies and federated Model, it is highly recommended to determine and have a successful federation strategy at the appointment phase. In respect to the project size, complexity, number of specialities, disciplines and task teams may participate in the project, the federation strategy which can be described as well as model break down structure to be generated and shall be aligned with the DRM (Detailed Responsibility Matrix).

However, this strategy can be updated during the collaborative production of work, but it still a cornerstone in time quality management and best use of resources.

Federation and information breakdown should be used to:

- Allow different task teams to work on different parts of the information model simultaneously without introducing coordination issues, for example, spatial clashes or functional incompatibilities.
- Support information security.
- Ease information transmission by reducing the sizes of individual information containers.
- Manageable spatial subdivision of a project defined by the lead appointed party.
- Allow for smooth delivery of a federated, coordinated model.

Federation and information breakdown can also be used to help define scopes of service for task teams.

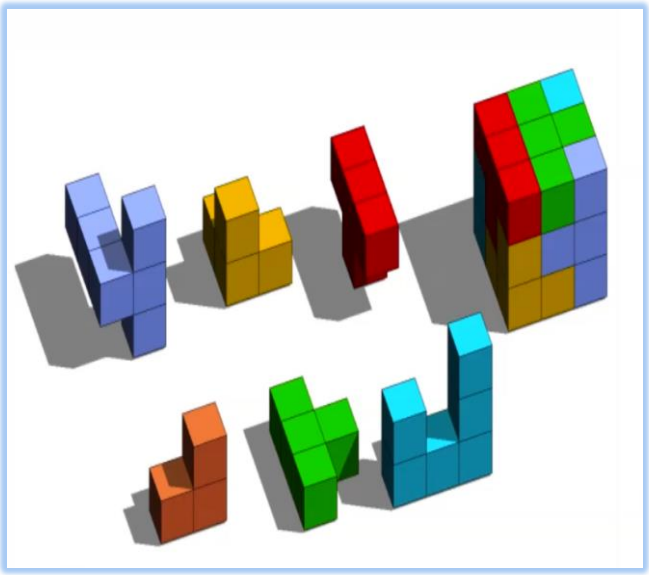
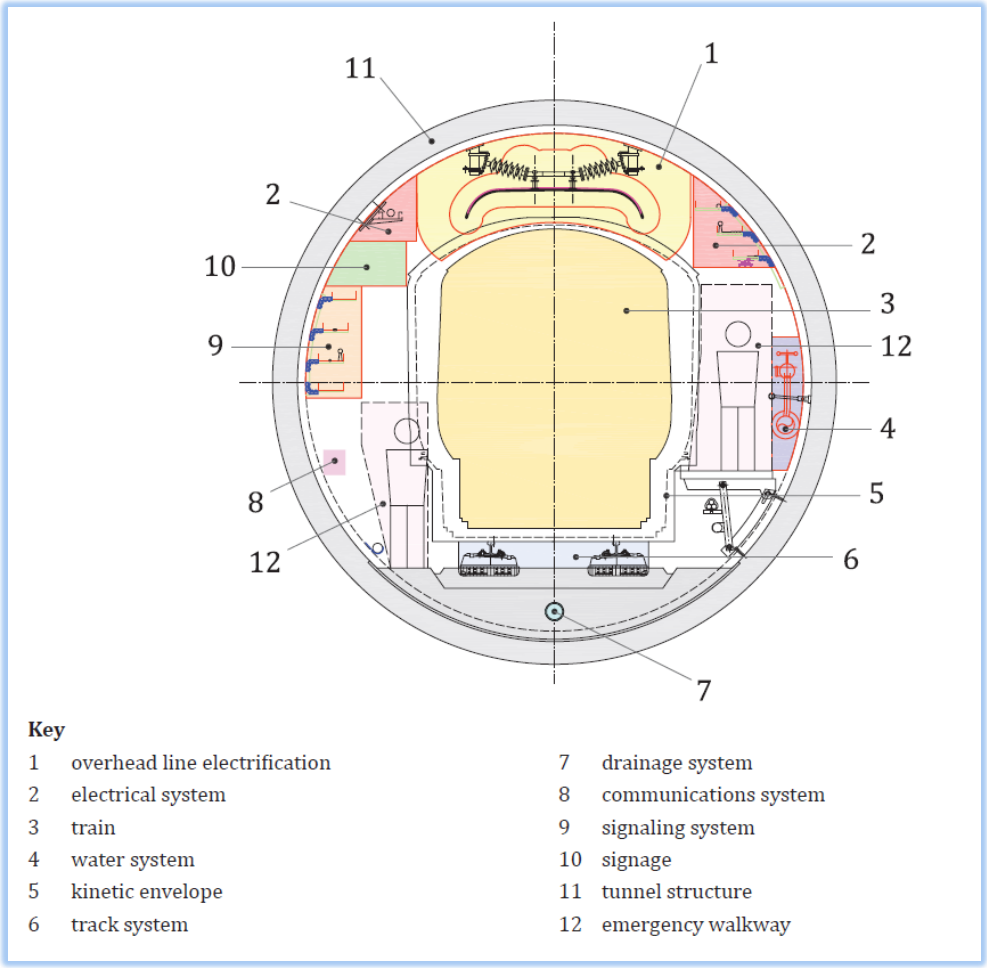


Diagram 10- illustrating the idea of breaking down the information into integrated parts



Key

1	overhead line electrification	7	drainage system
2	electrical system	8	communications system
3	train	9	signaling system
4	water system	10	signage
5	kinetic envelope	11	tunnel structure
6	track system	12	emergency walkway

@ISO 19650-1 Diagram 11- Illustration of a tunnel cross-section systems in a rail project and the federation strategy.

6.3. Information Security

Security-minded management of information, considering the need to monitor and audit compliance throughout the lifecycle of an asset, product or service, whether planned or existing, where sensitive information is obtained, created, processed or stored to be defined in the project EIR (Exchange Information Requirement) as part of the AIR (Asset information requirements) whether it is related of providing sensitive secured information or delivery of the same, such as locking systems, Surveillance systems, Evacuation procedures, Containment procedures

The federation strategy and model breakdown structure will allow for segregation of security-specific information, to be isolated and assigned to authorized Appointed party's task team or to be kept with the appointing party assigned delivery manager and not to be published on the CDE as shared or published information, while it still can be coordinated, located and managed by the assigned individual.

Appendix A – BIM Functions - Roles and Responsibilities.

Role	Company/ Organization	Responsibilities
Appointing Party	Employer	Complete and issue the EIR, assess consultant's/contractor's BIM competence and appoint key project team members
Project Delivery Manager	TBC	Assure delivery of information exchange, confirm supplier's ability to deliver information requirements, Accept/reject information exchange within the common data environment.
Project Information Manager	TBC	Enabling reliable information exchange through a CDE, configure information for project outputs, populate the information exchange format for the AIM, Accept/reject information exchanges within the CDE
Lead Designer/ Constructor	TBC	Coordinate the delivery of all design/ construction information, manage information development, confirm design/ construction deliverables, overall lead for configuration management, confirm the status and approve information for issue within the CDE, approve design/ construction changes proposed to solve clashes.
Asset Manager	TBC	Provide guidance as to the OIR and AIR, Support in the production of the EIR, Attend meetings and work with the design team supply chain and the information manager(s) to ensure planned assets are fit for purpose, meet the Client's needs and that the information provided will allow optimization of assets in operation, Review tender documents from a Facility Management FM and operational perspective regarding operational
BIM Author	TBC	Develop constituent parts of the information model in connection with specific tasks, production of project outputs, ownership of model information throughout the project construction phase.
Task Team Manager	TBC	Issue approved information within the CDE, production of design outputs related to a discipline-specific, package-based, or time-based task.
Task Information Manager	TBC	Direct the production of task information in compliance with standards and methods using agreed systems, confirm that information is suitable for issue within the CDE
Interface Manager	TBC	Manage spatial coordination on behalf of the task team, propose resolutions to coordination clashes.

Table 14 – BIM Functions - Roles and Responsibilities definition.

List of Tables:

List of Diagrams:

Bibliography:

- CPIx Post Contract Award Building Information Modelling (BIM) Execution Plan (BEP) Revision R1 March 2013.
- CIC BIM Protocol First Edition 2013 – Construction Industry Council
- BIM Task Group EIR Guidance – Version 7, 2013.
- 2018 Level of Development Specification - author: BIMFORUM www.bimforum.org/lod/
- UNIFORMAT II Element Classification for Building Specifications, Cost Estimation, and Cost Analysis - author: Robert P. Charette, Harold E. Marshall. US Department of Commerce NIST
- ISO 19650-1:2018 - Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 1: Concepts and principles
- ISO 19650-2:2018 - Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 2: Delivery phase of the assets
- ISO 16739-1:2018 - Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries — Part 1: Data schema
- BS 1192:2007+A2:2016 - Collaborative production of architectural, engineering, and construction information. Code of practice.
- PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information – author: BIM Task Group http://www.bimtaskgroup.org/
- PAS 1192-5:2015 –Specification for security-minded building information modelling, digital building environments, and smart asset management.