Rail Baltica
Coordinated by RB Rail

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RBR-DOC-BIM-BSF-0001

Detailed BIM Strategy

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Contents

0. Introduction

The document BIM Strategy Framework was initially prepared by Phil Jackson (Intra-Team IT Consultants LTD), as a Framework of Principles for the Development of the Detailed BIM Strategy of RB Rail AS.

The present document is the update of that document, as part of the Detailed BIM Strategy of RB Rail AS, which is developed by AECOM.

1. Executive Summary

This document sets out a strategy framework for implementing Building Information Management (BIM) on the Rail Baltica Projects. It outlines the strategic BIM goals, processes, standards and protocols for the capture, coordination, management and delivery of digital information throughout the lifecycle of design, construction and operation of the assets being delivered.

It is intended to act as a strategic guide to participating organizations and as basis for the development of a full project information strategy that details the standards and processes presented here. Plus set the process parameters for the delivery and implementation of technology platforms to support the BIM process.

Using this as a guidance document alongside the technical standards documents developed for the project, it is ready to be extended during a detailed strategy and standards development process which will include analysis of local, requirements, maturities and existing standards, risks and costs of implementation.

2. Project Context

2.1. Project Background

The Rail Baltica project has been planned for a number of years. Having received regulatory and financial approval for the conceptual alignment and corridor it has now reached the stage of detail design and construction. This BIM Strategy Framework is designed to set out the base for the use of 'Digital Engineering' during the period of detail design, construction and handover into operation of the railway. The BIM Strategy Framework is part of an ecosystem of documents that, in addition to the deployment of the Common Data Environment, will define the framework, the rules, the processes and workflows of the Rail Baltica project.

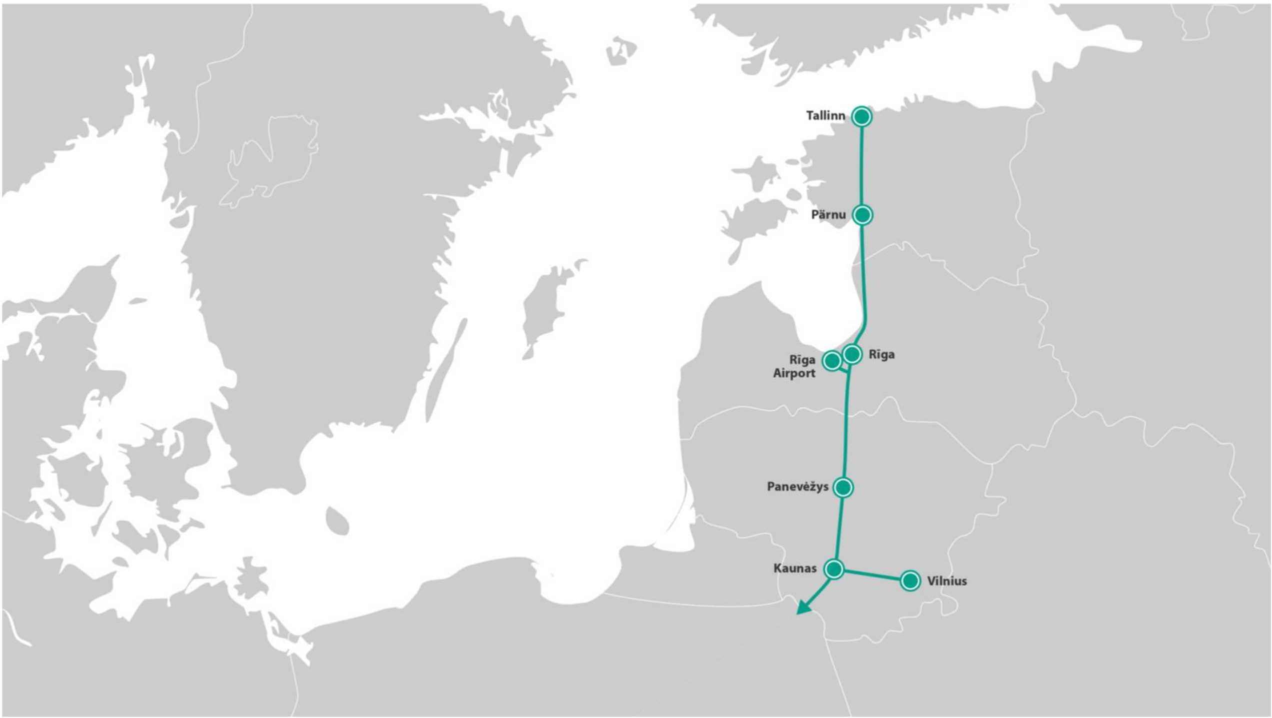
The key documents are:

- The BIM Strategy Framework Update. This document, which defines the framework of the BIM Strategy.
- The BIM Manual. A document defining in detail the BIM Strategy.
- The Specifications for the Supporting Technologies.
- The Terms of Reference for the Supporting Technologies.

2.2. Project Outline

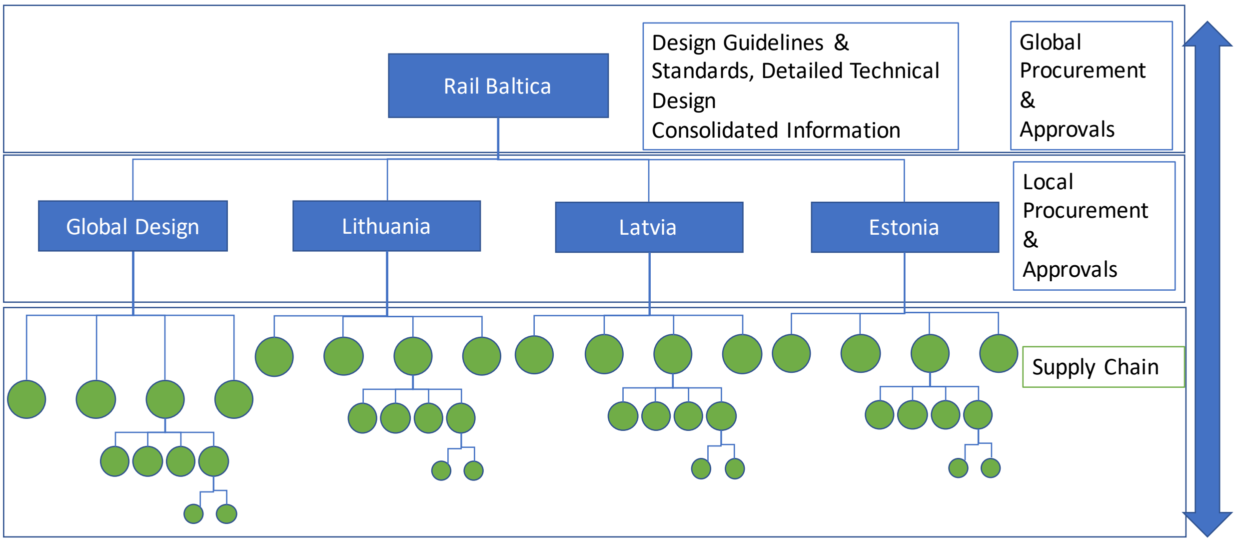
Rail Baltica is a new 'fast conventional' mixed traffic railway line linking Kaunas in Lithuania, Riga in Latvia and Tallinn in Estonia, and an extension to Vilnius from Kaunas. With a total line length of electrified double track, ERTMS L2 signaling and built to European standards and gauge, meeting their 'Technical specifications for interoperability' with a maximum design speed of 240kph for passenger trains and 120kph for freight trains.

Jointly funded by the European Union and the participating country railway authorities it will have multimodal terminals, located at Muuga in Estonia, Salaspils in Latvia, Kaunas and Vilnius in Lithuania, plus seven railway passenger stations located at Tallinn, Pärnu, Riga Central, Riga Airport, Panevezys, Kaunas and Vilnius plus connection between Kaunas and Vilnius Airports.



2.3. Project Delivery and Contracting Parties

The project will be coordinated by RB Rail and constructed locally by local country based Implementing Bodies. The organization of responsibilities is broadly set out in the diagram below:



Whilst it is headlined as a single project it is in fact a major 'Programme of Projects' each delivered under different procurements and contracts. Coordinated at the centre, with global and local approval mechanisms, but constructed locally.

Detailed organizational roles and responsibilities along with full approval rights, security rights and routings will be defined in the BIM Manual (see "Roles & Responsibilities" Section).

2.3.1. RB Rail

Is the central coordination organization that has been established to implement Rail Baltica. It is jointly owned in equal shares by SIA Eiropas dzelzceļa līnijas in Latvia, UAB Rail Baltica statyba in Lithuania and OU Rail Baltic Estonia in Estonia. Headquartered in Riga Latvia it has established branches in Lithuania and Estonia in order to ensure better project coordination process with the beneficiaries and implementing bodies.

RB Rail's main responsibilities are the design, cross border section construction and marketing of the railway. It also deals with the European Union submitting financing proposals for the Rail Baltica Global Project on behalf of the beneficiaries.

It serves as the central purchasing body for all parties for the procurement of studies, plans, designs for the global project, sub-systems (Control, Command, Signaling and Electrification, raw materials, key components and cross border track sections.

2.3.2. Beneficiaries

The Rail Baltica project is being implemented by the Baltic States, whose three ministries are responsible for the transport sector in their related countries. They are:

- Ministry of Transport and Communications of the Republic of Lithuania
- Ministry of Transport of the Republic of Latvia
- Ministry of Economic Affairs and Communications of the Republic of Estonia

2.3.3. Implementing Bodies

Rail Baltica project's national implementing bodies in Estonia, Latvia and Lithuania are responsible for implementing and constructing the project in their respective countries.

2.3.3.1. Estonia

Rail Baltica Estonia and the Estonian Technical Regulatory Authority

2.3.3.2. Latvia

SIA Eiropas Dzelzcela linjas (EDZL)

2.3.3.3. Lithuania

UAB Rail Baltica statyba and JSC Lietuvos gelezinkeliai

2.4. Delivery Constraints

There are some specific constraints that impact the strategy broadly these can be summarized as:

2.4.1. Integration of Approved Outline Designs

The project has gone through a long planning process cumulating in an approved base corridor plan and concept designs that have been approved by both Rail Baltica and the local implementing authorities. These concept designs have been delivered by local implementing authorities in each participating country as drawings with varying degrees of content. Although they meet the requirements of concept approval they cannot be regarded as information models. They almost certainly contain information implied or specific that set out the design and operational requirements for the railway.

The delivery of a BIM strategy is therefore coming little late in the overall process and be necessary to undertake a catch-up exercise to integrate the existing information.

RB Rail AS and the local implementing bodies shall define, according to the legal constraints of those project contracts, the limits and the exemptions to the integration of those projects to the BIM Strategy defined in these BIM Strategy documents. But those models should generate an equivalent documentation to the one described within the BIM Manual, in particular the one related to the geometrical 3D models and the information data (stored by means of Data Drops).

2.4.2. Early projects integration (Pilot project: Riga Airport Station)

A pilot project is being carried out prior to the start of the main BIM Strategy development contracts. The station at Riga Airport is being undertaken with the implementation of some of the approaches that are defined in the BIM Strategy.

2.4.3. Local standards

Whilst the railway is being designed and constructed to European Standards local regulations and standards, for other aspects of construction will prevail in obtaining approvals and authorizations. These might include for example planning, building, environmental, structural, drainage, and others. Information deliverables will, therefore, require inclusion of these local standards depending on project location.

2.4.4. Permissions and Approvals

In addition to project permissions and approvals, which will be governed at overall programme level, each local implementing authority will require capability of making the at local level in accordance with local standards.

2.4.5. Local Language Support

Models, information and documents for local approval will need to be made available with local language support. Hence asset dictionaries and attribute requirements will need to have multi-lingual referencing.

2.4.6. Asset Management

The future management of the built assets and their ownership is not yet fully determined. It is probable that there will be a number of asset management organizations involved. The strategy is based on a generic asset management information requirement that should meet any future ownership and management structure.

Existing railways asset management is carried out using information collected retrospectively. The BIM strategies presented in this document present the possibility of capturing data as it is created during design and building which presents an opportunity to not only save costs in post construction re-survey but also in delivering quality information hitherto not held in asset management systems.

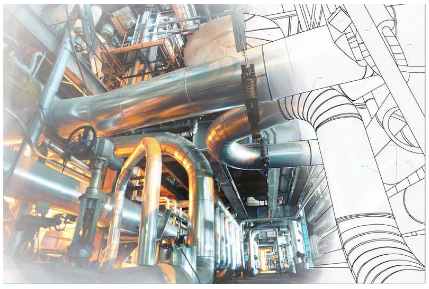
Hence it is proposed that asset information is systematically collected in a generic form which can be eventually transferred or referenced into multiple asset management systems.

2.4.7. Supply chain maturity

The use of BIM techniques and information delivery whilst not entirely new is evolving throughout the supply chain and within client organizations. The supply chain is likely to involve both large organizations who have some experience with BIM however it is also certain to involve many smaller specialist organizations that are less familiar with BIM. Added to the fact that, to date, most BIM implementation has centered on proprietary parametric 3D design models, rather than the wider requirement for life cycle information delivery, the project will potentially encounter a wide variation in maturity and experience. This places a significant need for training and support for all involved in the delivery and use of information if the project is to fulfil its goals. The strategy will need to recognize this varied maturity and reflect it the standards and processes which must be straightforward but recognize the need to mature as the market matures.

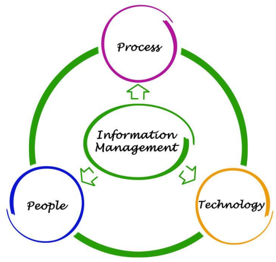
3. Strategy Framework

The strategy framework is centered around the information captured, created, shared and coordinated through the project's life cycle. It is designed to extend the use of BIM beyond the commonly perceived understanding of being 3D modelling to one of information modelling and management.



3D Modelling

Information Modelling



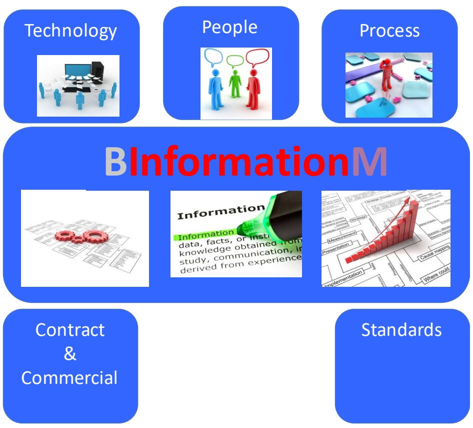
Information Management

It therefore is as much concerned with the data surrounding the project and the assets it creates as it is with 3D models although they of course play an important part in the process.

For the purposes of this strategy the following definition of BIM is used:

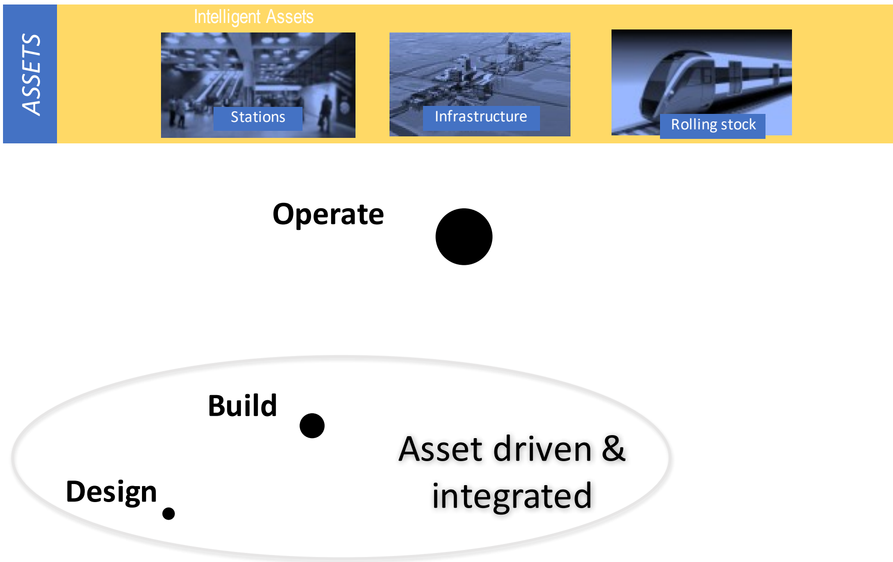
'Building Information Modelling is nothing more and nothing less than a systems approach to the design, construction, commissioning, ownership, management, operation, maintenance use, demolition and reuse of built assets.'

Focused around information relating to the project assets as they are conceived, designed, constructed and operated the strategy framework sets out the basic components necessary for information delivery. Namely the delivery processes and content, the standards necessary to achieve the goals of sharing and coordination, the commercial and contractual requirements for information delivery, the technology required to support the processes and the people roles and training requirements for successful delivery.



4. Rail Baltica BIM Objectives

Ideally Rail Baltica wish to realize the potential benefits of a digital approach to design, construction and operation of the Rail Baltica Project by using Building Information Management (BIM) delivery processes and standards. Realizing that the industry has varying degrees of maturity and that the BIM implementation on the project presents a number of risks and additional costs, the objectives below are measured against the potential benefits and their impacts and are defined and explained in the BIM Strategy documentation in order to allow the higher comprehension of the concepts so that the learning curve is easily overcome.



It has the following broad objectives:

- A life cycle centric approach to information delivery and use.
- Using BIM to create virtual assets prior to construction and translating those virtual assets into physical assets. In other words, to build the railway twice – once as data and once physically eliminating potential issues before construction and capture vital information during the process.
- Capture relevant information once through the life cycle of the project program, from step to step, stage to stage, but use it many times throughout the process, reducing duplication of effort and maximizing its use in analysis, procurement and eventual operation.
- To extend the use of BIM beyond 3D models to include wider information attributes, functional requirements, asset information together with linked documentation such as drawings, photographs, videos and related information sets.
- To capture operational and asset management information during the design and build process ready for handover to users once complete.
- Enable cross project information sharing and coordination.
- Developing a set of common shared asset object types.
- Encourage and support the design and construction supply chain to use BIM tools and technology in design and construction of the railway. With the specific aim of improved cross project coordination, removing errors early in the design process, reducing Requests for Information (RFI) between contracted parties, better quality and trustworthiness of deliverables.

- To encourage the supply chain to use the best technology to achieve the information requirements thus not restricting them to specific design tools.
- To implement technology that supports these objectives recognizing the evolving nature of BIM and related technology.

5. BIM Strategy Governing Principles

- Globally collect, review, approve and coordinate information delivery at overall project level.
- Coordinate across national implementing bodies, but not other national authorities.
- Extract and print/plot documentation for other national approving authorities.
- Local collect, review, approve and coordinate information delivery at each project level.
- Contracted information delivery from supply chain against Rail Baltica requirements.
- File based federated coordinating delivery of information
- Based on 'Open' standards where feasible and through project standards where not. Avoiding proprietary solutions wherever possible and adopting technology that delivers solutions best suited to allow the interoperability among the different actors.
- Recognition that that Technology will evolve over the period of the project.
- Leave the supply chain contractors to choose their own tools and solutions for information creation.
- Delivery of information to implementing bodies and global project in a consistent shareable, federated and useable format.
- Consistent standards for information delivery throughout the project

6. BIM Core Information Requirements

The following are the potential core information requirements: -

6.1. Asset centric delivery

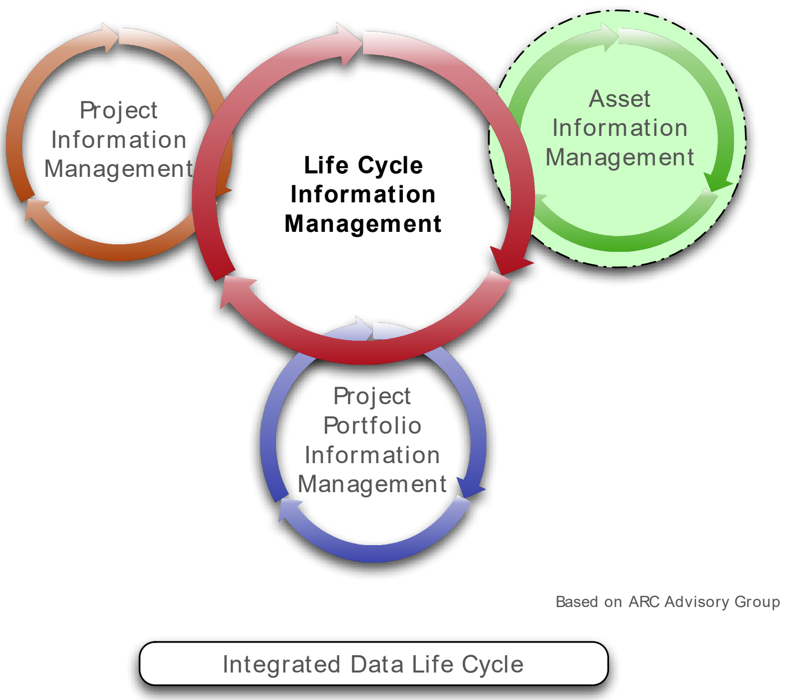
Information captured, created, analyzed and delivered relates to the assets the project is building. Information delivery should be asset centric rather than document or model centric.

Recognizing that an asset begins life when it is conceived and designed and not when it is completed and handed over into operation governs the requirements for information creation and capture. Information is required to be delivered and related to an asset that is being designed and constructed from the start of a project.

More detailed information can be found in the BIM Manual's "Information and Codification principles" and in the Supporting document "RBR-DOC-BIM-BMA-0003_CodificationDataManagement".

6.2. Asset life cycle

An asset follows a natural life cycle through each of its stages from existing infrastructure through concept, design delivery and operational management.



6.3. Life Cycle Stages

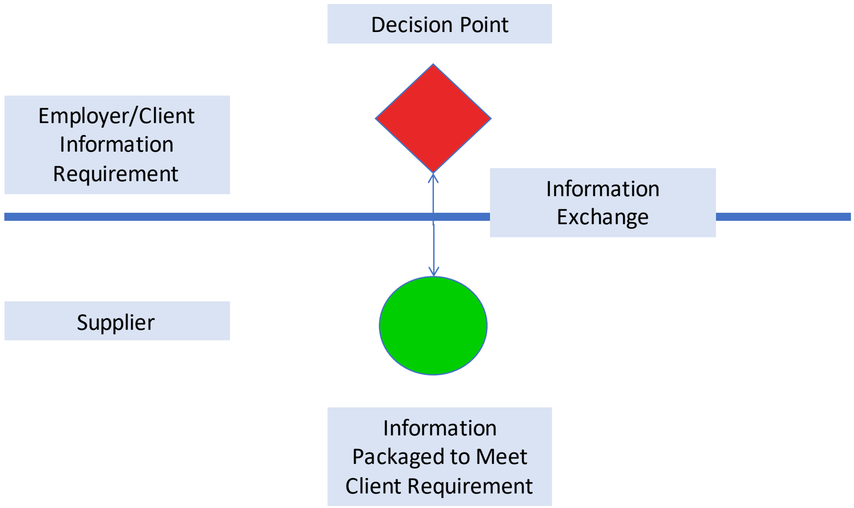
Project information requirements follow a similar life cycle stages and provide the keys to when information needs to be delivered.

These theoretical stages are related to the actual Rail Baltica BIM project stages as follows:

- PLAN: The BIM Strategy Development, implementation and future updates within Rail Baltica (done once and updated every certain period) and the definition of the Employer Information Requirements (done once per project).
- EXPLORE: The Master Design Stage, which looks for the best solution among the different studied options. Taking the PAS 1192 stages as a reference, the BIM stages included are:
  - Stage 1: Brief
  - Stage 2: Concept
- DEVELOP: The Detailed Technical Design Stage, which develops the design of the Master Design phase.
  - Stage 3: Definition
  - Stage 4: Design
- DELIVER: The Construction Stage, which makes the project come into a reality and document it digitally for a future operation and maintenance.
  - Stage 5: Build
  - Stage 6: Handover
- OPERATE: The Operation Stage, which manages, operates and maintains the built infrastructure.
  - Stage 7: Operation

All these stages are explained in depth in both this Strategy Framework and the BIM Manual (see "Model Delivery Plan" Section and point "Project lifecycle and Delivery"). It is worthy to mention that each of the three countries involved in RB Rail AS have their own level of definition with regards to each stage, therefore the EIRs and the Technical Specifications will define in each case what is the Level of Detail that will be requested at each Design / Construction / Operation stage, and the BIM Manual will provide as a reference and a guideline.

7. Process Framework for BIM Information Delivery



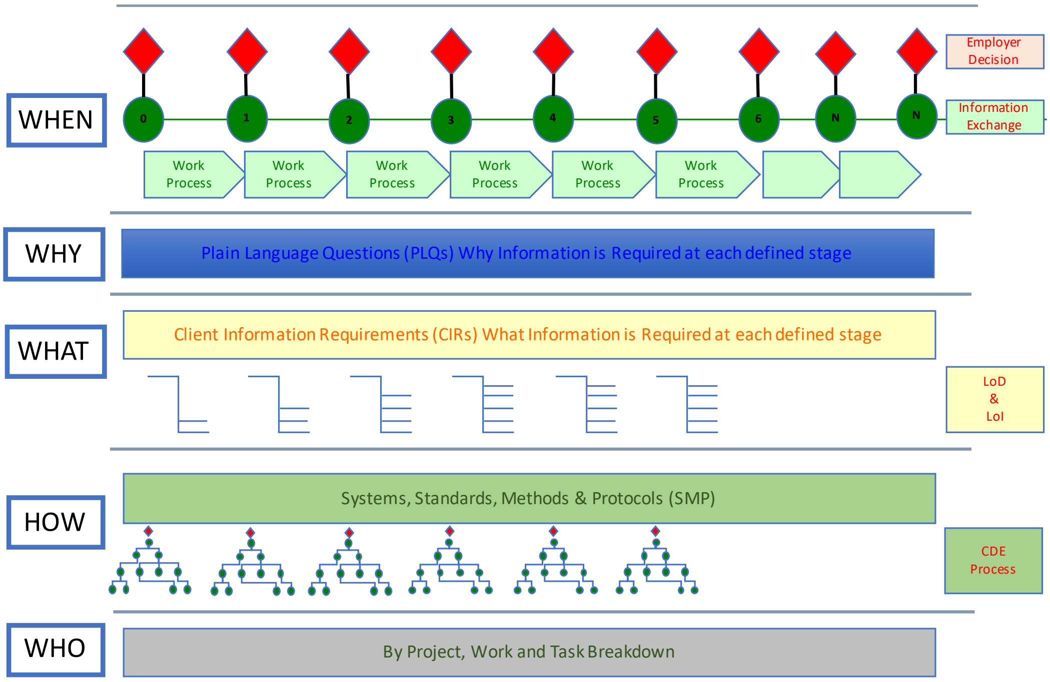
Information delivery is built on a series of staged information exchanges between the supply chain and the client. Diagrammatically these can be represented as shown in the figure on the right where the red diamond represents the approval and decision to be made by the client and the green circle representing the information packaged and delivered by the supplier to meet the information contractually required by the client at that particular stage.

It should be noted that these information delivery points are exchanges rather than one way processes. Thus the client can receive test and approve information and release it for sharing with others in the project including the supply chain.

Information is required at each life stage in order to make decisions which will include approvals and continuity to proceed to the next stage.

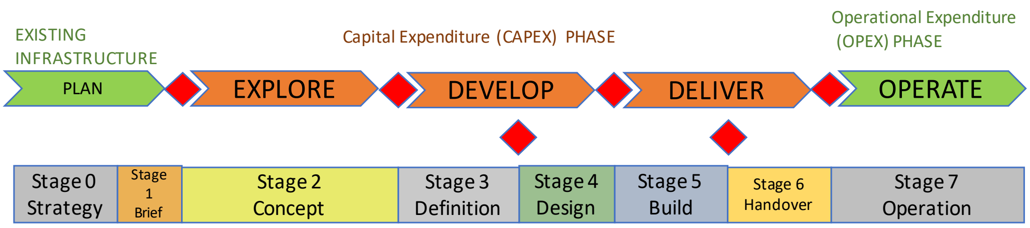
The BIM information delivery process requirements can be broken down into a series of standard questions namely When? - Why? – What? – How? - Who?

The diagram below illustrates how they fit together to achieve an integrated view of the delivery process.



7.1. Planning Information Delivery Timing (When)

Having established that information requirement follows the life cycle of planning, exploration, development, delivery and operation more detailed delivery points need to be established for the project. The diagram below sets out some generic delivery and decision stages which fit most projects.



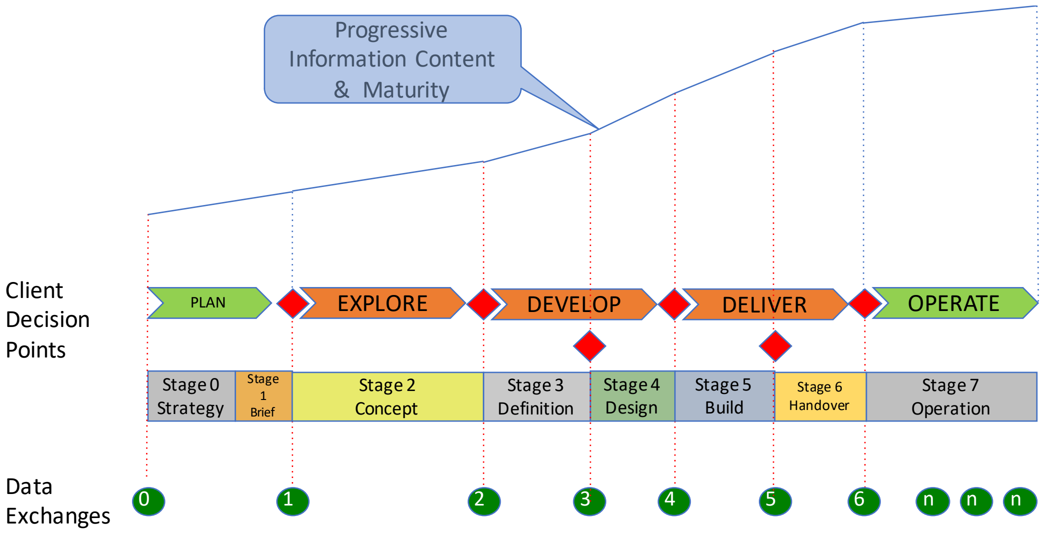
The Rail Baltica project stages are defined in the point 6.3. “Life Cycle Stages”. The stages mentioned above are referred to the BIM stages of the PAS 1192, used as a reference.

The headings shown are self-explanatory and follow the natural process of information development and provide key approval and decision points. A more detailed and specific lifecycle diagram is described within the BIM Manual (see “BIM Delivery Process” Section).

Exact mapping to these points will differ depending on the current stage of delivery. For instance, in the case of Rail Baltica the corridor alignment for the railway in general has been developed to definition stage and is about to enter into detail design stage. (It is intended that the proposed CDE will contain this information as a basis for detail design). However, future contracts such as buildings, overhead power and signaling will start at definition stage.

7.2. Progressive information delivery

Information delivered therefore is progressive adding to that delivered in the preceding stage building in content and maturity as the project moves through its life cycle. Each data exchange between suppliers and the client provides further and more detailed information to be managed, shared coordinated and utilized.



The Rail Baltica project stages are defined in the point 6.3. "Life Cycle Stages". The stages mentioned above are referred to the BIM stages of the PAS 1192, used as a reference.

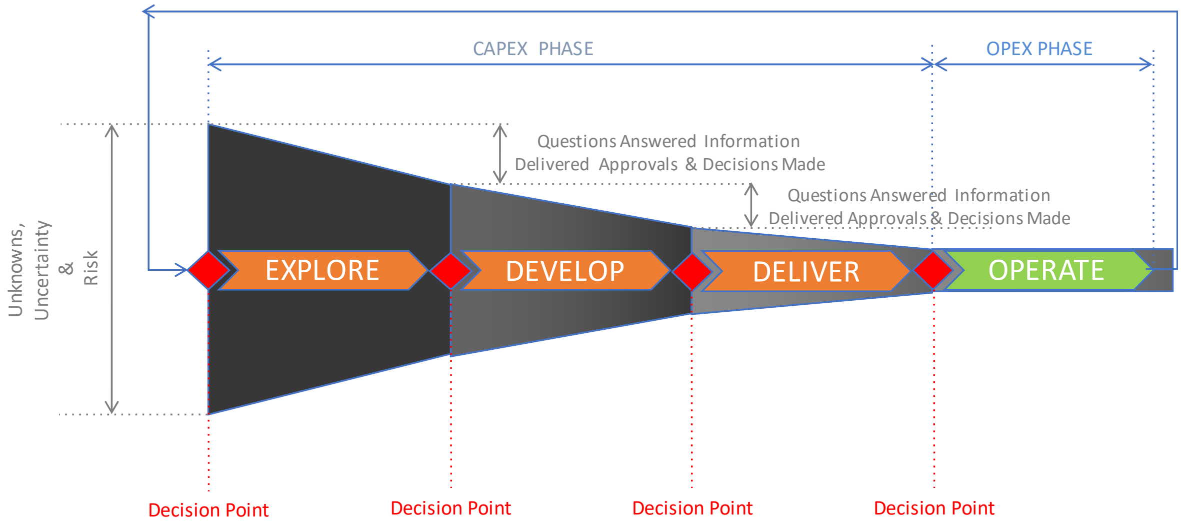
If changes are required, then change control to information previously created should be applied. The progressive development of the models require a continuous and iterative interface coordination, not only internal within the Supply Chain teams but also between the Service provider and RB Rail AS (or the local implementing bodies), this workflows are defined in the BIM Manual (see Section called "Interface Coordination").

7.3. Requirement driven information

Each data delivery should be designed to satisfy the requirements set out for the delivery stage it sits within hence the process can be said to be "Requirements Driven".

7.4. Asking the questions at each stage (Why)

In developing information requirements, it can be useful to ask the question, in as simple terms as possible, what information is required at this stage and why is it required. In essence what unknowns, uncertainties and risks need to be reduced and satisfied during the current stage of the project life cycle.



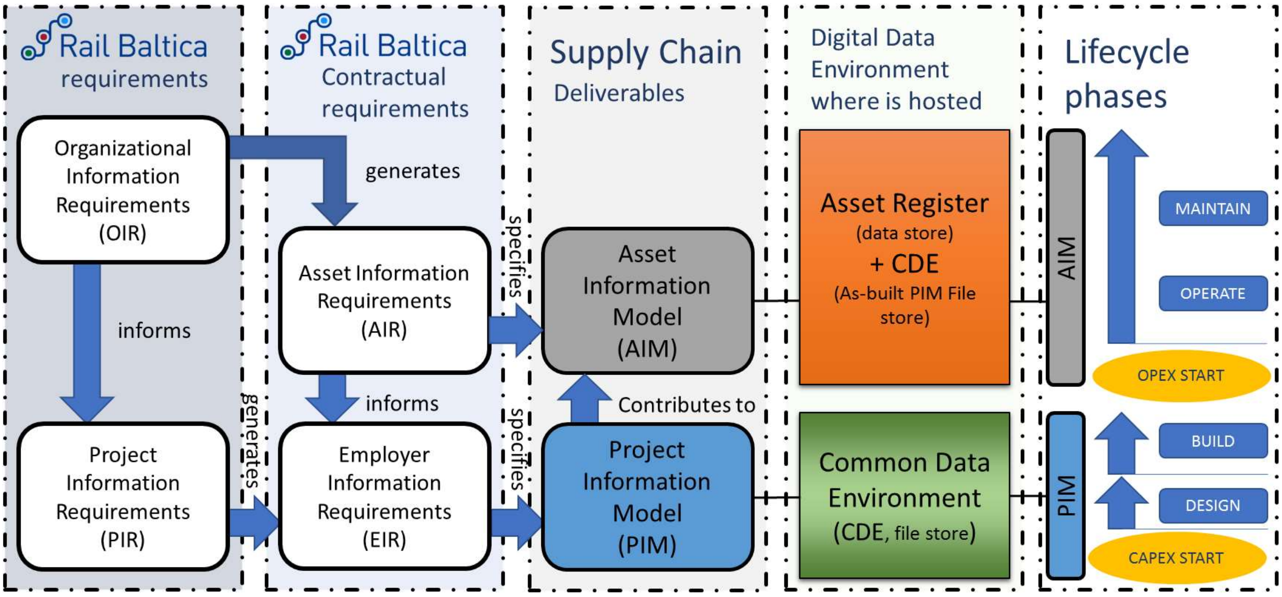
The required information becomes the answer to these questions.

7.5. Information Requirements (What)

Information delivery requirements comprise of several components:

- Organizational Information Requirements (OIR) – information to support the client running the railway and its functions once the project is delivered. Strategic business requirements, performance and service levels.
- Asset Information Requirements (AIR) – information about the physical assets being delivered and operated.
- Project Information Requirements (PIR) – information that needs to be available to support project delivery including cost, scheduling, approvals…

- Employer Information Requirements (EIR) – part of the information that is shared to a specific Contracting Party to support their particular project delivery. This documentation is commonly called Client Information Requirements (CIR) or even Contracting Party's Information Requirement (CIR), in the even those document exist, they will be considered equivalent to the EIR.



The diagram above shows the inter-relationship of these requirements delivering a Project Information Data Model that is ready to be transferred to an operating Asset Information Model. The diagram also shows the relationships among the AIM / PIM with the Digital Environments that host them and the phases of the lifecycle of the assets that are related with each one.

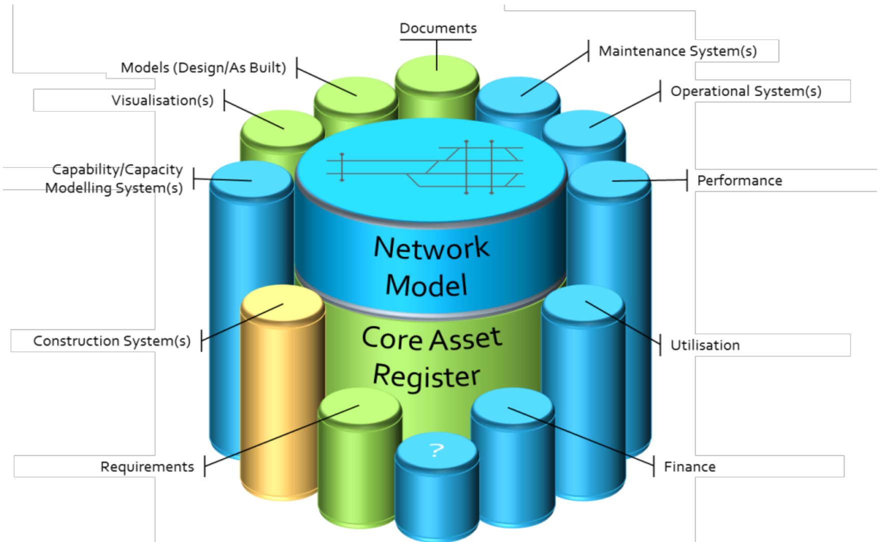
Further details of these information requirements and the PIM and AIM phases can be found in these two BIM Manual's chapters:

- "Phases of the Project Information Model process" point, part of the "Purpose" Section.
- "Information Lifecycle through PIM and AIM" point included in the "BIM Delivery process" Section.

7.6. Defining Asset Information

The term asset information is a generic term covering a range of information and data types. These data may or may not sit in a core asset register, but can be associated or linked with an asset.

This is illustrated diagrammatically here for a railway asset.



With acknowledgement to Douglas Young Asset Manager for the UK High Speed 2 Project

7.7. Asset Information Requirements MoSCoW Table

The following table gives summary guidance to the basic information requirements for any given asset. It is designed as a list that gives headers of information attributes required and to be fulfilled by detailed against detailed object descriptions. It uses the MoSCoW rating system for priorities specifically: -

M – Must have information

S – Should have information

C - Could have information

W – would have eventually information if time and money available

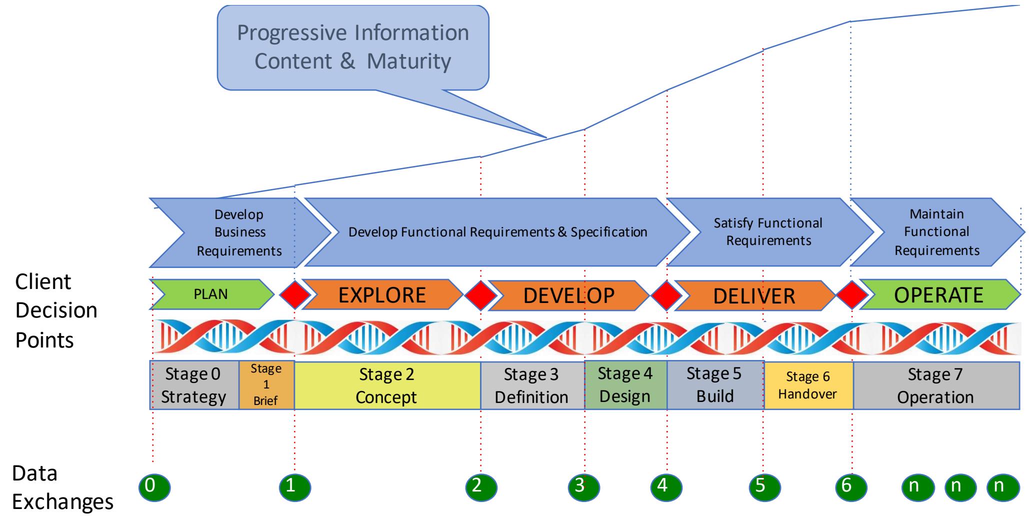
Subject	MoSCoW Rating	Notes
Asset Inception and Life Cycle	Must begin life as it is conceived not when it has been built and handed over after or during construction.	To satisfy life cycle information requirements, the development and collection of data about an asset must instantiated at conception and be progressively managed and added to through its life cycle
An Asset	Must have a unique identification and a reference to type of object. Managed revision identifier	As an asset is conceived in the planning & design process it should be uniquely referenced and from that point on version controlled.
	Should have information related to its: - Currency	Date of information currency Suitability of use of information including quality and accuracy.

	Suitability for information use Functional. Technical performance specification.	The function the asset performs. The technical performance specification for the asset
	Could have: - A location – Geospatial, Linear & Space A topological relationship and location. Geometric construction Dimensions Relationship to other assets and groupings such as Network, Entities, Facilities, Systems, and Assemblies.	Geometry and topology are not essential attribute requirements. This breaks with IFC tradition which currently mostly relies upon construction geometric components and use cases. However, these will generally be required attributes for locational and context purposes.
	Further Could haves: - Reference to Work Breakdown Structure Material Energy embedded Energy of installation Volume or other quantification measure related to a method of measurement Manufacturer Installation date and time Performance criteria of installed product.	An extendable list which will be dependent on type of asset being described and captured.
	Operational & Maintenance Could haves: - Inspection frequency, Condition, Criticality, Risk	Information that gives support to day to day operation and maintenance of the asset.

The previous table has been the base for the creation of the object attributes schema for the Project Information Model - PIM (see BIM Manual's "Phases of the Project Information Model process" point within the "Purpose" Section) and the recommendations for the Asset Information Model – AIM (see previously mentioned reference to BIM Manual). The Schema of attributes for the PIM and the concepts for the Asset identification throughout the PIM and AIM can be found in one of the documents supporting the BIM Manual, this document is called "Codifications & Data Management".

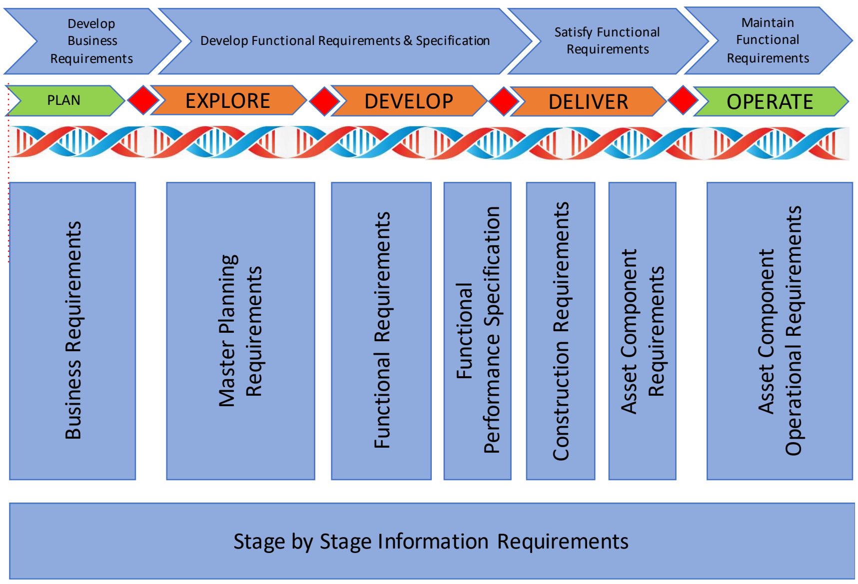
7.8. Asset Information Requirements Stage by Stage

The information collected at each stage reflects the work carried out during that stage developing requirements from the initial business plan through functional requirements, specification to satisfying those requirements in construction and handing over that information for eventual operation.



The Rail Baltica project stages are defined in the point 6.3. "Life Cycle Stages". The stages mentioned above are referred to the BIM stages of the PAS 1192, used as a reference.

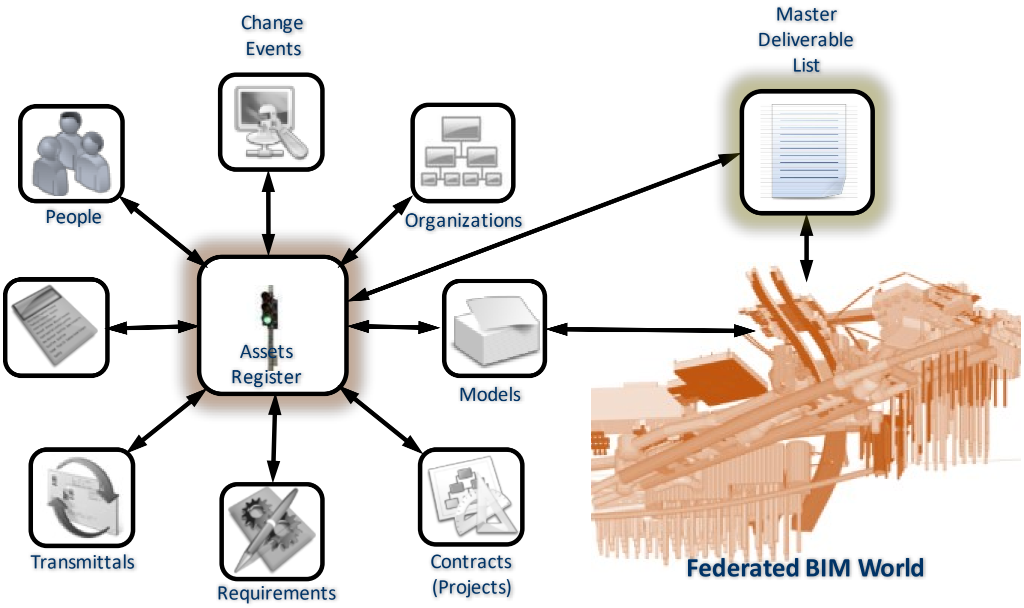
In more detail each stage develops and builds on the foundation laid down by the previous stage.



The Rail Baltica project stages are defined in the point 6.3. "Life Cycle Stages". The stages mentioned above are referred to the BIM stages of the PAS 1192, used as a reference.

7.9. Project Asset Register

It is proposed that in order to achieve the maximum from BIM implementation an asset register is implemented. This will facilitate linking capability between models, documents and other associated data sets providing a repository for assets as they are instantiated.



7.9.1. Asset Information Hierarchy

An asset breaks down into a natural hierarchy of information that follows its natural development and provides inherited information to the next level of the hierarchy.

The following table gives an illustration of such a hierarchy. Note that the naming structure is given for example purposes only. It should also be noted that this hierarchy should not be confused with Classification Hierarchy which does not define things but indexes types of things in the context of information user.

Group(s) Network Complex Facility	**Group(s)** A grouping of assets sharing common properties such as location or purpose.
Primary Asset	**Primary Asset** A discrete piece of infrastructure such as a tunnel, bridge, highway section etc
Elements of Asset	**Elements of Asset** Major elements of an asset described by management requirements e.g. bridge deck, foundations, supports, track, sub-base etc
Components of Elements	**Components of Elements** Individual

Both primary assets and elements of primary assets can be systems or assemblies of elements or components. Each step in the hierarchy can be recursive. That is a further primary asset can exist within a primary asset or an element or a system asset element can contain hold further elements.

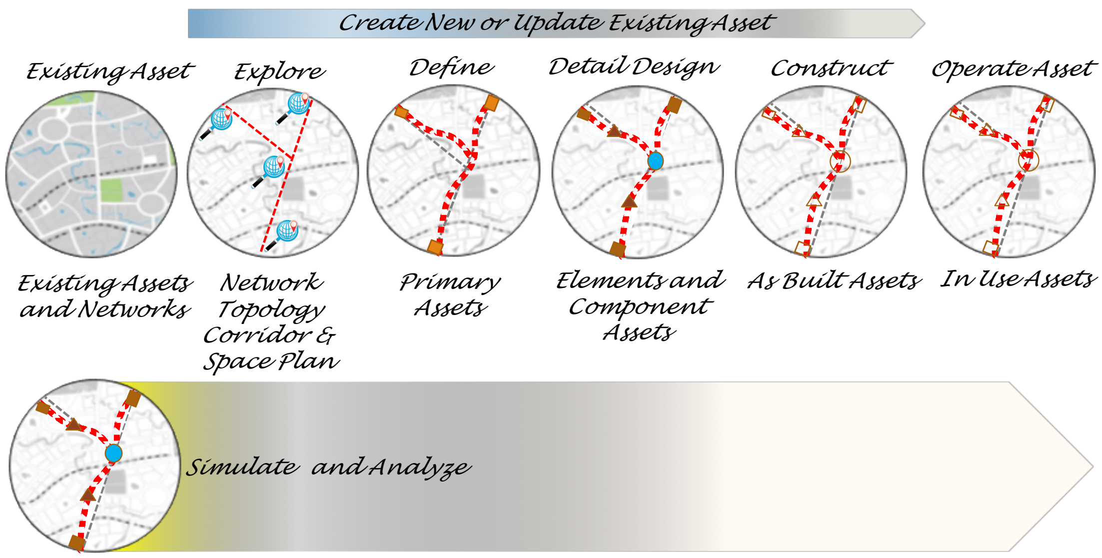
This data structure and further details about the data management are described in the BIM Manual's "Information and Codification principles" Section. In addition to that Section, the information is completed in the supporting document RBR-DOC-BIM-BMA-0003_CodificationDataManagement.

7.10. Level of Definition - Breakdown & Granulation

Depending on the life cycle stage of a particular asset and the asset hierarchy information that fulfils the managers needs is required. This has been interpreted in various ways across the world and across domain disciplines. Often this has been interpreted as the refinement of geometric detail required at each stage of development and harks back to the age of scale drawing/CAD/GIS detail. However, a number of more recent developments have recognised that this needs to cover not just geometry or scale but the total information attribute and metadata content required.

Depending on the stage, discipline, hierarchy or type of object different levels of definition may be required. Hence at the end of a stage or at a time in development a particular asset object may have geometric detail to one level and attribute information detail to another.

Information granularity is not therefore a continuously developed and refined object adding more detail but more a set of objects at each stage of development each with their own detail, accuracy and information content appropriate to the stage of development. Each inheriting the information from the previous stage but NOT replacing the object but adding new more detailed objects.



Information requirements will therefore be related to the stage and level of information appropriate to the stage of development.

This should not only inform the BIM requirements but also the structure and requirements for future Asset Information Systems.

7.11. Information Accuracy, Utility and Purpose

Additionally, at each group in the asset object hierarchy and at each stage of development the required accuracy of information will differ.

It is important therefore to record within asset object metadata to what level of accuracy the information contained is produced and for what use or that information can be applied.

To illustrate at an early new project stage of planning or concept design a new road corridor might be modelled to ascertain basic alignment, quantities and land requirements. At this stage the level of accuracy required would be sufficient to approve a concept design and make basic decisions on budget. However, the information would not be accurate enough to complete detail design and set out the construction which would be fulfilled at element level with detailed alignment and offset geometry. At asset management stage accuracy should be held at a level that is suitable for location and for future updating construction.

7.12. Standard Asset Type Libraries and Data Dictionaries

In order to maximize cross-project use it is proposed that a standard library of asset types be used on the railway be established. This will not only support naming consistency and common attributes but also encourage the use of repeat assets thus increasing efficiency of procurement and potential for off-site manufacture.

The Asset Type Libraries Strategy is described in the BIM Manual's "Information and Codification principles" Section, and within the supporting document RBR-DOC-BIM-BMA-0003_CodificationDataManagement, where libraries based on Asset Data Definition Documents (AD4s) are defined so that they could be defined by the Operators if they consider it necessary.

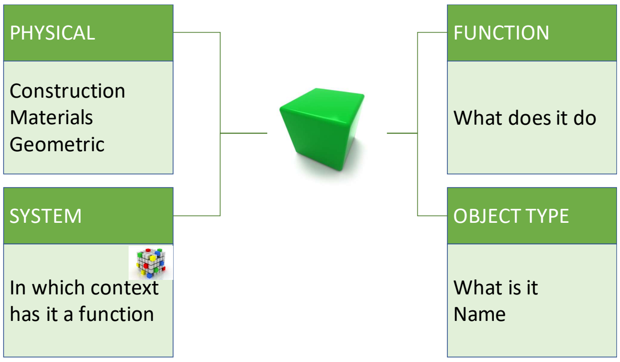
7.12.1. Language Mapping

By using a common asset register naming for objects and their attributes can be mapped to the different languages used on the project.

7.12.2. Classification

The Rail Baltica BIM Strategy sets up the UniClass 2015 classification for the asset data.

7.12.3. Attributes

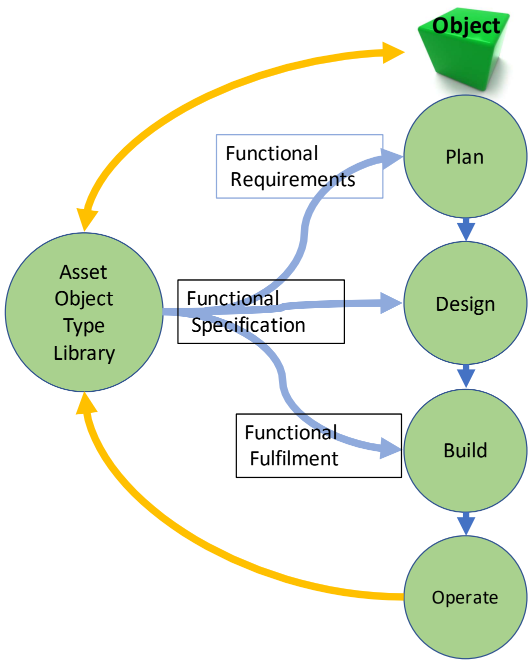


Attributes of an Asset Type Library Object

For each asset type attributes should be developed that name the asset type, define its function, what systems and/or assemblies it relates to and physical properties such as construction materials, dimensions, serial number, asset tag, and condition. Further attributes can be added as the project progresses as required.

Those attributes will increase in content and detail as the project progresses as illustrated below.

Interaction with a Type Library at different project stages



The attributes will be divided by groups and by use, permitting their integration in the Model Development Plan so that their implementation in the BIM Models is consistent with the requirements of each project stage. Thus, the BIM LOD (Level of Definition) will be divided into the graphical LoG (Level of Geometric Detail) and the LOI (Level of information), being the last one which will match requirements and attributes group along the project stages.

The attributes are defined in the RBR-DOC-BIM-BMA-0003_CodificationDataManagement document.

7.13. Project Information Requirements

Project information requirements relate to management of the project delivery. They will include: information for approvals, scheduling, progress monitoring, cost control, procurement and communication with stakeholders.

They relate to the assets being delivered and hence bear a close connection with the components of data models. Once asset components are identified their work breakdown structure for delivery can be ascertained and linked to cost, scheduling, issues and supporting documents such as 3D models, drawings, photographs, sketches and specifications.

This approach provides flexibility by not holding data in proprietary BIM tools but exposing the results to a wider audience of stakeholders and information users.

This approach facilitates the addition of what is known as 4D BIM (scheduling) and 5D BIM (Scheduling and cost). As well as a more flexible approach to adding data without resorting to significant proprietary BIM modelling output.

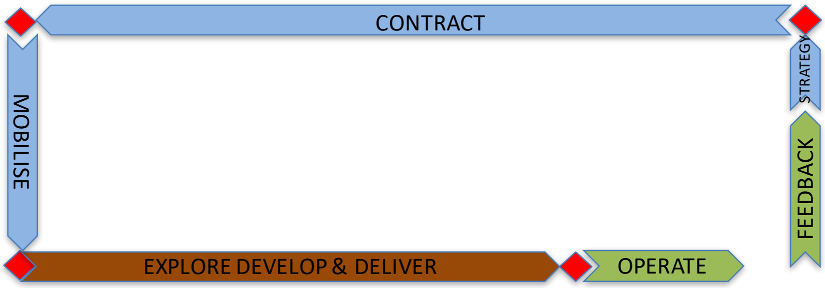
The BIM use cases are further detailed in the “Principles and Goals” Section within the BIM Manual.

8. Delivery Process (How)

The process of information delivery needs careful consideration as it sets out the contractual obligations and practical steps to ensuring that each party understands the information requirements and demonstrates how they will deliver against those requirements.

This strategy framework suggests a file based delivery approach to required information. Following the project delivery process step by step and details the actions at each step of the project lifecycle. From itemizing existing information, setting out client information requirements, through choosing and contracting with the supply chain, mobilizing, and delivering information.

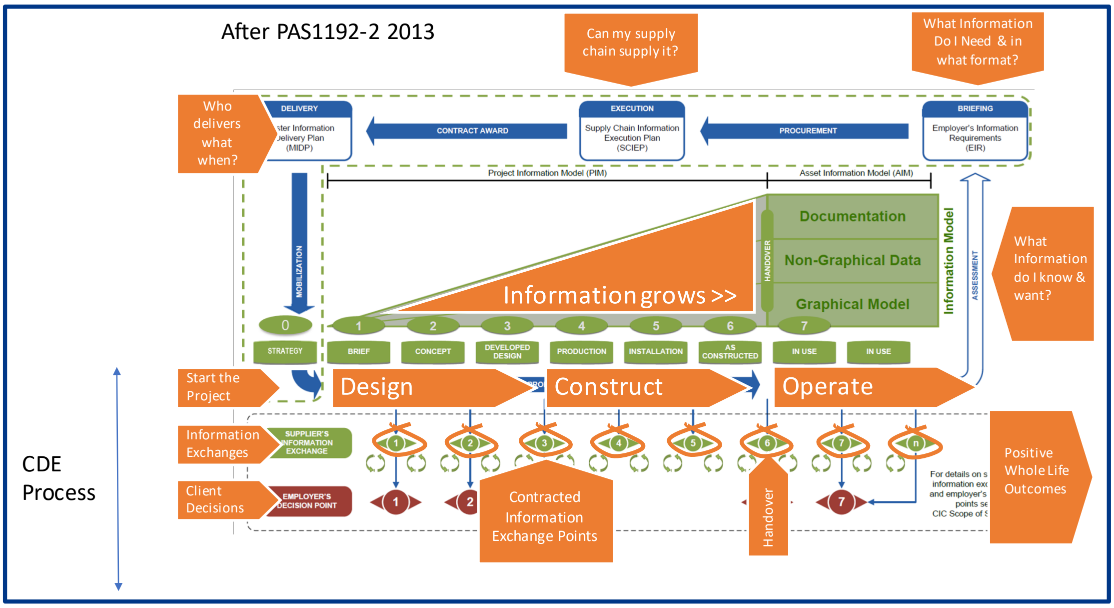
The process is best looked at as a 'racetrack' cycle idealized as follows:



There are process standards evolving to support this process. It is recommended that the solution adopted should be follow those currently being developed in the Nordic area and in particular meet local industry maturities and experience.

An example of such an approach is the one set out in the international standard ISO 19650-1, which fit with buildingSMART International Delivery standards. Previously the British Standards 1192 Series of Standards, specifically, British Standard PAS 1192:2:2013 had defined the process in depth.

The core of the detailed PAS 1192 delivery process shown in the following 'racetrack' diagram:



Reference to the British Standard PAS 1192:2 – 2013 and any updates for the detail of this process are freely available from the following web site https://shop.bsigroup.com/Navigate-by/PAS/PAS-1192-22013/

Summarizing the generic process step by step starting at the right hand side following feedback:

8.1.1. Gathering Existing Information

What information is available from earlier analysis, surveys, existing databases & previous projects. Made ready for sharing with the supply chain at briefing and contract start in an agreed format accompanied with metadata that describes its currency, accuracy, suitability and purpose.

8.1.2. Contract Briefing

Setting out the Employer Information Requirements and the delivery standards for the information, including format and structure of the data. Mandating how the information will be exchanged, coordinated, validated and approved.

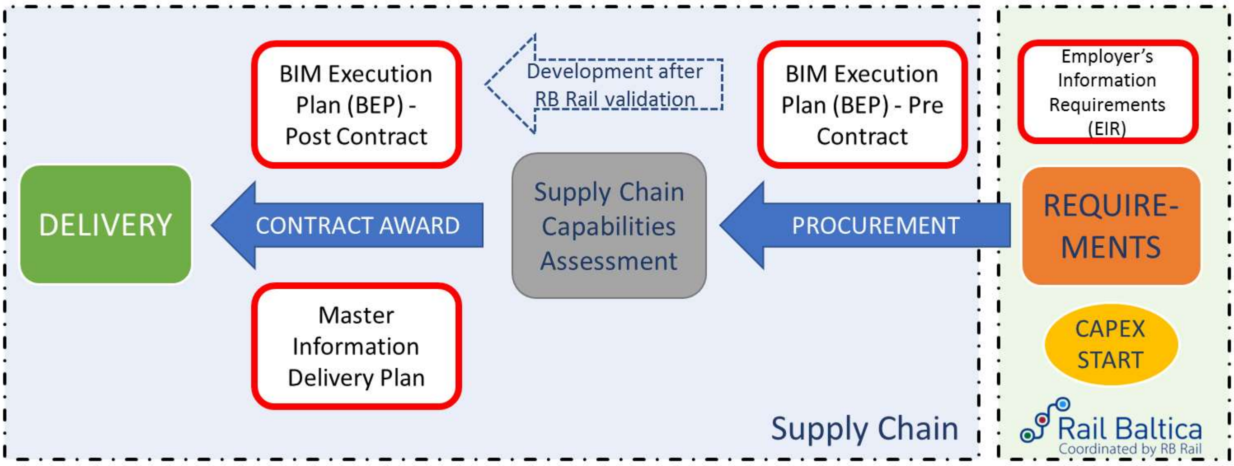
This makes the delivery of required information a contractual obligation to use a CDE approach to information delivery.

Note: The Employer Information Requirements (EIR) are sometimes called Client Information Requirements (CIR). Those two names are equivalent.

8.1.3. Procurement

Project goes to tender to designer / contractors. The tenderer responds with details of their capabilities and a reduced version of the BIM Execution Plan (BEP), commonly called BEP-Pre Contract, which outlines how they will fulfil the contracted information delivery.

Once RB Rail validates the capabilities (or the BIM implementation plan, in the event the Requirements accept it plan instead of validated capabilities) and the materialization of the requirements in the BEP-Pre Contract, the tenderer can be awarded with the contract.

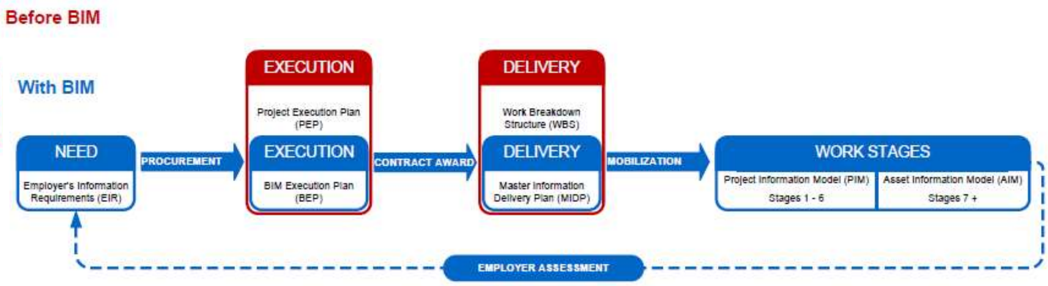


8.1.4. BIM Delivery Plans

On award of contract the selected designer/contractor produces, in discussion with the client, a detailed BEP (commonly called BEP Post-Contract) and a Model Information Delivery Plan (MIDP). This sets out what data models will be delivered, lists those deliverable, how they will be broken down and who is responsible for those deliveries.

As part of that delivery plan the designer/contractor will demonstrate how they will ensure that the delivery is coordinated and meet the requirements of Common Data Environment (CDE) including delivering data to the Rail Baltica Common Data Environment for approval and wider sharing.

Whilst this might seem complex it is very little different to the normal process carried out for Project Execution Plans as can be seen in the diagram below.



8.1.5. Mobilization

An often overlooked stage in the delivery process is mobilizing the technologies, people and communications to enable delivery and data exchanges to take place.

In the case of Rail Baltica it is proposed that central systems are set up ready for each project. This should include technology, start-up materials, training and education plus a central support mechanism. Hence mobilization for each project will consist of plans and implementation of communication, roles and responsibilities, systems and system connection.

Time and resources should be planned for this mobilization set up.

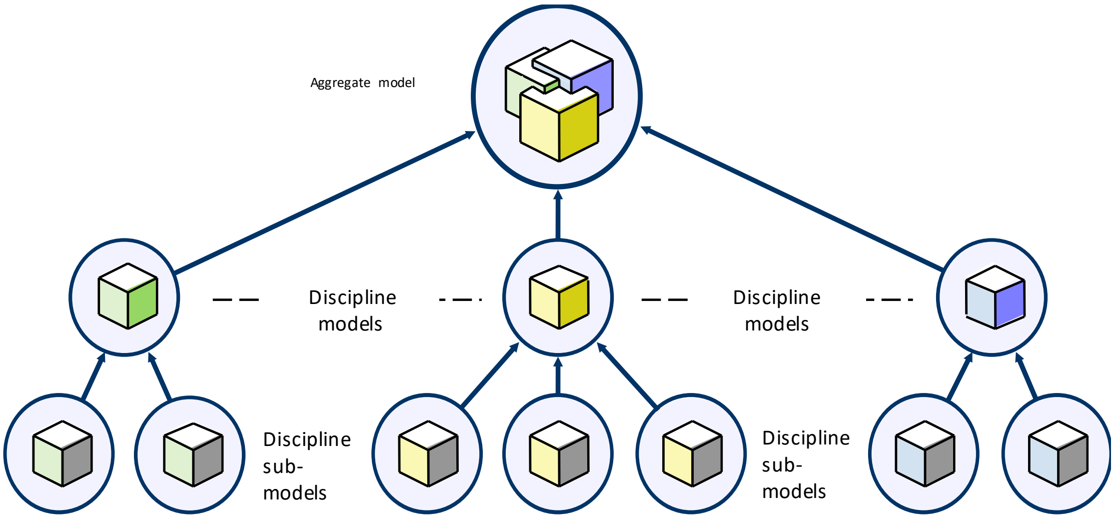
8.2. Delivery Stage

BIM Project information delivery starts supported by the project Common Data Environment data is collected progressively fulfilling the project 'Information Requirements' stage by stage coordinating across the project.

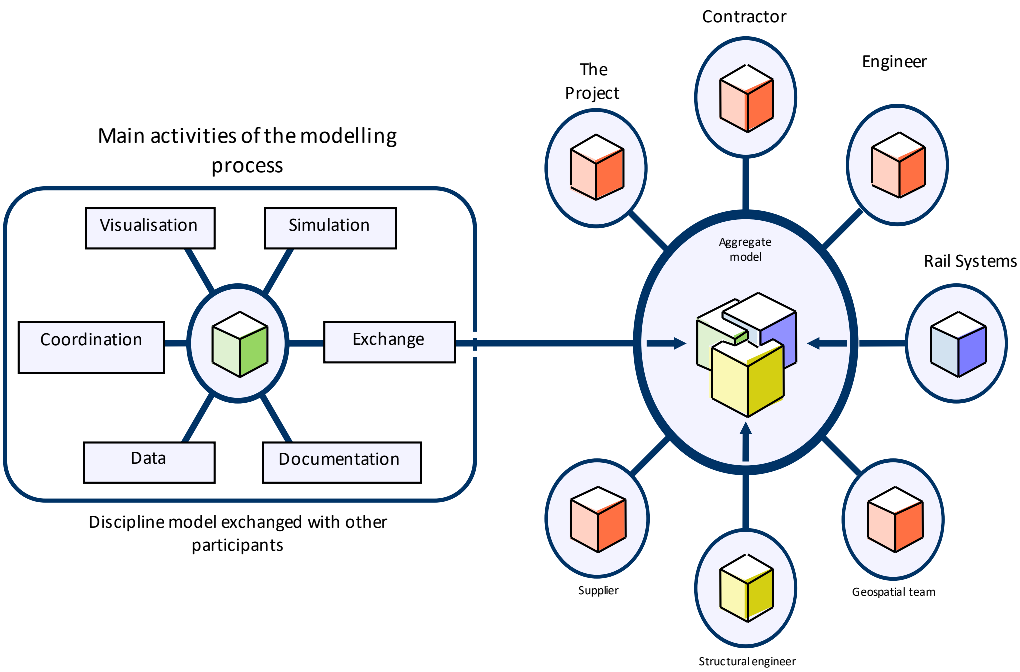
8.3. Delivery Content

The initial strategy set out in this document is founded on file based information delivery. Featuring files that can be viewed and referenced together (federated) it does not attempt to build one large single model but uses multiple sourced files controlled by the CDE.

Delivered data models can then be referenced by multiple users to carry out their tasks and deliver newly created information back to the overall CDE.



File delivery is composed of three distinct components combined as a single package. All these deliverables as a whole will be called Data Exchanges:



- Models files –that contain models of a defined part of the project. These can include 3D models of assets and point cloud files. All files should be referenced to a common grid, common origin and map projection standard, under a common coordinate system and elevation configuration. The BIM Manual provides further details about the geo-reference within the "BIM models' Geo-reference" Section.

- Data files – that contain information has been extracted from or related to delivered models, delivering data relating to each asset. Files should be extracted from the same version of the model file delivered with it. Data files should contain an index of the files contained in the delivery package. These data files will be called Data-Drops.

- Document Files – including drawing files that contain information cut from the related delivered models, sketches/drawings that relate reference the delivered models and asset data but not necessarily cut from those models, photographs that relate to the delivered models and the asset information data.

For further details see "Deliverables from BIM Models" Section within the BIM Manual.

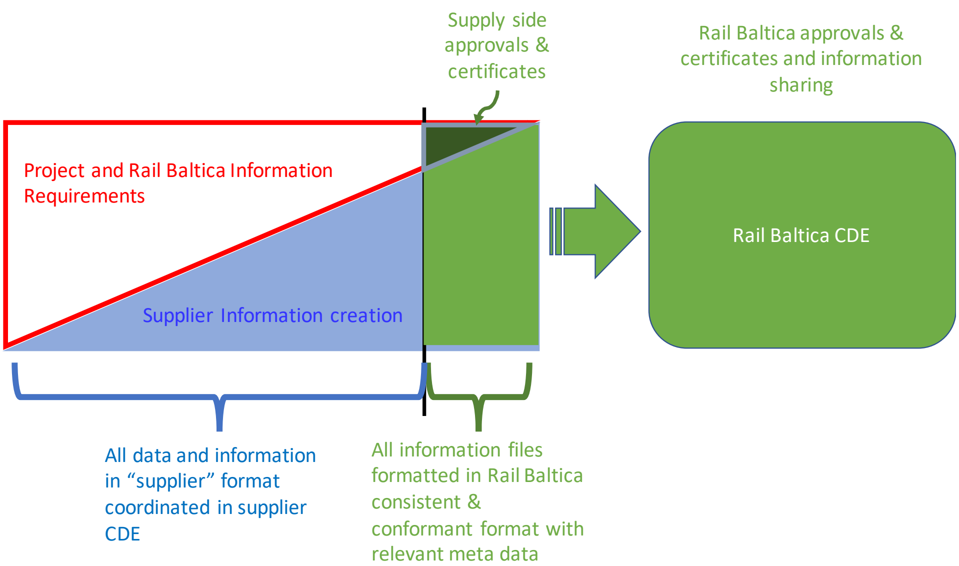
8.4. Delivery Format Standards

Information delivery to the project should be based as far as possible on non-proprietary formats which are capable of being federated, shareable and readable by all project participants.

Delivery should be based on enabling and permitting the supply chain to use the software creation and editing tools that suit their discipline and experience. Their delivery to Rail Baltica for project wide collaboration, coordination and approvals should be based on a format that can be consumed and used by the widest possible audience of stake holders.

The necessity for Rail Baltica to use proprietary BIM software should be avoided and all creation and editing should be undertaken by the supply chain.

This will necessarily require the supply chain participants to convert deliverable files into a more universally consumable format and structure.



If at all possible delivery formats be based on ‘building Smart International’ ‘Open Standards’. However, it is recognized that for many railway and infrastructure assets these standards do not exist or are under development and not mature enough to use reliably in the project. Where not possible to adopt Open Standards, tools developed by the Proprietary software market should be adopted.

During the delivery of the BIM projects, BIM standards investigation shall be made on the available common delivery formats. Typical of such formats are Bentley Systems iModel format or Autodesk’s Navisworks format. Each of these has capabilities to combine various sources of information into a single viewable and useable format. Specific criteria for the choice of these tools are:

- They should have characteristics that meet the need for federation and sharing without further conversion and manipulation.
- Ideally these tools should embed all model data including the identification of individual assets and their attributes.

These concepts are explained in depth in the BIM Manual’s “Deliverable from BIM models” and the “File Formats” Sections.

8.4.1. Model File Formats

Early BIM Model delivery centered around CAD file formats that defined geometry in 2D and 3D that could be referenced and delivered as drawings. These approaches delivered models in the common CAD formats of DWG for Autodesk AutoCAD and DGN for Bentley Microstation. Such models, whilst geometrically defining components and permitting coordination for clash detection, do not deliver full BIM information capability and therefore do not deliver many of the benefits of a BIM approach to project realization. The CAD formats will be an exchange format during the very first beginning of the Design Stage meanwhile the BIM processes are fully implemented. Those CAD formats use is explained in depth within the BIM Manual’s point “2D: drawing production and CAD Manual” within the “Deliverables from BIM models” Section.

The BIM Manual defines two kinds of models, the 3D Models without asset information and the BIM Models, which are also 3D Models but including asset information in the elements. The first ones are used as a reference of out of scope elements, whilst the BIM models are the “buildable” models of the project’s scope.

Serious consideration should be given to the use of BIM models that contain component information beyond geometry using an open set of standards for information exchange. As stated in our BIM objectives this requirement has risks of increased cost and need for skills which need to be considered the potential benefits for the overall project are significant and worth investigating.

A number of exercises to develop an open approach to model delivery are currently underway these include:

- 'building Smart' who have developed the concept of Industry Foundation Classes (IFC) to define construction assets, their geometry and their many attributes. Currently IFC have been developed to include most assets associated with buildings but not specifically railways and other infrastructure types. IFC standards for road, rail, bridges and tunnels are under development with at least a two to three-year horizon before delivery.

- The LandXML (http://landxml.org/) format will be considered the Open format for alignment and surfaces. In the future it is intended to use also the IFC alignment or any other IFC format with civil approach as soon as RB Rail consider it is mature enough for its implementation.

- Open Geospatial Consortium (OGC) who has developed a conceptual LandInfra model and encoded that in 'Open' Geometric Mark-up Language (GML). This standard is useful for wider geographic views of assets including networks, alignments and linear referencing. The OGC have developed this standard in conjunction with 'building Smart' and it shares a common conceptual model for alignment definition.

Whilst these standards are useful it is considered they are not yet ready for full implementation across the type of assets that will be encountered in Rail Baltica.

At the current state of the standards the following ones are adopted:

- Geographic features such as boundaries, land parcels, environmental areas and other similar areas OGC GML are be adopted.

- Network and corridor alignment OGC 'LandInfra' GML should be adopted buildings such as stations the IFC. But when possible these GML files will be replaced by IFC files to simplify the geometrical coordination.

- Buildings such as Stations that 'building Smart' IFCs are adopted.

- IFC alignment, IFC bridge, IFC tunnel and other future civil-related IFC formats will be adopted by the BIM Strategy as soon as they are mature enough for their implementation.

- For other infrastructure assets and features a proprietary tool provided by software vendors should be integrated. Multiple conversions of data should be avoided and a tool that can hold native IFC and GML would be preferable.

- Point cloud files should be delivered in PTS, PTX and XYZ as they are Open formats. Other native formats like RCP or PCG could be used if also one of the others is provided.

Further details are provided in the "File Formats" Section of the BIM Manual. For specific details about the IFC format, the point "IFC format and configuration" includes further details.

8.4.2. Data File Formats

Following the above principles data should be delivered in a format that can be checked, validated by Rail Baltica and consumed by the Rail Baltica Asset Register.

The file schema and content should match that of the asset attribute requirements defined in the 'Standard Asset Type Library'

It is suggested that this is delivered spreadsheet format similar to COBie (Construction Operations Building Information Exchange) which is a non-proprietary data format for the publication of a subset of building information models (BIM) focused on delivering asset data as distinct from geometric information. (https://www.thenbs.com/knowledge/what-is-cobie). Further defined by BS 1192-4:2014 "Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice" freely available from https://shop.bsigroup.com/forms/PASs/BS-1192-4-2014/

The exact format and schema may need to be modified to suit Rail Baltica requirements in particular matching to the information requirements set out in the 'Standard Asset Type Library'.

A spreadsheet format will permit all users throughout the supply chain to use as it is a de-facto common standard.

As the project progresses it may be possible to deliver this data in IFC or other 'Open' data file formats.

This requirement does place some burden on the supply chain and their software vendors in extracting the required asset information from their models. However, the ability of extracting this data and liberating it for wider use outside proprietary software is key to the success in delivering the full benefits of BIM to the project.

8.4.3. Document Format

Document formats will depend on the type of document being delivered. For every model submission, in addition to the model itself there will be a list of associated files that will be provided with different purposes.

- The native format. The model itself, produced with the Proprietary software chosen by the Supplier. Examples are RVT (Autodesk Revit), DGN (Bentley AECOsim, Rail Track, Open Roads and other Bentley software), NDW (Allplan), and so on.

- The Open Format. Rail Baltica requires IFC as the BIM Openformat. Every model will be exported to IFC, whenever possible.

- The aggregate model format. The combined model with a Proprietary software used for the geometry verification, the design review and other BIM uses cases. NWD (Autodesk Navisworks), IMODEL-I.DGN (Bentley Navigator)

- Although IFC is mandatory, in some cases, in special circumstances and if RB Rail AS agree, it is accepted to use DWG (Autodesk AutoCAD 3D and Civil 3D) or DGN (Bentley Microstation 3D, Rail Track and other Bentley software) if the BIM Management & Clash Verification software defined in the BEP can import them.

- The Data Drops. Microsoft Excel's XLSX and CSV will be used to provide the extracted database of the model. In addition, in future developments of Rail Baltica, other formats as JSON could be implemented if the BIM team considers it necessary.

- The quantity extraction (other Data Drops). Microsoft Excel's XLSX and/or CSV will be used to provide the quantity extraction of the model.

- Other BIM use cases-related formats. Such as AVI, MPEG or MOV for the planning/scheduling (4D) and JPEG or PNG for visualization purposes.

It is worth noting that Rail Baltica will not use Proprietary software to consume the BIM models, so the Supply Chain must ensure that the Proprietary formats that are provided could be opened with free-versions of those Proprietary softwares. (Navisworks Freedom, Tekla BIMsight…)

Drawings should be ideally delivered in the same format as the BIM Models retaining their link to the objects within the model. By doing so the objects in the drawing can be related to the asset register. However, if not in model format then one of the de-facto drawing CAD formats namely DWG or DGN. PDF versions of delivered drawings should also be delivered.

Other documents such as specifications and reports shall be delivered in xlsx, docx, csv and additionally as PDF.

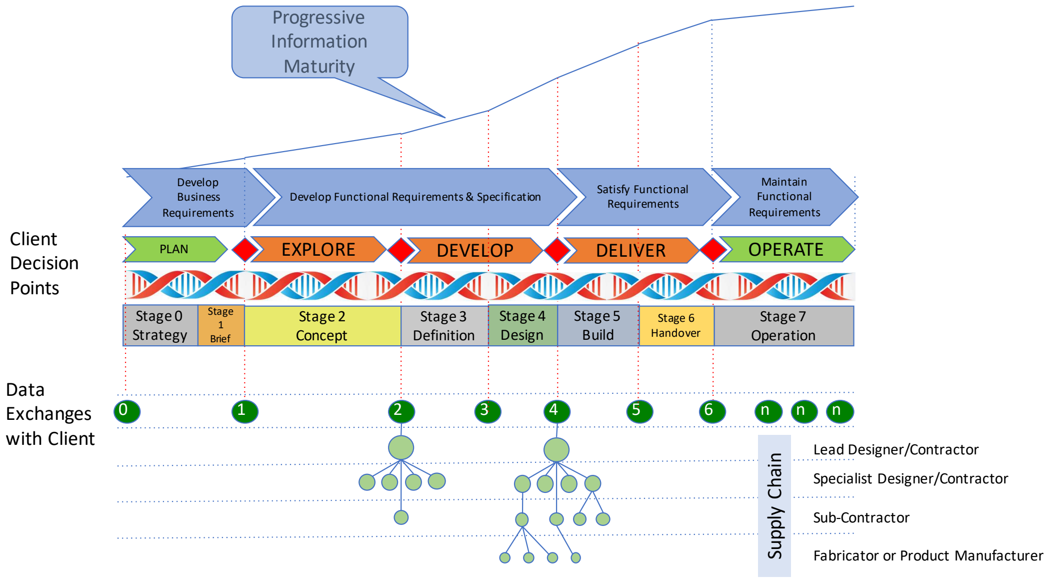
8.5. Delivery Collaboration and Coordination Common Data Environment (CDE)

In order to support project wide collaboration and coordination it is proposed that a Common Data Environment (CDE) process and technology is implemented.

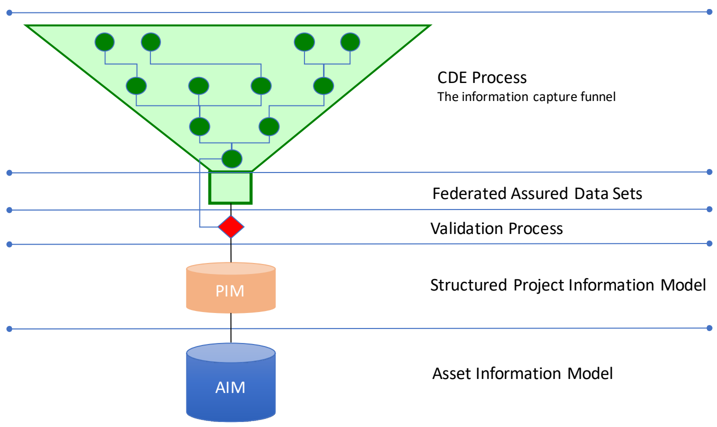
An example of such a CDE can be found in the principles of ISO 19650 and also in the British standard BS 1192:2007 and BS PAS 1192:2 – 2013. These principles define the process and standards for carrying out coordination between multiple supply chain sources and controlling the delivery of that information. Further information is provided in the Specifications for Supporting Technologies document.

8.5.1. CDE Information Capture Principles

Information is delivered in files from multiple sources in the supply chain and the CDE controls the coordination of that information in an organized, traceable and auditable process.



The CDE acts as an information funnel process capturing and coordinating each layer of the supply chain into a coherent and validated data set. Which can be used at each layer of the supply chain and eventually delivering assured federated data sets to the project.



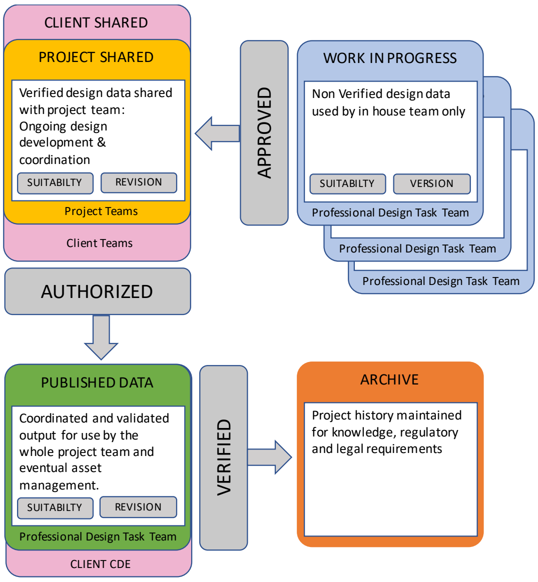
8.5.2. The CDE Coordination Process

The CDE supports and delivers a coordination, collaboration and approval process.

The European Standard ISO 19650 and the British Standards referenced above, namely BS 1192:2007 and PAS 1192: 2 -2013, are used here as examples of CDE processes.

It is important that the chosen process is suitable to the current state of technology and available software tools. It is recognized that within a single team or discipline it may be possible to develop models with a single proprietary system however there is currently no single system available that can model all aspects of a rail project neither it practical to do so.

The works by progressing federated data files through a series of states and sharing the results for coordination, revision and approvals at each stage.



Information Coordination Process after BS 1192 and proposed ISO 19650

Work in Progress

Starting with Work in Progress from a single team models and data are developed within that team until it has reached sufficient completion to share with other teams for them to coordinate with their work.

Project Shared

At which time having approved content and technical details the file can be shared for selected teams to reference. Those teams can then combine (federate) with their work and others, who have rights, if required to coordinate comment and resolve any issues. It should be noted that this process requires a rapid sharing discipline delivering coordination information to other project participants early in order to achieve a fast-combined goal.

It should be noted that commercial terms should be in place to ensure that all data created during the project for purpose other than for the project alone and not for instance for competition.

Often the coordination is best carried out in secure encrypted virtual meeting rooms where files can be viewed in federated form, differences can be resolved on the spot and actions recorded safely.

Client Shared

Once coordination has been completed to an agreed level the results can be Shared with the client for them to review, comment and approve. On approval the files can then be progressed to the Published state.

Published

Information is published for a specific defined purpose which might be for example costing, planning and regulatory approval, scheduling or for construction.

Published information is then available cross project (with appropriate permissions) a used as required in the context of the purpose it was delivered for.

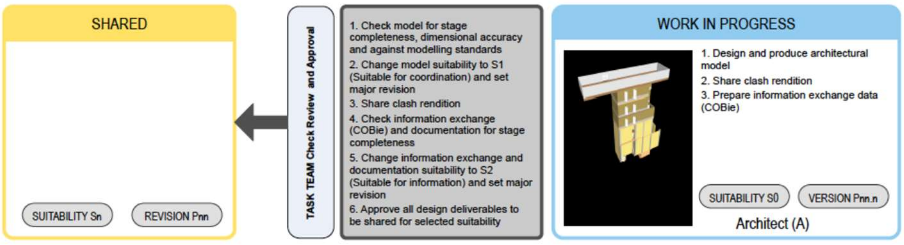
It should be noted that this Published State is not a Document Distribution Register it just contains the information that can be distributed outside the immediate project using document management techniques.

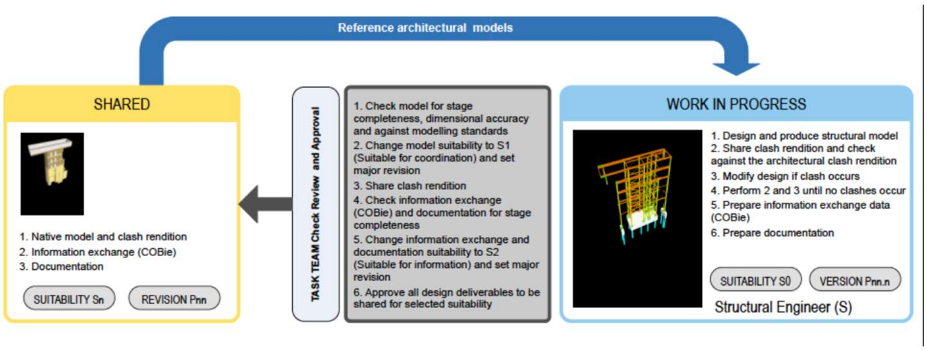
Archive

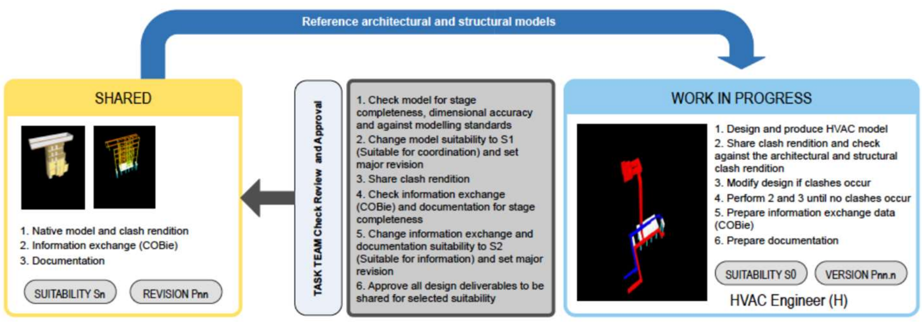
At each state, information is archived to enable development history to be audited and retrieved.

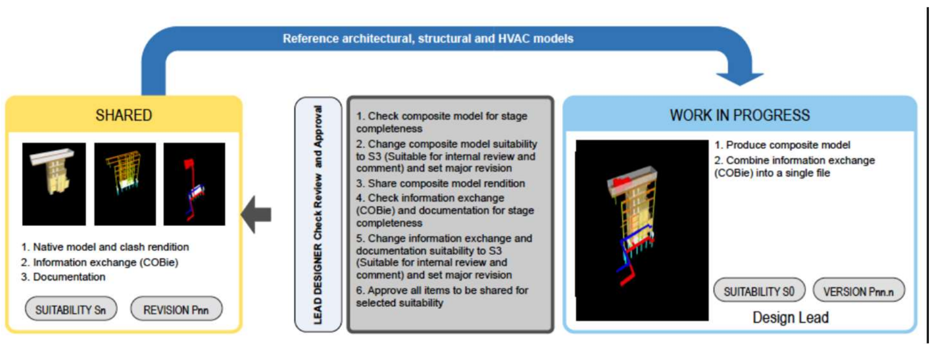
Further information is provided in the Specifications for Supporting Technologies document.

The following diagrams illustrate the principles of the WIP/Share process:









Spatial Coordination

Spatial coordination of building information model(s) is an essential component to successful project collaboration. Generated model data, whether 2D or 3D, shall be created to:

- The agreed Project Coordinate system;
- True height above project datum.
- Agreed map projection systems where appropriate.

This will ensure that each discipline's model data can be effectively shared and fully coordinated within the project's information database to enable design review, coordination and clash avoidance/resolution to be undertaken.

The spatial coordination must be aligned with the "BIM Models' Geo-Reference" Section of the BIM Manual.

8.5.3. Folder naming

Folder naming which considers the ontology of project information, contracts, disciplines and hierarchy of information are required to support information federation and the CDE process.

These is developed in the "Specifications for Supporting Technologies" document.

8.5.4. File metadata and naming

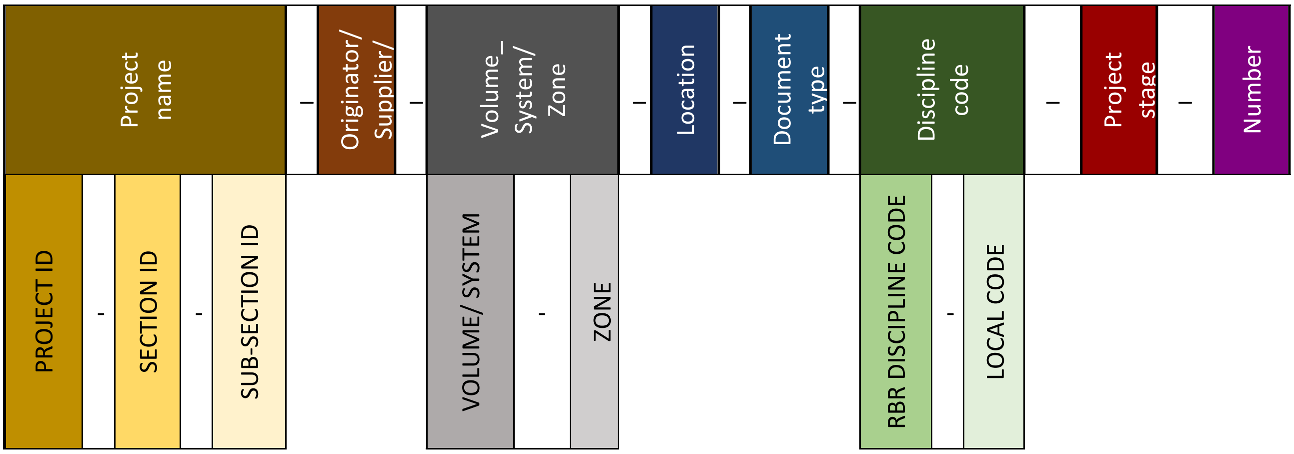
A CDE process relies upon data that describes the content, origin, location, model volume, purpose/suitability, state, version and revision of the files being developed and delivered.

For example, in the case of the European CEN-TC442 and the British BS 1192 standards this relies upon a series of file naming conventions, however this data could also be treated as file metadata. However, it is used it is important that this information is transmitted at the point of state change and that if any file is retrieved in digitally printed form the full metadata stack is included in the document.

The following conventions are shown as examples of required content. The detailed BIM strategy defines within the BIM Manual the naming conventions and coding related to file management and revisioning and versioning.

File Naming

The following file naming conventions are included in the example standard:



Generally, these names are self-explanatory:

- **Project**: Single common project identifier independent and recognizably distinct from any individual organisation's internal job number. It is composed of three fields:
    - **PROJECT ID**: Project name according to DTD TS (eight characters, five+[-]+two)
    - **SECTION ID**: Section Name according to DTD TS (three characters)
    - **SUB-SECTION ID**: Sub-section name according to DTD TS (four characters)
- **Originator**: A unique identifier shall be defined for each organisation on joining the project. The unique identifier should identify the organisation responsible for creating the data. (Three characters)
- **Volume_System/Zone**: the specific Volume_System (Physical sub-division 1, four characters) and Zone (Physical sub-division 2, two characters) of the model the file describes. A matrix of Volumes_Systems and Zones will be created at the project outset by RB Rail AS.
- **Location**: the Location within the model (Physical sub-division 3, four characters). Designed to have a third level of physical division that allows a better location of the model. A matrix of location identifiers will be created at the project outset by RB Rail As.
- **Document Type**: the type of file being developed and used, each file should contain a single type of information for instance a model, drawing, or data file.(Two characters)

- **Discipline code**: the discipline that the file relates to for instance track design, Overhead Line, structural etc. It is composed of two fields:
    - **RBR Discipline Code:** General discipline codes. (two characters)
    - **LOCAL CODE:** Discipline code according to local legislation. (two characters)
- **Project Stage:** Abbreviations of the project stages (three characters)
- **Number**: the number of the file within this discipline. (Disciplines can break this serial number into sections to manage aspects such as work packages and is managed by the Project Manager, Project Information Manager or BIM Manager). (five characters)

For further information about file naming refer to BIM Manual

Other data may be required for instance 'Confidential' status or mark.

It should be noted that these are not necessary drawing or document names but referential mechanisms. Published documents can be named according to any project convention however the file name (metadata) should be included at some in any printed rendition of the document and the information clearly available in any document register.

Status Code

Status defines the '**fitness**' of information in a model, drawing or document. It allows each design discipline to control the use to which their information may be put.

It is explained in depth in the BIM Manual's "Rail Baltica CDE" and in the Specifications for Supporting Technologies document.

File Revision Codes

The revision is required to track the progression of a file or document to its completion and authorization.

They follow the file through it states and act as a ratchet for each player within the process to recognize and record their file state.

Further information can be found in the BIM Manual.

8.5.5. File access and security

Control over who can see use and edit is critical to this process.

During WIP only the team creating the file can see edit and approve the content.

At the point of Share for coordination then the file is made visible to those who need to coordinate and approve the content. It should be noted that the file cannot be edited in this state and any changes are referred back to the originator.

Similarly, at the point of Publish then wider access is given but only for reference purposes not for editing.

Wider security issues regarding what should be made available and access to wider audience should developed. An example of the required procedures for developing security approach can be found laid out in PAS 1192-5:2015 Specification for security-minded building information modelling, digital built environments and smart asset management available freely from http://bim-level2.org/en/standards/. This standard provides practical advice on BIM file security across the project and the technical architecture standards that should apply.

The results of security investigations against processes will require a project access control matrix to be developed.

Further details about this subject are included in BIM Manual's "Rail Baltica CDE", within the point "CDE Security" and in the Specifications for Supporting Technologies document.

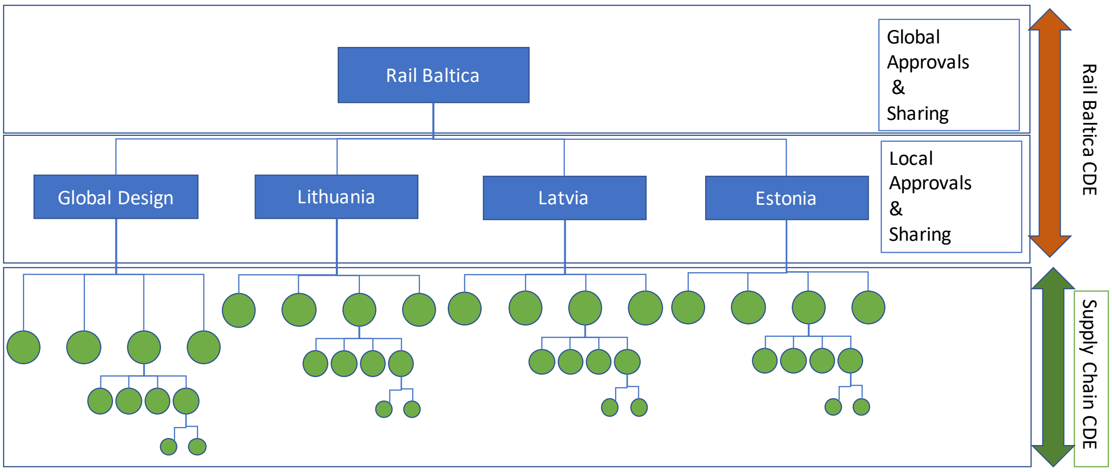
8.5.6. Multiple CDE Information Delivery Principles

Implementation of a CDE has multiple variations. Some projects have opted to control the full CDE chain including the suppliers within their system. Others have opted for a cascade approach asking suppliers to develop their own CDE that interacts with the client CDE in submitting information as it reaches Client Share State and making Published information available to the supply chain from the central CDE.

I the case of Rail Baltica it recommended that the cascaded option is adopted.

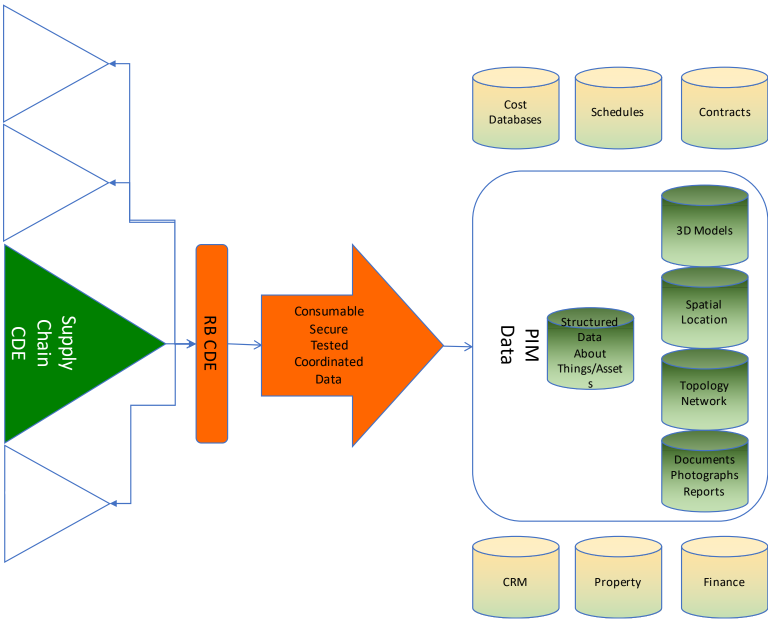
This frees the supply chain to use their own tools and systems based on a process that can be audited by Rail Baltica leaving Rail Baltica to deal with the collection, validation and approval of submitted and the distribution of project wide published data.

The recommended CDE architecture is shown in the diagram below:



The central Rail Baltica CDE acting as a project control for all submitted information permitting local approvals by participating authorizing bodies and overall project approvals and sharing by Rail Baltica. Thus, Rail Baltica will define in the EIR of the projects how and what information will be delivered so as to allow the local authorities to verify the compliancy with the local regulations.

Information then submitted can be assimilated into a Project Information Model and linked to other data relevant to the project.



8.5.7. Other environments integration

The BIM project information can need to be integrated within other data environments such as GIS and vice versa. If this BIM use case is to be implemented, the target environment will need to define the information to be transferred. This is especially important when there are asset attributes that are intended to be shared. The BIM Manual's "Geographical Information System (GIS)" point within "BIM Models' Geo-reference" provides details about this process.

9. People (Who)

Key to the success of the BIM strategy is the adoption of the practices by the people involved in the process. The process necessarily involves change and new approaches to delivery many of which encounter resistance from the professional community. The recruitment of all stakeholders and their involvement in the developing digital delivery of the project is an essential ingredient of realizing the benefits of BIM. This is often the most difficult part of the process and has been the cause of many issues in implementing BIM across a project.

It is therefore a core part of the Rail Baltica BIM strategy to ensure that roles and responsibilities are identified to support the implementation and that the necessary knowledge and skills are communicated by documentation, training and interchange of developing technologies and practice.

9.1. Roles and responsibilities

The goal of implementing BIM is to make the delivery and use of digital information business as usual. Rather than inventing new jobs and job titles, we want to involve all who are stakeholders in the project to work digitally and become BIM specialists.

However, and especially during the BIM implementation period, it is important that every team at every level counts with specialists who are able to implement, coordinate and manage all the BIM procedures and workflows as well as give support to the future BIM users. This way, we can differentiate two types of BIM profiles:

- BIM specialists: this group includes both BIM Management team which implement and coordinate all the BIM standards across the whole project, and the BIM-responsibles for every stakeholder, responsible for transmitting all the BIM standards to their organization, internal coordination and quality, etc. This team also provides support to the rest of team and check the compliance of the models / data drops according to the BIM requirements. There will be two BIM Management teams, one in each of both client and employer sides, being the BIM Management of the supplier the only BIM interface between client and supplier in terms of BIM.

- BIM users: this group includes every technician or manager participating in the project and who needs to make use of BIM but does not have a specific BIM role or a significant BIM knowledge.

Having said that, there are a number of roles that need to be undertaken and responsibilities to be allocated.

These include the following:

- RB Rail Information Manager – responsible for the overall coordination of information, the processes, standards and implementation on the project. The role does not have any responsibility for information technical content but does ensure that the BIM process is enforced and facilitate the delivery of information, its sharing and security across the project. It is suggested that this role is appointed by RB Rail.
- Implementer Information Manager – a similar role that supports the local (Country) delivery aspects of information. Again these should be appointed by RB Rail in close discussion with local implementation bodies.
- Individual Project Information Managers – Managers who liaise with the RB Rail Information Managers appointed as part of the project by the supply chain contractors.
- Individual roles supporting the CDE process should be appointed by the supply chain contractors including discipline and team coordinators.
- Creating and authoring of information should be the responsibility of the design and construction engineers. Although they may use technicians who are experienced in modelling the strategy does not create specific BIM or CAD roles.

The core RB Rail Information Management role will require an assistance team that support and implement the technical solutions.

More information about this chapter is included in the BIM Manual “Roles & Responsibilities” Section.

9.2. Communication, Promotion, Education, Training and Support

It is recommended that the BIM strategy is supported by a Support, Communication and Education programme. Key elements of which should include:

- Consideration should be given to the Information Managers having a small support team.
- A communication website that gives access to documentation, standards, reference manuals and short training videos showing process in practical detail.
- A support forum to answer queries and frequently asked questions plus the ability to share practical experience.
- Specific promotional events outlining the strategy, its benefits and components.
- A mechanism for all the project teams from client to supply chain sharing innovations, new approaches and technologies.

London Crossrail have set up an ‘Open Academy’, in conjunction with their technology provider, for the training and on- boarding of new project participants and the sharing of best practice and innovative technologies. This approach has proved very successful and it might be worthwhile making this part of the technology provision.

10. Commercial and Contractual

This BIM strategy makes the delivery of information through the stages of the life cycle and a key project asset. It is important therefore to bind in the information requirements and the delivery process to the supply chain contracts.

Individual information suppliers will need protection against unapproved copying of their supplied material. The recommended CDE process guards against this by making the Work in Progress state the only place where information can be changed.

Some information suppliers will have fears regarding the copying of their designs for purposes beyond the project in question. In order to guard against this the contract should include license to use the material for this project.

Finally, liability for content does not change in a BIM deliverable it remains as it always was with document related deliveries.

11. Technology

Technology to support the BIM delivery processes mandated in this strategy will need to be put in place.

There are two core technologies that are required:

11.1. The Common Data Environment (CDE)

Technologies to gather and manage the CDE process across the project automating the CDE processes and the validation of delivered information.

These technologies should be capable of collecting, federating for viewing reviewing, sharing across multiple users and locations. Information should appear as if one but may be distributed between systems.

The detailed strategy should include volume and capacity requirements for the CDE

A number of CDE potential solutions are available from the market however, these will need to be calibrated against the Specifications for the Supporting Technologies document before the selection is made.

The technical details of the CDE are included in the Specifications for the Supporting Technologies document.

11.2. Asset Register Systems

Working alongside the CDE an asset register system will be required to record asset instantiation and the capture of the associated attributes.

As this provides the links to many other sets of information such as scheduling, cost, contracts etc. a system that can be closely coupled with the CDE and linked to other databases is recommended.

Among the different sets of information there is a group of attributes related to Operation & Maintenance.

The technical details of the Asset Register are included in the Specifications for the Supporting Technologies document.