Federal Ministry
for Digital
and Transport

Federal Trunk Roads BIM Masterplan

Framework document: Employer Information Requirements (EIR) – version 1.0

Contents

Overview of the framework documents

This framework document, the Employer Information Requirements (EIR), is part of the Model Guideline for BIM (MG BIM). The MG BIM framework documents define the uniform application of the BIM method and support the implementation strategy explained in the Federal Trunk Roads BIM Masterplan. They provide practically focused answers on the BIM-specific topics and issues that are necessary for a uniform understanding of BIM throughout Germany in the federal trunk roads sector.

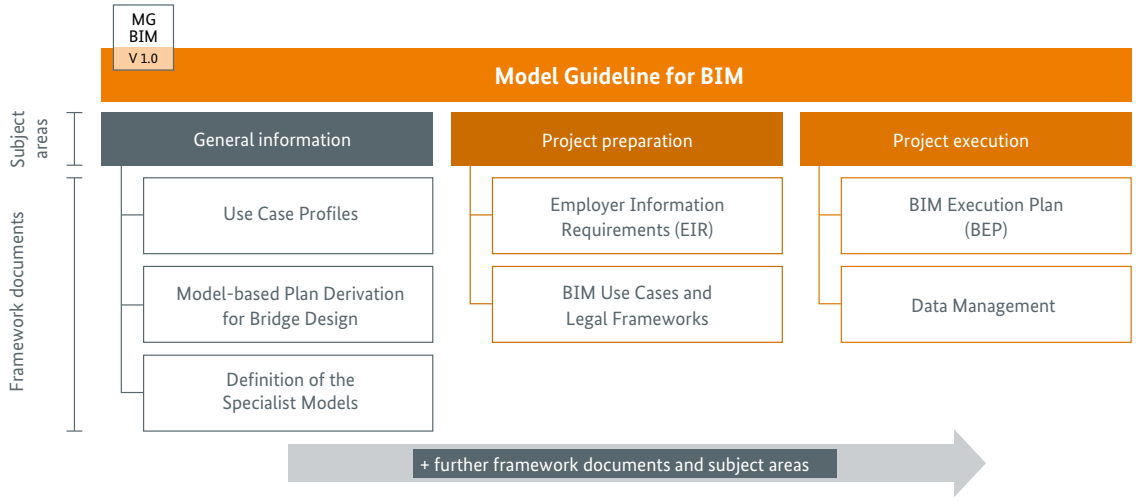
The version 1.0 framework documents were designed to facilitate updates to a new version of the Model Guideline for BIM at the beginning of phase II of the BIM implementation strategy; the same will apply again later for phase III. Finally, the documents will be transitioned to the Model Guideline for BIM for the standard process.

Framework documents are developed by the expert groups initiated by the Federal Ministry of Transport and Digital Infrastructure and in the expert groups established at the official meetings of the Federal Government and the federal states on BIM. In these groups, various technical experts – employees of the Federal Ministry of Transport and Digital Infrastructure, the Federal Highway Authority, Federal Autobahn GmbH, German Unity Planning and Construction Company for Trunk Roads (DEGES), the federal state authorities with delegated powers, the Federal Highway Research Institute (BASt) and the Road and Transport Research Association (FGSV) – are working with BIM Germany on the ongoing progress of the BIM implementation strategy for federal trunk roads. The lessons learned from completed and ongoing projects, the proven BIM4INFRA2020 toolkits and input from the continuous participation of all stakeholders were taken into account. At the same time, general developments in the BIM method were considered for national and international standardization.

As a result, the documents present the respective state of the art and progress in standardization. Reflecting these increasing knowledge levels, the framework documents replace the thematically identical parts of the BIM4INFRA2020 toolkits and should be construed as recommendations for future projects and for a potential adaptation of various standards and guidelines.

Each framework document is assigned to a thematic category based on the project schedule and is thematically self-contained. Cross-references to other framework documents are explicitly highlighted. Further information on the framework documents can be found in the document entitled ‘Explanation of the framework documents’.

Version 1.0 of the Model Guideline for BIM comprises the documents shown in the figure.



Outline

For public sector contracting entities in the Federal Ministry of Transport and Digital Infrastructure's remit, use of the Building Information Modelling method will become mandatory for new infrastructure projects once the Road Map for Digital Design and Construction is implemented. From pre-design to completion and subsequent operation, BIM should be used as fully as possible for projects.

This document is aimed at **public sector contracting entities, especially in federal trunk road construction**, which implement these requirements in their role as the most important contracting entities for infrastructure construction projects and thus play a decisive role in applying the BIM method on the market. **The implementation recommendations also address other stakeholders/companies** in the planning, construction, structural maintenance and operation value chain, which are involved in federal government-related BIM projects in federal highway construction in the near future (planning firms, construction companies, service providers) and which have to satisfy employer information requirements (EIR).

The document primarily answers the following questions: What are EIR? How can their contents be described and mapped specifically using an example? It clarifies the relationship between EIR and other documents, the aspects that should generally be considered when preparing EIR, and what the main difficulties are. When describing the contents of the EIR, the implementation recommendations set out what should be observed for each item mapped in the EIR, the information to be defined respectively on a mandatory and voluntary basis, as well as the project-specific adaptation options.

The implementation recommendations generally describe the step-by-step procedure for the preparation and application of project-specific EIR in the Ministry's remit. They clearly state what needs to be considered both when defining EIR as well as when applying them. The implementation recommendations provide specific examples for selected project phases.

Document information

1. References to other documents

The implementation recommendations build on the previous, already recognized **BIM4INFRA document 'Guidance and model for Employer Information Requirements (EIR)'** as well as the results of the **activities within the scope of work package 4.3b of BIM Germany**: namely, the cross-sectoral model EIR as well as the model EIR for the road, waterway, rail and building construction sectors.

Compared with the BIM4INFRA EIR toolkit, the following additions or adjustments have been made:

- Specialist aspects for federal trunk roads are described in more detail
- Where necessary, previous contents were updated or supplemented
- New model EIR were added and the implementation recommendations were prepared for the new items of the coordinated inter-sectoral structure of the model EIR
- New EIR example was attached
- The LOIN annex was considered in more detail and aligned with the new DIN EN 17412-1 standard

2. Document structure

The document consists of the following three main sections, which contain the fundamentals and implementation recommendations for EIR and answer the questions formulated in the outline:

- **Section I: EIR in general**

  The section describes the basic principles (fundamentals, framework etc.) and the basic recommendations (highlighted in yellow/ orange) for preparing EIR. Since little has changed in the basic modules, the text modules are largely based on the BIM4INFRA toolkit.

- **Section II: EIR in detail**

  This section provides detailed recommendations (highlighted in yellow) for the preparation as well as application of the individual contents of the model EIR in each designated chapter. The wording of implementation recommendations is based on the new version of the model EIR, which were drawn up in the context of BIM Germany (the version of the document may have to be changed if new requirements are introduced).

- **Section III: Sample EIR**

  This section presents the implementation of the recommendations in the form of sample EIR, answering the third block of questions. The sample EIR for a bridge construction project in the road sector is based on the results of the activities as part of BIM Germany in WP4.3b.

Section I:
EIR in general

1. Fundamentals

The EIR describe, from the contracting entity's (also referred to as purchaser or appointing party) perspective, the requirements that a contractor (also referred to as supplier or appointed party) must take into account when providing services using BIM.

The EIR are part of the invitation to tender and are therefore intended for the contractor to be commissioned. If multiple contractors are to be commissioned for a project, project and contract award-specific EIR are required for each service and contract award. For this reason, **only the BIM services that are relevant for the respective contract award are to be described in significant detail in the EIR**. In order for the contractor to prepare a bid, it may need have supplemental information available on all planned BIM services. This includes, in particular, an overview of BIM use cases provided by the contracting entity or other contractors in the context of other contract awards. A description of how the individual contractors and the contracting entity are to cooperate must be available, either already in the EIR or in the BIM execution plan (BEP).

2. Boundary conditions

In Part 1 'Fundamentals and overall BIM process', the BIM4INFRA toolkit describes in detail how EIR are embedded in the overall digital construction project management process. The **EIR** primarily define information-related content requirements of the contracting entity for digital construction project management. They do not stipulate the tools contractors must use to provide the required services. The question of how the EIR targets are to be reached is specified in greater detail in the BEP and evolved during the course of the project, if necessary, in accordance with the contractual requirements.

The **BEP** essentially details how the procedural cooperation between the parties involved is implemented when using the BIM method. The EIR are part of the contract. As a rule, all changes to the EIR constitute contract amendments. It is not uncommon for projects to be specified in greater detail during the course of their implementation. This can also be documented in the BEP.

3. Challenges

Creating clear and accurate EIR is a fundamental task that impacts the entire project.

For this reason, EIR should be prepared with sufficient lead time, reviewed and coordinated before the call for tenders. A **balance** must be struck **between too many detailed requirements and too few non-specific** ones. It is important that the BIM use cases, digital groundwork provided and the digital deliverables expected are clearly described. **Only the information that is required for the provision of the services** or is used by the contracting entity in the context of decisions or further phases (e.g. in operation) **should be requested**. Excessively detailed specification of technologies (software and hardware) and libraries to be used should be avoided. However, appropriate references to the use of existing technologies and libraries can be included in the EIR, comparable to a non-binding specification of a brand. The contractor must always ensure that the defined digital deliverables are created with the required structures and content and are delivered in the necessary data formats and at the required level of information need.

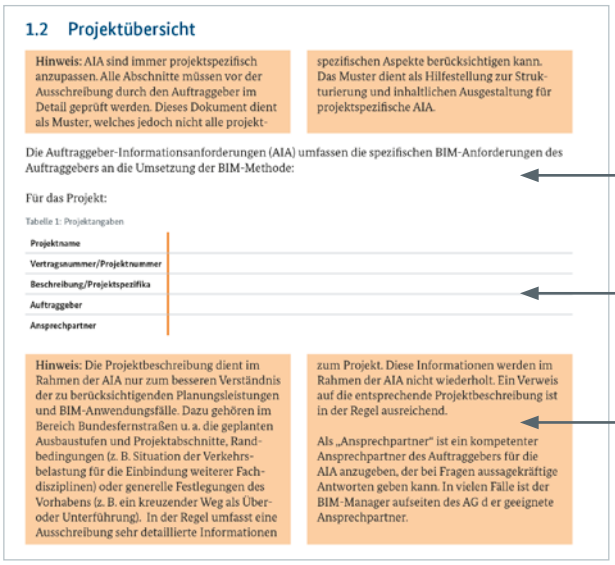
4. Model Employer Information Requirements (model EIR)

In order to be able to incorporate the requirements of the public sector contracting entity in the remit of the Federal Ministry of Transport and Digital Infrastructure and Federal Ministry of the Interior for the implementation of the BIM methodology in their own projects in a structured and uniform manner, it is recommended that the contracting entities use the BIM Germany model EIR as a template when drawing up their own standards and project EIR.

The inter-sectoral model EIR (see section II, 'EIR in detail'[1], in this document) define a uniform structure for EIR based on a non-project-specific organization of the contents required for description. The contents presented in this document are not mandatory; they should be considered suggestions. The inter-sectoral model EIR form the basis for further elaboration of the sector- and structure-type-specific model EIR and are not intended to be adopted without changes.

1 The document is to be updated if new requirements arise in the future.

The model EIR consist of the following parts:



1.2 Projektübersicht

Hinweis: AIA sind immer projektspezifisch anzupassen. Alle Abschnitte müssen vor der Ausschreibung durch den Auftraggeber im Detail geprüft werden. Dieses Dokument dient als Muster, welches jedoch nicht alle projekt-spezifischen Aspekte berücksichtigen kann. Das Muster dient als Hilfestellung zur Strukturierung und inhaltlichen Ausgestaltung für projektspezifische AIA.

Die Auftraggeber-Informationsanforderungen (AIA) umfassen die spezifischen BIM-Anforderungen des Auftraggebers an die Umsetzung der BIM-Methode:

Für das Projekt:

Tabelle 1: Projektangaben

Projektname	
Vertragsnummer/Projektnummer	
Beschreibung/Projektspezifika	
Auftraggeber	
Ansprechpartner	

Hinweis: Die Projektbeschreibung dient im Rahmen der AIA nur zum besseren Verständnis der zu berücksichtigenden Planungsleistungen und BIM-Anwendungsfälle. Dazu gehören im Bereich Bundesfernstraßen u. a. die geplanten Ausbaustufen und Projektabschnitte, Randbedingungen (z. B. Situation der Verkehrsbelastung für die Einbindung weiterer Fachdisziplinen) oder generelle Festlegungen des Vorhabens (z. B. ein kreuzender Weg als Über- oder Unterführung). In der Regel umfasst eine Ausschreibung sehr detaillierte Informationen zum Projekt. Diese Informationen werden im Rahmen der AIA nicht wiederholt. Ein Verweis auf die entsprechende Projektbeschreibung ist in der Regel ausreichend.

Als „Ansprechpartner" ist ein kompetenter Ansprechpartner des Auftraggebers für die AIA anzugeben, der bei Fragen aussagekräftige Antworten geben kann. In vielen Fälle ist der BIM-Manager aufseiten des AG d er geeignete Ansprechpartner.

Project- and segment-independent contents (model texts) that can be copied directly to your own EIR

Empty templates for specialist content (project- or structure-specific for completion)

Notes (implementation recommendations) for mapping individual points of the EIR (highlighted in orange)

Figure 1: Excerpt from the German model EIR

The empty tables (dynamic contents) must always be completed for the selected project. As a rule, the contracting entity- and/or project-specific contents can be added in every chapter. The proposed static text modules shown in black can also be adapted as required. In some places, the text passages were still suggested in the subjunctive. If these are either not relevant or are actually considered mandatory, the passages should also be adapted. If any of the chapters or subchapters are not relevant to the contracting entity or a selected project, this should be noted in the appropriate chapter (leaving the original numbering of the chapters unchanged).

The procedure for using the model EIR to create project-specific EIR is briefly described below:

- Adopt model texts, supplement if necessary
- Complete empty tables with specialist contents
- Remove notes in project-specific EIR

Figure 2: Procedure for the application of the model EIR (Pictures of the excerpts in German)

The key principles and normative guidelines considered when drawing up the model EIR are as follows:

- BIM4INFRA2020 Part 2: Guidance and model for Employer Information Requirements, April 2019
- DIN EN ISO 19650-1 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, December 2018
- DIN EN 17412-1 Building Information Modelling – Level of Information Need - Part 1: Concepts and principles, June 2021
- VDI Standard 2552 Part 7 Building Information Modeling. Processes, June 2020
- VDI Standard 2552 Part 10 Building information modeling - Employers information requirements (EIR) and BIM execution plan (BEP), February 2021

Section II:
EIR in detail

Recommendations (highlighted in orange) for defining more detailed requirements and formulating individual sections of the EIR are explained in more detail on the basis of model EIR presented in the following section.

Figure 3: Cover sheet from the model EIR

1. Introduction

1.1 Scope and content

Please note: The EIR and BEP are the key project documents used in the BIM method. The EIR must be defined on a project-specific basis and made available to bidders as part of the call for tenders. If model EIR and model BEP exist, these must be adapted specifically to EIR and BEP for a given project. Additional, non-project-specific documents can be drawn up and referenced in the EIR and the BEP. It is important that the document version numbers are managed properly.

It is recommended that you compile your own EIR templates and use them as part of the contract when tendering and awarding contracts for services. You can compile them quickly in digital form in the BIM portal based on these uniform model EIR, integrating appropriate catalogues for the selected structure types in the road segment.

A general description of the objective of the document as well as its connection with other documents listed here can be copied directly to the EIR or further specified if required.

1.1.1 Employer information requirements

The employer information requirements (EIR/ formerly also BIM requirement specifications) "describe the requirements of the appointing party for the appointed party's (in this document contracting entity and contractor, respectively) information delivery to achieve the defined BIM objectives and use cases.

This includes that the information is available at the specified time in the required quantity and quality for collaborative use."[2] The EIR do not distinguish the individual basic services and special services, but describe the services that have yet to be agreed in the contract by assigning them to the schedule of services. Nor do they describe how this information is provided. The EIR apply in conjunction with the LOIN annex.

1.1.2 BIM execution plan

The BIM Execution Plan (BEP/formerly also BIM functional specification) "documents the procedure developed jointly by the appointed party and the appointing party after conclusion of the contract to supply information and data and to fulfil the contractually agreed EIR. For this purpose, the appointed party specifies the processes, project-related workflows, interfaces, and allocates staff to the roles defined in the EIR. Furthermore, requirements for the planning and documentation standards as well as the software and communication tools used are specified."[3] The BEP applies to all project stakeholders and is to be drawn up under the responsibility of the overall planner that serves as the overall BIM coordinator with the participation of the specialist planners in coordination with the BIM manager. The BEP is a dynamic document and is updated during the planning process.

2 Objectives of EIR according to VDI 2552 Part 10, p.3
3 Objectives of the BEP according to VDI 2552 Part 10, p. 7

1.1.3 Document structure

The following diagram shows a breakdown of the contents of BIM-relevant documents.

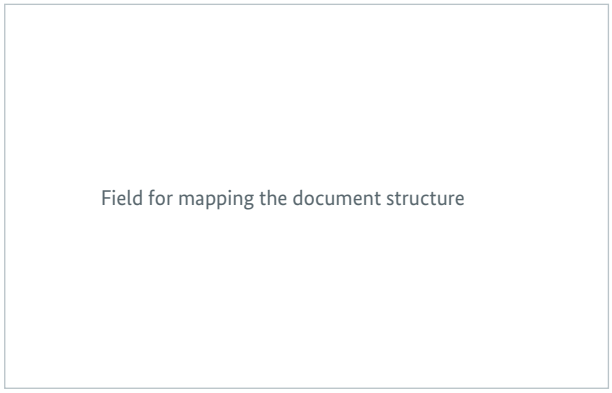


Figure 4: Mapping the document structure

Please note: The diagram is intended to show project-relevant documentation and links between the individual documents. The figure below can serve as an example of this. Depending on the project, the scope of the documents may vary. In practice, for example, the contracting entity does not always provide check rules, and not every contracting entity has BIM guidance. If not all documents are available or required, or if additional specialist documents are provided by the contracting entity, this diagram must be adapted accordingly. For a description of the documents shown (e.g. BIM special conditions of contract [SCC]), see the BIM4INFRA toolkits.

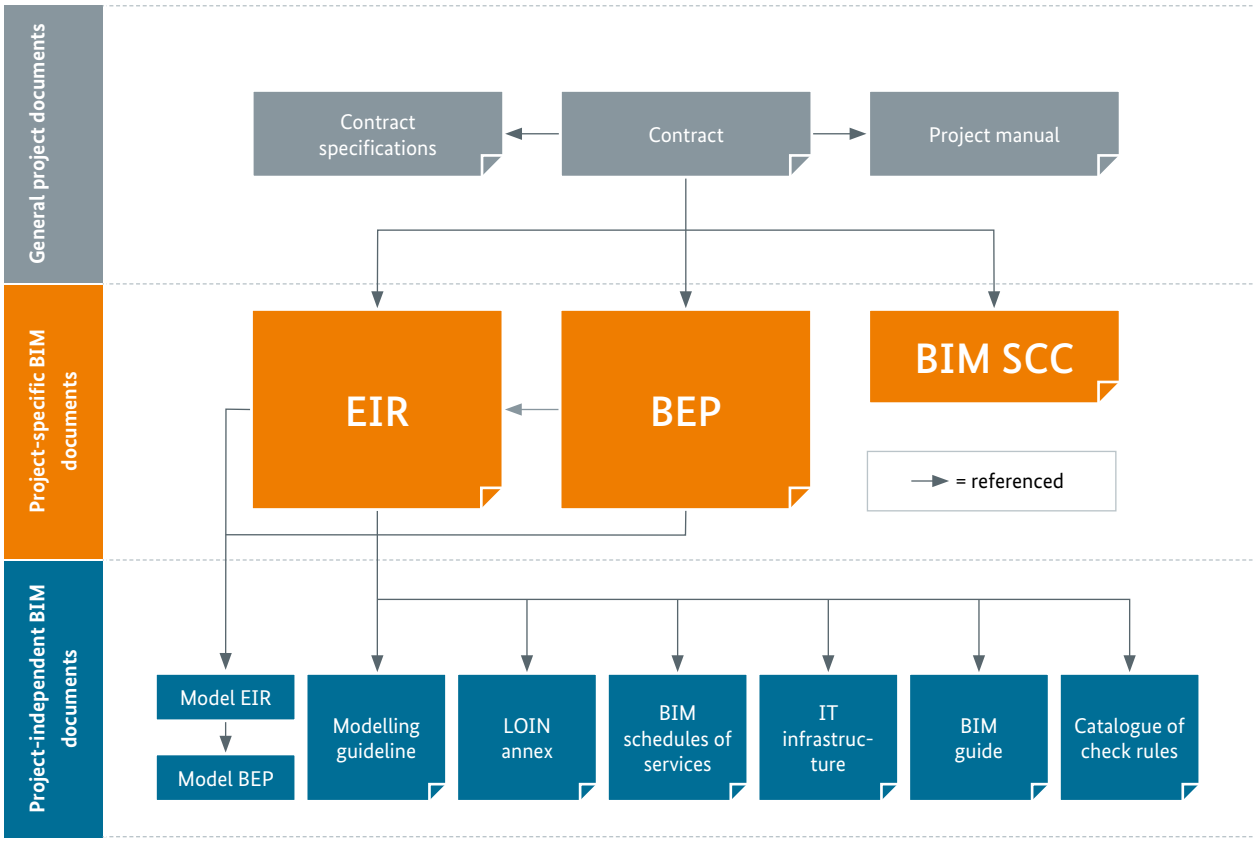


Figure 5: Sample document structure (based on 'Future of Building - Supporting research for the BIM pilot projects of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), 1st interim report')

1.2 Project overview

Please note: EIR must always be tailored to the specific project. All sections must be reviewed in detail by the contracting entity before the call for tenders. This document serves as a model and, as such, it cannot take into account all project-specific aspects. The model serves as a guide for the structure and content formulation of project-specific EIR.

The employer information requirements (EIR) comprise the contracting entity's specific BIM requirements for the implementation of the BIM method:

For the project:

Table 1: Project details

Project name	
Contract number/Project number	
Description/Project specifics	
Contracting entity	
Contact person	

Please note: In the context of the EIR, the project description only serves to provide a better understanding of the planning services and BIM use cases to be considered. In the federal trunk roads segment, this includes the planned development stages and project sections, boundary conditions (e.g. traffic volume situation for the involvement of other disciplines) or general specifications of the project (e.g. a crossing route as an overpass or underpass). Calls for tenders generally include very detailed information about the project. This information is not repeated in the EIR. A reference to the corresponding project description is usually sufficient.

A suitable contact person of the contracting entity, who can provide informative answers to questions, must be named as a contact person for the EIR. In many cases, the BIM manager on the contracting entity's side is the appropriate contact person.

For the intended commissioning:

Table 2: Details of the intended commissioning

Schedule(s) of services	
Project phase(s)	

Please note: The EIR are to be drawn up individually for each call for tenders or contractual commissioning. In the case of an individual award, only the schedule of services to be awarded is specified here, e.g. overall planner. In the case of a general planning contract, all the schedules of services included are specified. The EIR always address only the services within the project phases, which may also be commissioned in stages. Classification of service phases according to the Statutory Fee Schedule for Architects and Engineers (HOAI) is not mandatory. Project phases may also be subdivided in any other way.

For the project area:

Table 3: Structures/Project sections

Section	Description	Structure number

Please note: BIM projects or structures can be divided into individual project areas like the spatial or chronological breakdown of sections. This applies in particular to major infrastructure projects, which are characterized by a high number of structures and large footprint. The project sections can be subdivided by discipline (see following table) and sub-model. The EIR should incorporate basic information on the project sections to give the project stakeholders an overview of the entire project and to show the interdependencies between the sections. In the federal trunk roads segment, this includes affected structures and road sections of the overall measure, which are to be listed in the project overview.

For the disciplines involved:

Table 4: Disciplines involved

Discipline	Abbreviation

Please note: The list of participating disciplines should include all disciplines involved in the implementation of the BIM method in the project. Each discipline creates its own BIM models or other documentation relevant to the project and model-based planning, and is responsible for the results of its own deliverables.

2. BIM objectives and use cases

2.1 BIM objectives

Please note: A distinction can be made between overarching objectives and specific BIM objectives. The BIM objectives relevant to the project are identified based on the overarching project objectives. If necessary, overarching objectives can be addressed at the beginning of the EIR and an explanation can be provided of why BIM is being used in the project. However, these are usually very general project objectives that are pursued when managing projects in any way (with or without BIM). Therefore, the recommendation is not to repeat these in the EIR.

In addition to the general BIM objectives such as increasing the quality of planning and execution or cost and schedule reliability, detailed BIM objectives of the respective project/structure can be addressed. In the federal trunk roads segment, this can include, for example: integrating and processing GIS data in BIM models, improving collaboration across disciplines by providing appropriate interfaces for the section design and structural planning, or ensuring an efficient transition from planning to construction with BIM-based generation of bills of quantities.

The project-relevant objectives for the use of BIM as specified by the contracting entity form a basis for defining and selecting the BIM use cases in the project. In principle, the contracting entity expects the use of the BIM method to improve planning and execution quality and, ultimately, the quality of the structure, while also increasing cost and schedule reliability, as well as providing a comprehensive data basis for the subsequent operating phase. In the course of the project, these objectives are regularly reviewed and adapted accordingly to the evolving methods, software products and interfaces.

This BIM project focuses primarily on the following project-specific objectives on the part of the contracting entity:

Table 5: Project-specific BIM objectives

No.	BIM project objectives

2.2 BIM use cases

Please note: The use cases to be processed by the contractor are defined in the EIR. The expected services must be described as clearly and understandably as possible for each use case. Requirements for the digital deliverables to be provided can be derived from the selected use cases. The use cases are selected based on the objective of the project. However, the level 1 use case (UC) defined in the Federal Trunk Roads Masterplan should be applied as a first priority (see Masterplan).

The recommendation is to follow the inter-sectoral nomenclature for use cases established by BIM Germany and shown in Table 6. A general description of these use cases as well as their numbering scheme will be published in future by BIM Germany as a separate document.

The use cases necessary for the specific project must always be assessed. The contracting entity can define further use cases or sub-use cases. For example, several types of the reports and studies required in the federal trunk roads segment can be defined as sub-use cases (e.g. noise study, environmental impact, specify traffic impact under Use case 070 Design and verification). As a result, the above-mentioned cross-sectoral standard use cases (main use cases) serve as a basis for further specification in the infrastructure segment. The basic descriptions of the use cases can be copied from the UC profiles, which have been formulated for the eight prioritized use cases (bold in Table 6) for the road sector (see the profile and the associated further documents). Further classification in service phases and schedules of services is made in connection with the definition of requirements for the models and model elements in the LOIN annex.

The contractor can also internally define and implement further BIM use cases that are important for the planning and execution processes and do not affect either the use cases specified by the contracting entity or the deliverables. If these processes affect the cooperation between the planners, they must be supplemented in the BEP.

To achieve the objectives defined in chapter 2.1, the contracting entity selects the use cases to be implemented in the project on the basis of the use cases already standardized in Table 6. However, the table can also be supplemented if necessary.

Table 7 describes the selected use cases, grouping them as needed and relating their implementation to the project phases applied in the project. The respective BIM specialist models must be created to apply all use cases.

Table 6: Standardized use cases according to BIM Germany

Use case (UC) no.	Designation of the use case	Selection (X)
000	General	
010	**Existing conditions modelling**	
020	Requirement planning	
030	**Planning variants and/or preparation of documents substantiating the budget***	
040	**Visualization**	
050	**Coordination of the professional trades**	
060	Planning progress review and quality control	
070	Dimensioning and verification	
080	**Derivation of planning documents**	
090	Approval process	
100	**Quantity take-off and costing**	
110	**Bill of quantities, tender, contract award**	
120	Execution scheduling	
130	Logistics planning	
140	Construction progress review	
150	Change and follow-up management	
160	Invoicing of construction services	
170	Acceptance and defect management	
180	Commissioning management	
190	**Project and structure documentation**	
200	Operational use and structural maintenance	

* Depending on the specialist area, either 'Planning variants' or 'Preparation of documents substantiating the budget' can be selected.

In the course of the project, these objectives and use cases are regularly reviewed and adapted to the evolving methods, software products and interfaces. These adaptations are recorded in updates to the BEP.

The project-specific guidance compiled in Table 7 applies to the use cases to be implemented by the contractor in the project.

Table 7: Description of the selected BIM use cases

Use case (UC) no.	Detailed description of use in the project	Project phases	Grouping

Please note: The contractor should address the individual use cases in its bid, and explain how it plans to implement them. Instructions to this effect can already be integrated in the description of the use case. If further BIM use cases are assigned to other contractors or handled internally, they can also be listed here if required. However, the BIM use cases that are part of this EIR must be clearly identifiable.

If necessary, the use cases can be grouped to show the connections or relationships between the corresponding use cases. Clustering is voluntary and for information purposes only at this point, and the commissioning packages are contractually managed in the commissioning documents. The project phases in which the use cases are to be implemented can also be listed here, e.g. on the basis of the service phases of the statutory fee schedule for architects and engineers (HOAI) or another phase breakdown.

3. Groundwork provided

For the service provision and implementation of the BIM use cases, the contracting entity provides the following groundwork:

Table 8: Compilation of groundwork for model-based planning from the contracting entity

Groundwork	Description	Data format

Please note: Please specify in detail here the groundwork provided by the contracting entity and the data format in which it is provided. In particular, the groundwork required, processed and integrated in the context of the use cases should be listed here (e.g. digital 2D plans, information on piping and cables, raster DTMs from the geoportals, subsoil reports). Where appropriate, the contracting entity can already provide relevant groundwork during the tendering process. In any case, the contractor has to check whether this groundwork is suitable for implementation of the use cases.

Furthermore, the contractor should inform the contracting entity if further groundwork is required or if it has to be drawn up by the contractor or requested from the respective responsible body in order to incorporate it into a model structure and to be able to process the use cases. If digital models have been created for these structures or infrastructures as part of another contract (e.g. model of the existing structure or a digital model of the existing terrain by the surveyor following a terrestrial survey), these must also be made available to the contractor. The digital design models are handed over when commissioning construction works. If bills of quantities have been drawn up based on a model, this digital information should also be made available to the contractor for bid preparation. The EIR must be adapted on a project-specific basis with regard to the groundwork provided.

4. Digital deliverables and delivery deadlines

Within the scope of the contractor's service provision, digital deliverables are to be created, checked against the requirements and handed over to the contracting entity. The digital deliverables are described by project phase or milestone and represent the results of implemented use cases. Digital deliverables mean all files that must be handed over to the contracting entity as a result of a service at the end of a project phase or on reaching a specific milestone. This includes digital models, derived 2D plans, audit reports and other documents. Regular reciprocal communication of the current progress statuses of the individual digital deliverables at the planning meetings is also key for efficient coordination and management of the project. The digital deliverables are exchanged exclusively via the common data environment (CDE).

The following deliverables and delivery deadlines are specified by the contracting entity, whereby this may be described in greater detail in an agreement on the BEP between the contracting entity and the contractor.

Table 9: List of digital deliverables and delivery deadlines

Project phase			
Milestone			
Deliverable	**Description/LOIN**	**Delivery deadline**	**Data format**

Please note: It is very important to list and precisely describe the digital deliverables. A specific LOIN must always be defined for the delivery of digital models (cf. chapter 8.5). In addition to the required deliverables, a reference to relevant guidelines or regulations should be integrated if possible (e.g. in the federal trunk road area, the requirements of Guidelines for Drawing up Design Drafts for Engineering Structures (RAB-ING) should be mentioned when deriving plans from the digital model. These are currently being adapted to the BIM methodology (see the Implementation recommendation for plan derivation)).

The deliverables are generally attributed to project phases (e.g. HOAI service phases). If necessary, another milestone can be formulated. In the case of phased commissioning and the pooling of related items across multiple services (e.g. stage 1: service phases 1 and 2; stage 2: service phases 3 and 4), the information on delivery items can be combined accordingly. In the case of federal trunk roads, the deliverables can also be assigned to the phases of requirements planning, preliminary design, outline design, approval planning, detailed design, contract award and construction in accordance with the procedure for federal trunk roads.

The delivery deadlines are based on the general project deadlines and other scheduling requirements of the contracting entity. It makes a lot of sense to save progress statuses on an ongoing basis, so that potential problems can be identified at an early stage, e.g. as part of regular project meetings. The contractor itself may be asked to provide feedback on scheduled deadlines as part of its bid or to define deadlines or the frequency of exchanging this information.

5. Organization and roles

5.1 Project organization

When introducing BIM, BIM-specific roles with specialist knowledge are assumed on the part of both the contracting entity and the contractor. For service provision, the contractor must fill specific BIM roles with competent personnel. The contractor must ensure that the BIM capabilities named in the employer information requirements are in place. The contractor must name the persons who are to fill specific roles.

The working relationship of the project stakeholders (designated BIM roles) is illustrated by the following graphic and described in more detail in the following chapter.

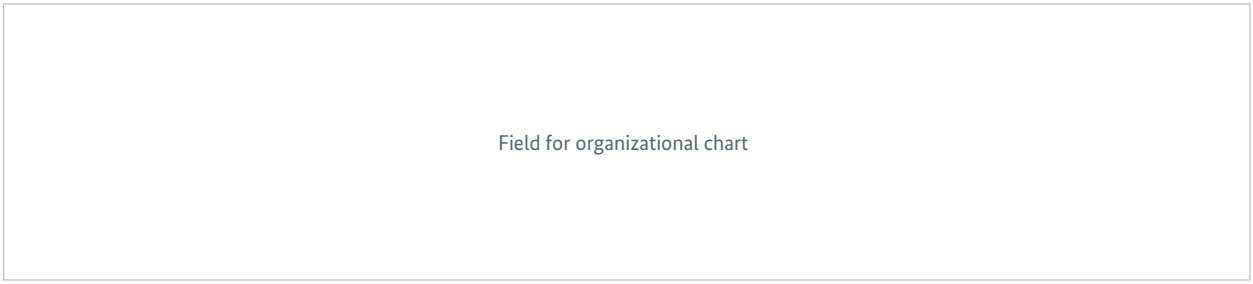


Figure 6: Project organizational chart

Please note: An organizational chart is included to better structure the various roles. Especially in large projects, inclusion in the EIR of a schematic diagram with the BIM project organization specified by the contracting entity is recommended. The contractor's project organization is presented in the BEP. An exemplary project organization chart can be found in the following graphic.

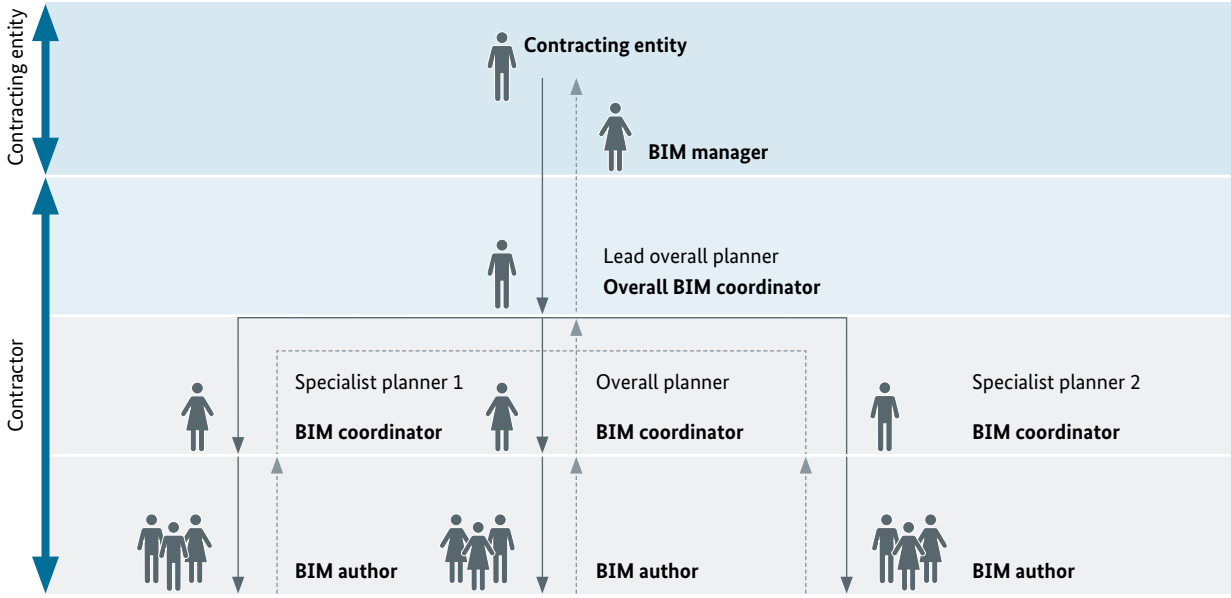


Figure 7: Sample project organizational chart

5.2 BIM roles and responsibilities

The contracting entity defines the following BIM roles and responsibilities as part of the project:

Table 10: Description of individual BIM roles (sources: VDI Standard 2552 Part 7, June 2020 and BIM4INFRA, Part 2, April 2019)

BIM role	Role description	Responsibility

Please note: The EIR clearly describe the interaction between the roles while handling the project or implementing the use cases. Information on and evidence of the experience or abilities of the contractor's personnel may also be requested in the tender documents, and will be used for evaluation. The names of BIM roles should be based on the established roles from existing processes and thus on the terminology of VDI Standard 2552 Part

7. The exact role description, including the responsibilities of individual BIM roles, such as those of the BIM coordinator and the BIM manager, can also be based on the aforementioned VDI Standard (see Table 11). The role of the overall BIM coordinator should be included in addition to the roles described in the VDI Standard. A corresponding description has been proposed for this in the table (source: BIM4INFRA Part 1).

Table 11: Role description supplemented with the role of the overall coordinator*

BIM role	Role description	Responsibility
BIM manager (Information manager)	Information managers are project members who document the employer information requirements and define BIM objectives and applications as part of the project management process. They are responsible for the organizational tasks required to define, implement, comply with and document BIM processes throughout the entire lifecycle of a structure. They are also the contact persons for the contracting entity and responsible for the CDE (Common Data Environment). The information managers in the individual lifecycle phases come from different disciplines. When information management changes, the new information manager is responsible for checking that the data model meets the quality requirements, is up-to-date and complete. The information manager coordinates tasks and processes with stakeholders, especially with the information coordinator at the operational level.	Contracting entity
Overall BIM coordinator	The overall BIM coordinator is a project member who is responsible for the overall coordination of all BIM models of the individual planning disciplines. They perform clash detection and ensure that the BIM specialist models form a consistent overall dataset.	Contracting entity or contractor
BIM coordinator (Information coordinator)	Information coordinators are project members who are responsible for the operational implementation of BIM objectives throughout the lifecycle of a structure as part of the value creation process. They define and coordinate tasks and responsibilities based on the BIM processes and BIM applications. They ensure the contractually agreed quality of the data model and error-free data exchange. To this end, they coordinate the information authors as they develop the data model and have the information manager issue clearances at project-specific intervals.	Contracting entity or contractor
BIM author (Information author)	Information authors are project members who edit the data model throughout the entire lifecycle of a structure in consultation with the information coordinators. They add information from the various disciplines to the data model in line with the contractually agreed quality and taking into account BIM standards as part of the BIM processes. The information authors have data sovereignty over the specialist models and sub-models they create.	Contractor
BIM user (Information user)	Information users are project members who use the data model solely to obtain information and do not add data or information to the building information model.	Contracting entity and contractor

* Sources: VDI Standard 2552 Part 7, June 2020 and BIM4INFRA, Part 2, April 2019

The responsibilities of the individual roles must be tailored to each specific project. The individual roles in the respective area and their connections should be described as specifically as possible (in the area of federal trunk roads, for example, specialist coordinators for subsoil, surveying or civil engineering). In addition to the main roles, all roles of the contracting entity and other external contractors are also specified insofar as the contractor needs this knowledge to submit a bid. On the contracting entity's side, additional technical reviewers can also be appointed for the respective discipline along with the BIM manager. In addition to the functions of the respective role, the role description indicates whether the contractor or the contracting entity is responsible. The main priority is to decide whether the contracting entity or contractor provides the overall coordinator – either party may do so – and assign the role. In most cases, the role of overall coordinator is assumed by the overall planner in receipt of the largest order or commissioned for multiple service phases, e.g. traffic installation planner or the overall planner for civil engineering.

6. Cooperation strategy

6.1 Information management

The technical coordination between the contracting entity and the contractor is implemented based on digital deliverables, which are to be stored in the CDE (Common Data Environment). The procedures for cooperative collaboration in DIN EN ISO 19650-1 and VDI Standard 2552 Part 5 must be observed. The mutual coordination processes, their frequency and information management processes using a CDE must be defined in the BEP.

Progress on the deliverables is described in the CDE by means of a status. At transitions between levels (status), the contractor must conduct a quality control (clash detection, EIR and BEP compliance, file and naming convention) and the contracting entity must clear it. The status names include:

- In progress – data with this status is not exchanged between the disciplines or with the contracting entity
- Shared – this data is exchanged between disciplines, models are merged into a coordination model for conducting quality control, or referenced as read-only for own planning. These two steps (processing and sharing) are iterative.
- Published – authorization from the contracting entity and prior quality control are required for clearance of the planning. Once published, data is no longer modified.
- Archived – the project data is archived for further potential use.

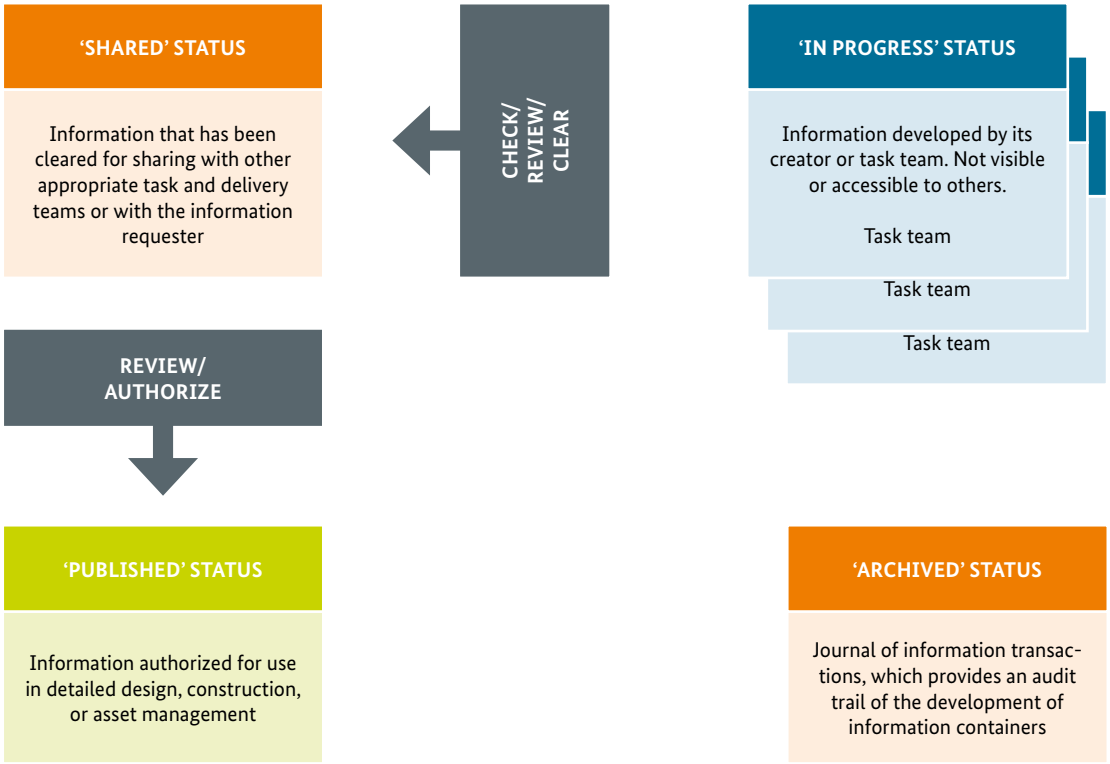


Figure 8: Common data environment scheme (source: DIN EN ISO 19650-1:2019-08, image: BIM D)

Please note: This chapter explains information management processes using a CDE in more detail. The basic features of a CDE are described under 9.1 (p. 42) in the context of BIM technologies.

As a rule, the contracting entity provides the common data environment. If this is the case, it is recommended that the contracting entity organize training for the project stakeholders. The contractor may be asked to provide details in its bid of its experience, capabilities, or procedures for cooperative collaboration. The contractor must clarify the rules for using a CDE (e.g. access data must not be disclosed, allocation of permissions, no deletion of data). A matrix of responsibilities in the clearance process (processing, approval, sharing, authorizing, publication, verification and archival) in the CDE can serve as an aid. The procedure for providing digital deliverables should be explained using a workflow with an example. Before the project work starts, a test run is performed on the CDE to ensure that the workflow and data exchange run efficiently. The workflows defined as part of projects are to be implemented in the platform according to the CDE rules. The contractor is required to comply with the data protection and data security regulations. For more information, see the framework document focusing on the CDE.

6.2 Creating a coordination model and BIM coordination

The overall BIM coordinator is responsible for compiling the coordination model. Only quality-assured digital deliverables (see chapter 7 Quality assurance) may be used to build coordination models. The respective specialist planner is responsible for the quality assurance of the specialist models. The contractor must document exactly which digital deliverables have been merged in a given version for a specific coordination model, and the purpose for doing so. The individual deliverables that define a coordination model must be archived. The contractor is free to choose the software and hardware for creating, preparing and presenting its own digital deliverables and coordination models. Compliance with the contractually specified security standards must be ensured.

Please note: The overall BIM coordination can be provided either by the contractor or the contracting entity. If a contractor is responsible for overall BIM coordination and this is included in the call for tenders, the contractor should be requested to submit a strategy for the overall coordination. However, the overall BIM coordinator can also be provided by the contracting entity or other external contractors. In this case, the contractor is only responsible for coordinating its own digital deliverables and assists the overall BIM coordinator in generating superordinate coordination models.

The EIR must define exactly who is responsible for creating specific coordination models. They must also explain the preparatory work that is required and how this work is required. The contracting entity may define further specific requirements for coordinating or holding meetings and describe them in the EIR. Again, it should be noted that no vendor-specific technologies (software or hardware) should be stipulated.

6.3 Planning meeting

During the planning meetings, the specialist digital models (specialist models) created by the respective specialist planner are compiled in a coordination model in BIM review software. Depending on the subject of the meeting, appropriate views of the coordination model are generated. The overall coordinator and the BIM coordinators discuss conflicts documented during the review process based on the coordination model. The person responsible for the specialist model is tasked with eliminating the conflict, with documentation and based on the model where appropriate. If possible, a BCF-based task management system should be set up for entering, importing, reviewing and tracking model-based tasks, updates for planning changes, model coordination comments and conflicts based on coordination models. The anticipated frequency of planning meetings was defined in chapter 4. The final number of meetings will depend on the open conflicts that need to be worked through before the final overall model can be generated.

Please note: The specific format for the technical coordination is to be defined in detail in the BEP. However, the contracting entity may already include specific requirements for the planning meeting workflow in the EIR. The implementation of the meetings or the planning coordination depends on the overall BIM coordinator's affiliation (see 5.2, p. 28). If virtual planning meetings with the contracting entity using special technologies such as virtual reality (VR) are planned, they must also be explained in the EIR.

7. Quality assurance

Please note: Quality assurance is not a technical examination of individual services. It is a review of the information requirements for digital deliverables. The main focus is on completeness, freedom from redundancy, consistency and homogeneity of geometrical and alphanumeric information. Particularly in the case of complex projects with many different specialist models and stakeholders, multi-stage quality assurance can also be specified, i.e. the professional trades are reviewed first, before the contractor's assessment on the coordination level and the contracting entity's check during acceptance.

If the contractor generates multiple digital models, the contractor must be required to implement clash detection (e.g. checking alignment parameters, checks on standard cross sections of civil engineering structures). In addition to clash detection, the sub-models are checked for quality in terms of compliance with technical specifications and regulations. If the contractor also performs overall coordination tasks (usually the lead overall planner, transport planner or overall civil engineering planner), detailed quality assurance procedures for the individual models of different contractors must be explained. Information on how clearance of the different models is implemented must be provided by the contractor if the contractor is responsible for the overall coordination. The contracting entity may specify the structure of the quality assurance reports or have the contractor suggest one. If the contracting entity requires a specific structure, it must not be tied to specific software.

7.1 Quality assurance by the contractor

The contractor is responsible for quality assurance of the required digital deliverables, which must be specified in the BEP in accordance with the contractual requirements of the EIR. The contractor is asked to explain its approach to quality assurance and generation of coordination models in the bid. Quality reports must be generated independently for each digital deliverable and stored in the common data environment. The reports must be prepared in such a way that the quality of the digital deliverables can be checked on a random basis. The template for the quality reports is prepared by the contractor in coordination with the contracting entity as part of the BEP.

In particular, the contractor must ensure that the digital deliverables contain the required information as efficiently as possible. Checks for compliance with the requirements in the EIR and BEP should be IT-backed where possible. If necessary, the contractor must consolidate the digital deliverables to minimize their file size.

The various responsibilities for quality assurance as well as the quality assurance steps on the contractor side are assigned to the BIM roles in the following table.

Table 12: Responsibilities for quality assurance and quality assurance steps on the contractor side

BIM role of the contractor	Quality assurance

7.1.1 Clash detection

Clash detection assesses whether there are any clashes in the progress statuses as well as the deliverables at the end of the respective project phase within the agreed tolerances. Clash detection is performed by the overall BIM coordinator using coordination models.

Conflicts that can be identified using clash detection include:

- Geometrical clashes between specialist models as well as between specialist models and the existing structures
- Duplicate or incorrect element entries
- Entry of objects that are not part of the plans (e.g. existing buildings and general objects)
- Elements that do not interact with each other (e.g. clashes due to the door swing direction)

If possible, BIM review tools should be used to perform clash detection. The criteria for selecting the appropriate software are listed in chapter 9.2.

The required changes must be communicated in the BIM Collaboration Format (BCF), including the assignment of responsibility. The following contents are to be mapped in the BCF message:

- Author, responsibility, object, problem, solution, status, due date
- Viewpoint if possible directly showing the problem area in the model

7.1.2 Checking for compliance with the EIR and BEP requirements

Compliance with the EIR and BEP requirements is reviewed based on the coordination model by the overall BIM coordinator and, for individual examples, by the BIM manager. This entails an analysis of a potential absence of compliance of information with guidance for objects, models and documentation. The primary test is evaluating whether

- the modelling criteria (e.g. requirements for structuring the model) are met;
- the information required in the EIR, such as features or components, is contained in the specialist model at the agreed level of information need (LOIN);
- the model elements are classified as specified in the LOIN annex;
- the defined file naming convention, data formats and maximum file sizes, if applicable, are observed; and

- the derived plans match the digital models.

In addition to verifying the model's compliance with the EIR and BEP, the requirements of other technical rules or regulations may also be incorporated in the review process.

7.2 Review and clearance by the contracting entity

Only after quality assurance has been carried out by the contractor, and samples have been reviewed by the contracting entity with the involvement of BIM management, are the digital deliverables cleared by the contracting entity and set to the 'Published' status. The clearance is not equivalent to the legal acceptance of the service.

The responsibilities for quality assurance and the quality assurance steps and criteria on the contracting entity side are explained in more detail in the following table.

Table 13: Responsibilities for quality assurance and quality assurance steps on the contracting entity side

BIM role of the contractor	Quality assurance
Please note: In the table, the individual quality assurance steps and criteria of the contractor must be entered with the planned timing and frequency of the implementation of the review process. Reference can be made here to additional relevant information, such as the existence of a quality manual.	

8. Model structure and model contents

Naming, classification, composition and structuring of the digital models are crucial for the contracting entity's use. The contractor must ensure that the specifications laid out below for modelling the digital deliverables are met.

The contractor may propose additional requirements for modelling, structuring and attribution necessary to provide its service, but these requirements must not conflict with the requirements of the contracting entity. The contractor's additional requirements for the model structure and the model contents are set forth in the BEP in coordination with the other project stakeholders and do not have to be submitted separately to the contracting entity.

Please note: Specifications for modelling (structure and contents) should be developed by the contracting entity to create its own modelling guidance, i.e., they are created once and only adapted for specific projects as part of the EIR. Existing administrative regulations of the contracting entity and general guidelines and standards (e.g. VDI standards, DIN standards, etc.) must be observed. If there are no general specifications for modelling (e.g. in the form of a modelling guideline), further information on structuring the digital deliverables must be provided here. The contractor may be asked to submit proposals of its own. In general, however, care should be taken not to define excessively restrictive specifications for modelling (how the models are created), so as not to overly limit contractors' entrepreneurial creativity. Overall, the specifications should instead focus on the result to be provided, the digital deliverable (what the models should contain). The contracting entity must make it clear in the invitation to tender whether the contractor is expected to provide proposals of its own.

8.1 Modelling principles

The specialist models must be modelled in such a way that they ensure compliance with the objectives and specifications for data requirements defined in the individual BIM use cases. Consequently, modelling rules must be observed when creating the individual objects in the digital models. This simplifies quality assurance and increases reusability. The following general requirements, which are explained in more detail in the following chapters, must be observed:

- The structure agreed and specified for the specialist models must be adhered to, see also chapter 8.2.1.
- The file sizes of individual models are to be kept as small as possible. The models should be subdivided where this makes sense. Subdivisions of models must be agreed with the contracting entity and documented in the BEP.
- Agreed and specified units of measurement should be observed. A coordinate reference system (position system, elevation system) agreed with the contracting entity must be used, as must an agreed position of the model relative to the coordinate system.
- Model elements are to be created as closed solids. Terrain and soil layers, alignment lines and spatial data are exceptions to this.
- Each model element has a globally unique name that may not be changed. The specified naming convention for file names and contents of the models as well as the naming of structures and construction stages should be adhered to.
- Model elements in a specialist model must be created without overlaps. If overlaps cannot be avoided, they must be documented accordingly.

- Model elements are to be created in an object hierarchy according to the contracting entity's model structure specifications.

- Model elements should contain the required and necessary details (see level of information need). Model elements are to be consolidated, where applicable, before they are submitted to the contracting entity.

Additional detailed or project-specific modelling guidelines can be described in a Modelling guideline annex.

Please note: The contracting entity should not define too many restrictive modelling rules in the EIR. This would include, for example, requiring the use of specific libraries or software tools.

For modelling in the federal trunk roads sector, the specifications in the Road Information Database instructions (ASB) and the instructions for calculating and estimating costs in road construction schemes (AKVS) must always be observed. The contracting entity may specify the areas in which more detailed requirements are made of object modelling, e.g. which objects (e.g. for traffic facilities, subsoil, utilities, mapping, protected areas, pavement structure) should be incorporated, in which detail (e.g. exact modelling) and for which purpose (e.g. dimensioning and verification). For more information, see the following chapter 8.2 on the level of information need.

The contractor must still be able to create the models to its own specifications under the EIR. The modelling rules listed can be supplemented on a project-specific basis. The list is not exhaustive.

8.2 Level of information need

8.2.1 Project and model structure

Please note: The contracting entity should develop general specifications for the structure of digital deliverables. These specifications usually apply across projects. If there are to be project-specific requirements for the structure, the contracting entity must explain them in detail here. The contractor may be asked to propose an appropriate structure for the digital deliverables to satisfy the use cases. The structure is finalized and contractually agreed in the BEP.

Each specialist discipline involved in the planning process creates its own BIM specialist model in the respective BIM planning software. The BIM specialist models can be divided into sub-models in the course of the project, e.g. based on the individual buildings and building sections. Both this and the maximum file sizes of the individual models are agreed in the BEP. Each specialist model or sub-model must be saved in a separate file and managed in line with the file naming convention. At regular intervals, coordination models are combined separately for all trades from the respective BIM specialist models.

The following BIM models are part of the BIM process:

Table 14: Compilation of superordinate model types

Responsible person/discipline	Model type	Use case

Table 15: Compilation of specialist and sub-models

Responsible person/discipline	Specialist model	Sub-model

Please note: It is recommended to list the different types of models first, e.g. as-built model, coordination model, overall model, 4D and 5D models, and then to list the specialist models and sub-models of the federal trunk roads sector (e.g. traffic facility specialist model – alignment or surfacing sub-models or the civil engineering specialist model – bridge and retaining walls sub-models). They are usually divided into specialist models based on the disciplines involved in the project (see 1.2 on p. 19). The typical specialist models and sub-models in the federal trunk roads sector are listed and described in more detail in the implementation recommendations for specialist models. Superordinate model types are to be listed in Table 14. Table 15 is intended for a compilation of corresponding specialist models and sub-models. These two tables can also be combined in project-specific EIR.

To map the selected project or model structure, the following IFC classes or their subclasses can be used for identification based on the IFC standard:

Table 16: Project structure with classification

Project and model structure	Classification (e.g. IFC class)

The contractor can also propose additional structuring elements. However, the structuring elements must not conflict with the guidance in these EIR. The final structure is defined in the BEP.

Please note: Currently, the IFC schema with the hierarchy IfcProject, IfcSite, IfcBuilding and optionally IfcBuildingStorey is used as standard in civil engineering and infrastructure construction projects. Work is currently underway to extend IFC to mapping typical project structures in infrastructure construction; as of version IFC4.3, infrastructure-typical classes such as IfcBridge, IfcRoad, IfcRailway will also be available. If classification according to other standards is required, this must be adapted accordingly in the table.

8.2.2 Information need

The Level of Information Need (LOIN) defines a structure for requesting and delivering information for BIM models and their elements, which are to be used in the project. In the project, the level of information need is mainly based on DIN EN 17412-1 'Building Information

Modelling – Level of Information Need – Part 1: Concepts and principles' and is described in the following information categories:

- Geometrical information
  - Including information on details, dimensionality, location, appearance, parametric behaviour
- Alphanumerical information
  - Identification information: such as name, type, classification
  - Information content: list of property sets and properties
- Documentation

The level of information need is defined in the project depending on the following conditions:

- Delivery deadline (milestone in information provision)
- Use objective (purpose of information delivery)
- Actor (information requester and provider)
- Granularity of the breakdown of the deliverables in question (per model, per model element)

Section 8.2.1 shows the breakdown of the deliverables. Property sets, properties and potential values can be assigned to each deliverable. A detailed Compilation and description of the building models, model elements, and general properties, as well as the assignment to project milestones and use cases, can be found in the LOIN annex.

Please note: In the project, a uniform LOIN structure should support an efficient exchange of information in the BIM process, to limit information to what is required, and to simplify the award, clearance and review processes. The breakdown of the deliverables is shown in the following table using a bridge as an example.

Table 17: Deliverables and properties as used in LOIN with a bridge in road construction as an example

	Taxonomy	Structural engineering example
Deliverables	Coordination model	Coordination model
	Specialist model	Bridge
	Sub-model	Road section 1
	Model element group	Substructure
	Model element	Bearings
Properties	Property set	Identification
	Property	Bearing type
	Value/characteristic	Elastomer
	Data type/unit	Text

The LOIN annex is drawn up by the contracting entity. This guidance can usually be reused for other projects as well. The LOIN annex is an annex to the EIR and is the basis for the invitation to tender and the contract.

The LOIN annex provided by the contracting entity is reviewed by the contractor and, if necessary, supplemented with properties relevant to the planning. The coordinated LOIN document is updated in the project as part of the BEP updating process. In the course of the modelling work, at least the required level of information need must be reached. For each milestone, the contractor must therefore fill in the requested model elements and properties in the building model.

8.2.3 Classification

Different classification systems can be used to classify an object. The contractor must implement the following classification(s).

Table 18: Compilation of classification systems

Classification system	Description and application	Models/objects

The contracting entity should develop general specifications for the classification of model elements. These specifications usually apply across projects. For example, there can be classifications based on object types, costs, functions and materials (e.g. instructions for calculating and estimating costs in road construction measures – AKVS). The contractor may be asked to propose an appropriate classification for the model elements to satisfy the use cases. The classification is finalized and contractually agreed in the BEP.

8.2.4 Nomenclature

The file naming specifications for the digital deliverables are critical to allow the contracting entity to easily filter and evaluate items within the common data environment. The digital deliverables are named by the contracting entity according to geographical and technical criteria to facilitate a clear spatial and technical classification.

Table 19: Nomenclature for plan and model coding

Nomenclature

Please note: The nomenclature includes all file types, both models and a range of documentation. The scheme drawn up in the EIR is implemented in the BEP. The nomenclature must be uniform, unambiguous and plausible for users. The basis for formulating model coding should be as interdisciplinary as possible.

8.3 Coordinate systems

A project origin, north and a main coordinate system are defined. This ensures that all digital deliverables are in the correct position, modelled in the same geodetic reference system and exchanged correctly. All digital models to be delivered must include the specified project origin in a verifiable form and the predefined north. In the project start phase, the overall BIM coordinator creates a project-specific BIM reference file in the IFC format using the defined coordinate and elevation system and the project origin and stores it in the CDE.

Table 20: Coordinate systems and project origin

Coordinate system			
Elevation system			
Project origin in world coordinates	East value/x coordinate	North value/y coordinate	Elevation/z coordinate
	x.xxx	y.yyy	z.zzz

Please note: The contracting entity must provide information on the geodetic reference systems to be used, the project coordinate system and the reference points for all georeferenced data (section models, alignment data, structure models, geotechnical data, CAD data, GeoTIFFs, etc.). If necessary, the contractor can be asked to provide information on how it can ensure compliance with the specifications.

8.4 Units

In order to be able to verify models efficiently and avoid incorrect calculations and inaccuracies, appropriate units should be used when attributing model elements. The specifications for this are compiled in the following tables.

Table 21: List of units

Model unit	Unit

Please note: The list of units is not exhaustive and must be supplemented or reduced on a project-specific basis. Where appropriate, different units can also be agreed for different digital models. As a rule, the parties can always switch to another unit if the unit currently in use is known.

9. Technologies

9.1 Common data environment

The project uses a common data environment (CDE) to centrally manage digital deliverables. The common data environment is based on DIN EN ISO 19650-1 and VDI Standard 2552 Part 5. Individual users are set up with specific roles for the individual project stakeholders. The access data may not be passed on. All activities to access the common data environment are documented and saved in compliance with data protection requirements. Once data has been transferred, it can no longer be deleted. The contractor must ensure that the employees working on the project have the basic skills required to use a common data environment and implement data security and data protection.

The common data environment provides the following basic functionalities in particular:

- Management of all file types (models, reports, plans etc.) and linked data
- Documentation distribution and division of responsibilities
- High data security with a cloud-based solution
- User management, group, permission and role assignment with the corresponding access management
- Workflow definition, collaboration and clearance processes according to ISO 19650
- Visualization and coordination of building information models
- File versioning

The contracting entity provides a common data environment and general information on the use of the common data environment.

Please note: If the contracting entity provides the common data environment, precise information on the system, permissions, access details, IT security and naming conventions must be provided. The requirements that must be met in order for the digital deliverables to be exchanged via the common data environment have to be clear to the contractor. Training on the use of the common data environment should be provided to the contractor. If the contractor is to provide the common data environment, the contractor must provide the abovementioned information or procedures as part of its bid. In particular, the functional requirements of DIN EN ISO 19650-1 and VDI Standard 2552 Part 5 should be queried and answered by the contractor. If the common data environment is to be offered by the contractor, a quote for training the contracting entity and other external contractors should be requested. It is recommended that the contracting entity provide the common data environment.

9.2 Software tools and licences

The contractor is free to choose the software tools it uses to implement the individual BIM services. The contractor must ensure that the software tools used can create and export the digital deliverables in the required data formats. At the beginning of the project and in the event of any subsequent changes to the software products, these must be coordinated between the project stakeholders and the data exchange must be tested and documented using an example. This example-based test is initiated by the BIM manager and implemented by the overall BIM coordinator with the involvement of all BIM coordinators. It is recommended that the contractor should only use software tools that are certified for the required data formats. The software solution agreed with the other project stakeholders and the contracting entity and specified in the BEP, including details of the version, must be used where possible during the course of the project. Software changes must not be made without prior coordination with the contracting entity and a BEP update.

Please note: In the tender documents, information on the availability of appropriate software tools and evidence of the experience or skills on the part of the contractor's employees in using the software tools and required data formats can be requested and used for evaluation.

9.2.1 BIM planning software

BIM planning software is used to model geometrical, three-dimensional objects and describe them alphanumerically by means of properties. The selected specialist BIM planning software for creating the BIM specialist models must provide at least the following functionalities:

- Creating database-backed model elements as three-dimensional configurable objects with the assignment of arbitrary alphanumeric information using appropriate object tools in the Cartesian coordinate system
- Defining logical dependencies between the model elements and tracking changes
- Creating logical structural elements, such as the storey and site structure, and assigning model elements to this structure
- Supporting dynamic plan derivation from the model so that plans can be generated as documentation and tracked in all kinds of views without requiring additional work, if possible
- Generating lists, quantity statements and other calculations from the BIM model
- Integrating other BIM models via the IFC format

9.2.2 BIM visualization and review software

The BIM visualization and/or review software must be suitable to display, review and coordinate the BIM specialist models in accordance with the requirements of the BIM use cases. Functioning interfaces between the BIM planning software used to create the model and the evaluation and simulation software must be ensured. To review the BIM coordination model (including checks for clashes), a BIM model checker that supports IFC and BCF formats is required. The selected BIM visualization or review software must provide the following functionalities, among others:

- View geometrical and alphanumerical object information, specialist models and coordination models
- Display, filter and dimension sub-models and objects

- Combine models by referencing sub-models or specialist models
- Create sections and views
- Perform clash check
- Display, comment and edit clashes (e.g. using a BCF format)

9.3 Data exchange formats

Data exchange in the project is based on the openBIM concept, i.e. as a rule, all digital deliverables are transferred using open and neutral (non-proprietary) data exchange formats. At the start of the project, a sample data exchange between the contracting entity and the contractor is tested based on the defined formats (see chapter 9.4).

Table 22: Compilation and description of data formats

Data format	Version	Description

Please note: To exchange data for digital deliverables, the data formats to be used must be specified with the corresponding version number. Typical formats in the federal trunk road sector include: IFC 2x3 or IFC 4 for object structures and geometry, DGM IFC 4x1 or OKSTRA for alignment, multi-model container GAEB-DA-XML & IFC for quantity take-off and bills of quantities, CityGML or LandXML for GIS data.

Where applicable, a standardized Model View Definition (MVD) must be prescribed for the use of IFC. The contracting entity may agree additional delivery in the native manufacturer-specific data format with the contractor. However, it must be ensured that digital deliverables transferred using different data formats are based on the identical planning status and that the same contents are correct and complete for the purposes of the EIR. This should be coordinated between the contracting entity and contractor when finalizing the BEP. The EIR must not require the exclusive use of native manufacturer-specific data formats for the specialist models.

9.4 Test run specifications

In order to ensure effective and project-wide implementation of the BIM methodology and the selected use cases as well as use of appropriate IT solutions and successful and smooth data exchange, also across disciplines, the following test cases must be implemented during the start phase in the period to be defined in the BEP or EIR:

Table 23: List of test cases

No.	Test case

Please note: The test cases are intended to trial use cases so the project can progress without interruptions later on. The test cases should be selected based on the intended use cases. The contractor must document the quality of the results from the test runs and coordinate with the contracting entity.

The timing and deadline for completion of the test runs must be defined in the EIR or BEP. The test runs should be performed during the project preparation, after the appropriate conditions have been put in place (e.g. availability of the software, CDE ...). As a rule, at this point, contractors have not yet created any project-specific data or models, which could be used for test runs. Therefore, this section must specify whether the test data is provided by the contractor or the contracting entity.

The extent to which other responsible parties in the project partnership may be called in for demonstration purposes and the test data which may be shared with them should be determined.

Table 24: Detailed information on individual test cases

Test case	
Objective	
Scope/processing step	

9.5 Data security

Please note: If data protection and data security aspects are already governed in the contract or in the CDE instructions, the section can be omitted.

A suitable data protection and data security strategy must be developed and implemented throughout the entire project. The relevant standards that must be complied with for this purpose are listed in the next chapter. All project data is confidential. By providing its data, the contractor transfers its rights of use to the contracting entity. More detailed information on data protection and data security can be found in the additional agreement on confidentiality, data security and data protection.

10. Applicable standards and guidelines

Please note: In addition to ISO standards, DIN standards and construction guidelines, object catalogues for bridges or geotechnical engineering, for example, can be documented here.

Table 25: List of relevant standards and guidelines

Number	Standard/Guideline

Annex

A. List of abbreviations and glossary

Please note: The BIM Germany glossary will be available at a later date.

B. LOIN annex

Please note: The LOIN documents are attached to the EIR as an annex.

C. Other annexes

Please note: The EIR may include additional annexes, such as a BIM execution plan (BEP) structure, BIM process specifications and a modelling guideline. These are to be prepared by the contracting entity.

Section III:
Sample EIR

The following is an excerpt from an **EIR document for the planning of a new replacement motorway bridge** construction project based on the model **EIR**. The example defines a specific project organization. Only selected use cases are described. The example must be modified and supplemented for other project phases and for construction. The contents presented are not mandatory; they are only intended as suggestions. **The example should not be used without changes.**

The entries marked in black are the model texts from the model EIR, which were copied directly and have not been changed. The entries marked in blue refer to the specialist or project-specific part and were additionally filled in for the sample EIR.

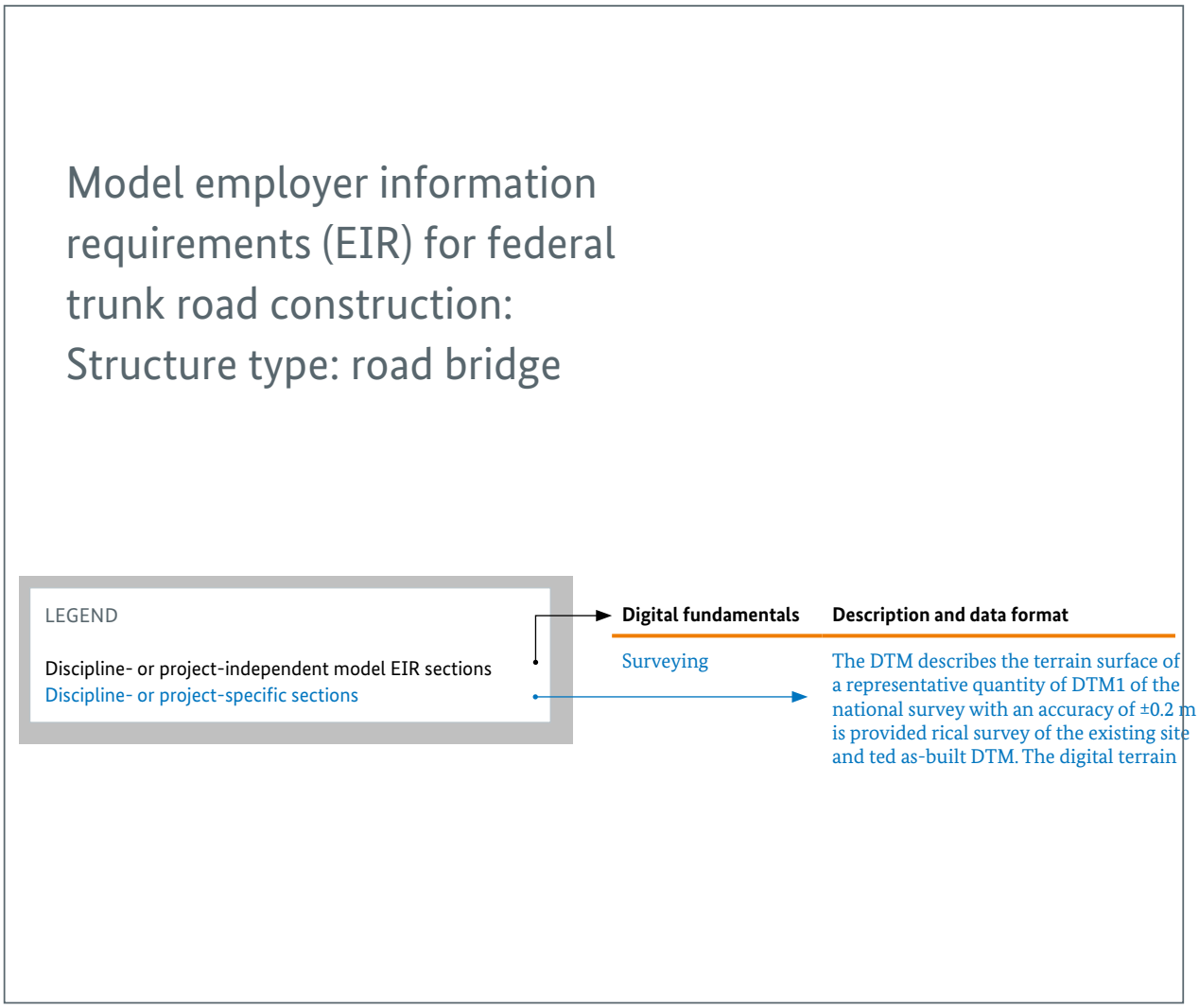


Figure 9: Sample cover sheet for the EIR of a road bridge

1. Introduction

1.1 Scope and content

1.1.1 Employer information requirements

The employer information requirements (EIR/ formerly also BIM requirement specifications) "describe the requirements of the appointing party for the appointed party's (in this document, contracting entity and contractor respectively) information delivery to achieve the defined BIM objectives and use cases. This includes that the information is available at the specified time in the required quantity and quality for collaborative use."[4] The EIR do not distinguish the individual basic services and special services, but describe the services that have yet to be agreed in the contract by assigning them to the schedule of services. Nor do they describe how this information is provided. The EIR apply in conjunction with the LOIN annex.

1.1.2 BIM execution plan

The BIM execution plan (BEP/formerly also BIM functional specification) "documents the procedure developed jointly by the appointed party and the appointing party after conclusion of the contract to supply information and data and to fulfil the contractually agreed EIR. For this purpose, the appointed party specifies the processes, project-related workflows, interfaces, and allocates staff to the roles defined in the EIR. Furthermore, requirements for the planning and documentation standards as well as the software and communication tools used are specified."[5] The BEP applies to all project stakeholders and is to be drawn up under the responsibility of the overall planner acting as the overall BIM coordinator with the participation of the specialist planners in coordination with the BIM manager. The BEP is a dynamic document and is updated during the planning process.

4 Objectives of EIR according to VDI 2552 Part 10, p.3

5 Objectives of the BEP according to VDI 2552 Part 10, p. 7

1.1.3 Document structure

The following diagram shows a breakdown of the contents of BIM-relevant documents.

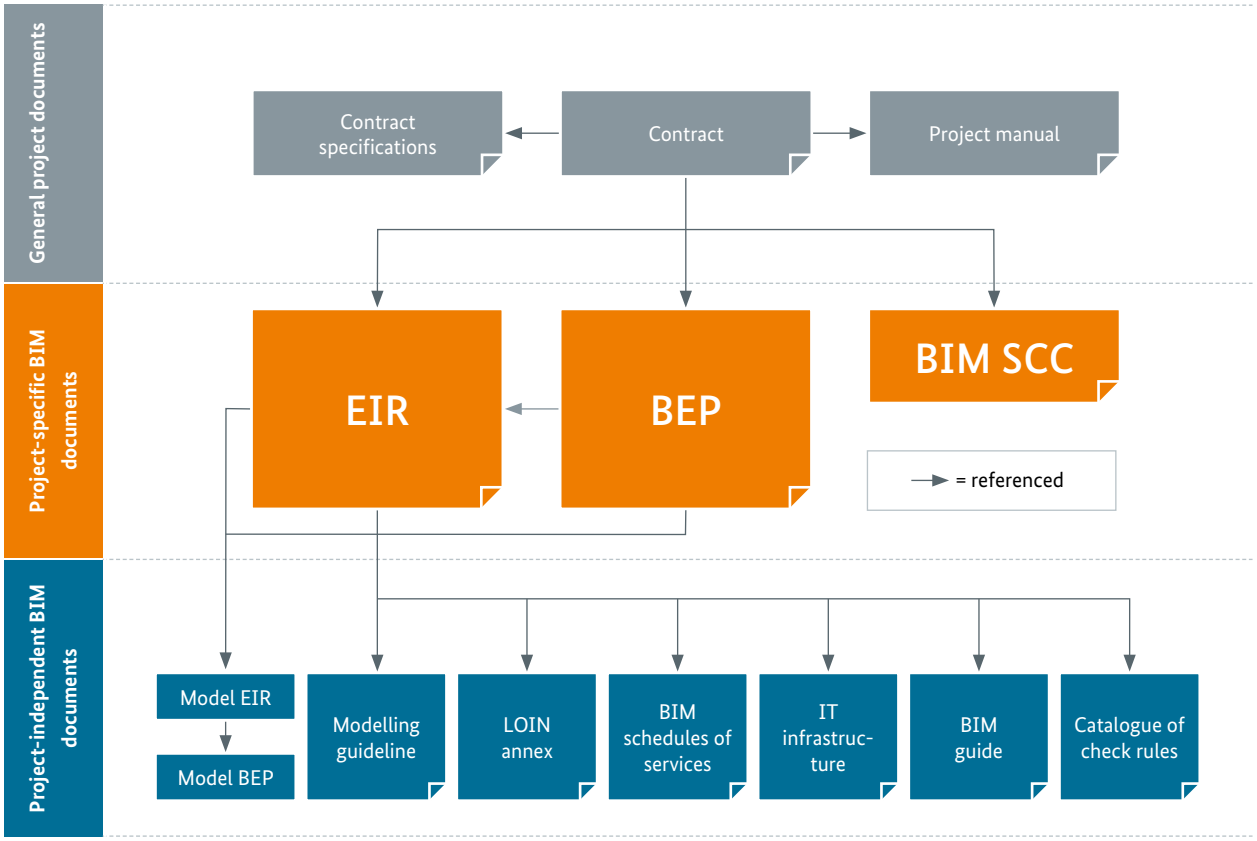


Figure 10: Document structure (based on 'Future of Building - Supporting research for the BIM pilot projects of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), 1st interim report, 2018')

1.2 Project overview

The employer information requirements (EIR) comprise the contracting entity's specific BIM requirements for implementation of the project using the BIM method:

For the project:

Table 26: Project details

Project name	Construction of a replacement motorway bridge	
Contract number/Project number		
Description/Project specifics	Year of construction Length of structure Width of structure Type of structure Foundations Bridge category Mark for structural condition	1960 52 m 15 m Box girder bridge, prestressed concrete Piling 60 3.0
Contracting entity	State road construction authority (Landesbauamt für Straßenbau)	
Contact person		

For the intended commissioning:

Table 27: Details of the intended commissioning

Schedule(s) of services	Overall planning of civil engineering structures
Project phase(s)	1, 2, 3, 8

For the project area:

Table 28: Structures/Project sections

Section		Description	Structure number
1	1.1	Structure 1	H001
	1.2	Section A	T001
	1.3	Structure 2	H002
	1.4	Section B	T002
2	2.1	Structure 3	H003

For the disciplines involved:

Table 29: Disciplines involved

Discipline	Abbreviation
Building logistics	BLG
Geotechnical engineering	GEO
Civil engineering	ENG
Landscaping	LDG
Line construction	LCO
Technical equipment for the section	TES
Environment	ENV
Traffic facility	TRF
Surveying	SUR

2. BIM objectives and use cases

2.1 BIM objectives

The project-relevant objectives for the use of Building Information Modelling as specified by the contracting entity form a basis for the definition and selection of the BIM use cases in the project. Fundamentally, the contracting entity expects the use of the BIM method to improve planning and construction quality and, ultimately, the quality of the structure, while also increasing cost and schedule reliability, and providing a comprehensive data basis for the subsequent operating phase. In the course of the project, these objectives are regularly reviewed and adapted accordingly to the evolving methods, software products and interfaces.

This BIM project focuses primarily on the following project-specific objectives on the part of the contracting entity:

Table 30: Project-specific BIM objectives

No.	BIM project objectives
	Improve integration of operation and maintenance
	Improve quantity take-off and costing for subsequent construction work
	Interface coordination and clash-free planning
	Increase transparency for all project stakeholders
	Improve target/actual comparison for deadlines and costs

2.2 BIM use cases

To achieve the objectives defined in chapter 2.1, the contracting entity selects the use cases to be implemented in the project on the basis of the use cases already standardized in Table 6. However, the table can also be supplemented if necessary. Table 31 describes the selected use cases, grouping them as needed and assigning their implementation to the project phases used in the project. The respective BIM specialist models must be created to apply all use cases.

Table 31: Standardized use cases according to BIM Germany

Use case (UC) no.	Designation of the use case	Selection (X)
000	General	
010	Existing conditions modelling	x
020	Requirement planning	
030	Planning variants and/or preparation of documents substantiating the budget*	
040	Visualization	x
050	Coordination of the professional trades	x
060	Planning progress review and quality control	
070	Dimensioning and verification	
080	Derivation of planning documents	x
090	Approval process	
100	Quantity take-off and costing	x
110	Bill of quantities, tender, contract award	
120	Execution scheduling	
130	Logistics planning	
140	Construction progress review	
150	Change and follow-up management	
160	Invoicing of construction services	
170	Acceptance and defect management	
180	Commissioning management	
190	Project and structure documentation	x
200	Operational use and structural maintenance	

* Depending on the specialist area, either 'Planning variants' or 'Preparation of documents substantiating the budget' can be selected.

In the course of the project, these objectives and use cases are regularly reviewed and adapted to the evolving methods, software products and interfaces. These adaptations are recorded in updates to the BEP.

The project-specific guidance compiled in Table 32 applies to the use cases that are to be implemented by the contractor in the project.

Table 32: Description of the selected BIM use cases

Use case (UC) no.	Detailed description of use in the project	Project phases	Grouping
UC 010	Documentation of the key aspects of the existing structure via an appropriate geodetic survey and/or from as-built documents. Transfer to an as-built model.	Service phase (SP) 1	
UC 040	Visualization in line with demand derived from the BIM models as a basis for project meetings for preliminary, outline and detailed design up to photorealistic depictions and animations, for public relations, among other things.	SP 2 SP 3 SP 8	
UC 050	The digital models must be merged on a regular basis in a coordination model with subsequent clash check and systemic conflict resolution. For this purpose, the contractor produces quality-assured coordination models. The contractor is to document the individual coordination models in a comprehensible manner. The contractor defines appropriate check rules for the clash check. If the contracting entity specifies check rules, they must be implemented. Relevant conflicts are analysed, coordinated and documented in coordination meetings with the parties involved. A procedure for tracking conflicts is implemented.	SP 2 SP 3 SP 8	
UC 080	The preliminary design, outline design and approval plans are derived based on the digital models to be created. The consistency of these plans, as well as other digital deliverables, must be ensured. The digital deliverables must be structured and furnished with information in a manner that allows preliminary design, outline design, and approval plans to be derived. If all design details cannot be derived from the model, the contractor must explain which plan details are to be added manually.	SP 2 SP 3 SP 8	
UC 100	This use case includes the derivation of structured and component-specific quantities (volumes, areas, lengths, quantities) from the digital models as a basis for cost estimation and cost calculation. The quantity take-offs and costing must be presented in a transparent and comprehensible manner. If all quantities cannot be derived from the model, the contractor must explain which manual additions are to be made.	SP 2 SP 3	
UC 190	Creation of an 'as-built' model as a digital construction file with detailed information on the execution, e.g. materials and products used as well as references to test reports and other documents, if applicable. Continuous updates to the BIM model during construction, updates in the event of deviations and supplementing with additional objects are recommended.	SP 8	

3. Groundwork provided

For the service provision and implementation of the BIM use cases, the contracting entity provides the following groundwork:

Table 33: Compilation of groundwork for model-based planning from the contracting entity

Groundwork	Description	Data format
Surveying	The Digital Terrain Model (DTM) describes the terrain surface via the spatial coordinates of a representative set of terrain points. A DTM1 by the State Surveying Agency with a grid size of 1 m and an accuracy of ± 0.2 m is provided. In general, a terrestrial survey of the as-built site is conducted and a triangulated as-built DTM is generated. The digital terrain model comprises the area of the existing bridge with an offset of XX m.	ASCII or ESRI Shape/possibly DWG or LandXML
Digital subsoil model	In the area of the existing bridge, a digital subsoil model is provided based on the subsoil survey. A subsoil survey is enclosed with the digital subsoil model.	IFC
2D as-built plans of the structures	As-built plans (e.g., construction and permit plans) of existing structures are provided. There are no digital structure models for the existing bridge.	PDF
Current alignment in the access area of the existing bridge	Information on the current alignment in the area of the existing bridge is provided.	OKSTRA; possibly IFC version 4.0.2.1 or LandXML
Spatial data	The retrieval of spatial data from the state geodesy offices can be enabled via standardized web services. If required, ESRI shape files, ALKIS data, 3D city models, digital orthophotos and digital topographic maps can also be provided. These are to be obtained accordingly from the geo-information systems.	ESRI Shape, CityGML, digital orthophotos, digital topographic map
Digital documents and additional 2D plans	Information on lines (power, water, telecommunications, drainage, etc.) as well as existing ordnance exploration areas/depths and contaminated sites is provided.	PDF, DWG or DXF

4. Digital deliverables and delivery deadlines

Within the scope of the contractor's service provision, digital deliverables are to be created, checked against the requirements and handed over to the contracting entity. The digital deliverables are described by project phase or milestone and represent the results of implemented use cases. Digital deliverables mean all files that must be handed over to the contracting entity as a result of a service at the end of a project phase or on reaching a specific milestone. This includes digital models, derived 2D plans, audit reports and other documents. Regular reciprocal communication of the current progress statuses of the individual digital deliverables at the planning meetings is also key for efficient coordination and management of the project. The digital deliverables are exchanged exclusively via the common data environment (CDE).

The following deliverables and delivery deadlines are specified by the contracting entity, whereby this may be described in greater detail in an agreement on the BEP between the contracting entity and the contractor.

Table 34: List of digital deliverables and delivery deadlines – pre-design

Project phase	SP 1 Pre-design		
Milestone			
Deliverable	**Description/LOIN**	**Delivery deadline**	**Data format***
As-built model	The as-built model includes all major accessible structural shells and components of the existing structure. The components were modelled based on a survey, documentation of the as-built situation, the materials, the contaminated areas and the existing 2D plans with an appropriate level of information need (see LOIN annex). The as-built model also includes planning-relevant components and structures in the affected vicinity of the bridge, for which sufficient groundwork is also available. This includes, for example, the existing bridge structure and other relevant objects such as lines or shoring. The as-built model is used for quantity take-off, costing of dismantling and implementation of a demolition strategy.	At the end of the service phase	IFC
BIM execution plan	The BEP includes the contractors' implementation strategy to meet the EIR during the contracted service phases and ensures the implementation of the targets it describes. The BEP applies to all project stakeholders and is to be drawn up under the responsibility of the overall planner acting as overall BIM coordinator with the participation of the specialist planners in coordination with the BIM manager. The BEP is a dynamic document and is updated in every service phase. An updated version of the BEP is to be available by the beginning of a new service phase at the latest.	At the end of the service phase	DOC, PDF, XLS

* For exact specifications/versions of the exchange formats, see section 9.3 Data exchange formats.

Table 35: List of digital deliverables and delivery deadlines – preliminary design

Project phase	SP 2 Preliminary design		
Milestone			
Deliverable	**Description/LOIN**	**Delivery deadline**	**Data format**
Digital model of the preliminary design/ delivery statuses* of the digital specialist models and overall model	The digital model of the preliminary design includes the as-built model and the possible solutions, referencing the BIM objects/models. It is created on the basis of the section model provided in the access area of the existing bridge. Components are modelled as solids with the approximate quantity, dimensions, shape, location and orientation at an appropriate level of information need (see LOIN annex). The model is used to compare preferred options and visualize the proposed solutions. The documentation of the planning status contains a summary comparison of the proposed solutions.	At the end of the service phase	IFC, Native, DGN
Progress statuses of the digital specialist models**	The contractor regularly stores and archives its own specialist models in the common data environment at the agreed intervals.	Every XX weeks for the planning meetings	IFC
BIM execution plan	The BEP includes the contractors' implementation strategy to meet the EIR during the contracted service phases and ensures the implementation of the targets it describes. The BEP applies to all project stakeholders and is to be drawn up under the responsibility of the overall planner acting as overall BIM coordinator with the participation of the specialist planners in coordination with the BIM manager. The coordinated version is available for all project stakeholders at the beginning of service phase 2. The BEP is a dynamic document and is updated in every service phase. An updated version of the BEP is to be available by the beginning of a new service phase at the latest.	At the end of the service phase	DOC, PDF, XLS
Visualizations of the work statuses	Visualizations to be derived from the BIM model form a basis for project meetings in the course of planning and execution and are not subject to photorealistic post-processing (e.g. visual highlighting of components).	At the end of the respective service phase and at the respective planning meetings	PNG, PDF
Derived plans, final quality reports*** and other information	The associated preliminary outline designs are derived from the structure models, which also include necessary construction pits. Information that is created manually must be documented. The associated views of the digital models are to be created for each of the preliminary design plans. The outline designs contain information on the revision number of the digital models that is used.	At the end of the service phase	DWG, PDF
Results of the quantity take-off	The digital model must be used for quantity take-off. A quantity model contains the calculated quantities and links them to the associated elements of the structure and construction pit models. The aim is to derive all relevant quantities automatically from the structure and construction pit models where possible. Manually changed or supplemented quantities must be flagged.	At the end of the service phase	CSV, XML, PDF
Model with linked cost structure/ model with stored object-based cost parameters Cost estimate	The digital model must be used for cost estimation. All quantities relevant for cost estimation must be derived as far as possible from the quantity take-off model and linked to the costs.	At the end of the service phase	IFC, CPIXML/ IFC, native, OKSTRA, GAEB XML

* Delivery statuses must contain the required level of information need.
** Progress statuses represent the current work status and therefore do not yet contain the level of information need required at the end of the service phase.
*** The template for the quality reports is prepared by the contractor in coordination with the contracting entity as part of the BEP.

Table 36: List of digital deliverables and delivery deadlines – outline design

Project phase	SP 3 Design planning		
Milestone			
Deliverable	**Description/LOIN**	**Delivery deadline**	**Data format**
Digital model of the outline design/ delivery statuses of the digital specialist models and overall model	The digital model of the preferred option is evolved to the extent and level of detail required for the outline design on the basis of the preliminary design model. It is created on the basis of the section model provided in the access area of the existing bridge. Components are modelled as solids with precise quantity, dimensions, shape, location and orientation at an appropriate level of information need (see LOIN annex).	At the end of the service phase	IFC, Native, DGN
Progress statuses of the digital specialist models	The contractor regularly stores and archives its own specialist models in the common data environment at the agreed intervals.	Every XX weeks for the planning meetings	IFC
Derived outline designs, final quality reports and other information	The associated outline designs are derived from the digital model. The RAB-ING* standards must be observed. Details that have not yet been modelled in this service phase will be added as 2D plans. Information that is created manually must be documented. The associated views of the digital models must be created for each of the outline designs. The outline designs contain information on the revision number of the digital models that is used.	At the end of the service phase	DWG, PDF
Derived documents	The corresponding documents such as room and component lists are to be derived from the model. Number and contents must be determined for each service phase.	At the end of the service phase	PDF, XLS
Updated BIM execution plan	The BEP is a dynamic document and is updated in every service phase. An updated version of the BEP is to be available by the beginning of a new service phase at the latest.	At the end of the service phase	DOC, PDF, XLS
Test reports and change tracking. Quality reports on the progress statuses of the digital specialist models	The results of the model-based quality assurance are made available to all project stakeholders in a common data environment for change tracking via standardized test reports, which are created by the contractor in coordination with the contracting entity as part of the BEP.	Every XX weeks for the respective planning meetings	DOC, PDF, XLS, BCF
Visualizations of the work statuses	Visualizations to be derived from the BIM model form a basis for project meetings in the course of planning and execution and are not subject to photorealistic post-processing (e.g. visual highlighting of components).	At the end of the respective service phase and at the respective planning meetings	PNG, PDF
Results of the quantity take-off for cost calculation	The digital model must be used for quantity take-off. A quantity model contains the calculated quantities and links them to the associated elements of the structure and construction pit models.	At the end of the service phase	CSV, XML, PDF
Model with linked cost structure/ model with stored object-based cost parameters/ cost estimation/cost calculation	The digital model must be used for cost calculation. All quantities relevant for cost calculation must be derived as far as possible from the quantity take-off model and linked to the costs.	At the end of the service phase	IFC, CPIXML/ IFC, native, OKSTRA, GAEB XML

* Current specifications are difficult to implement in model-based planning. The new version is currently in development (cf. Federal Trunk Roads Masterplan Implementation Recommendations, Plan Derivation in accordance with RAB-ING)

Table 37: List of digital deliverables and delivery deadlines – site supervision

Project phase	SP 8 Site supervision		
Milestone			
Deliverable	**Description/LOIN**	**Delivery deadline**	**Data format**
Digital as-built model/ delivery statuses of the digital specialist models and overall model	The as-built model is the verified digital representation of the structure actually built. All model elements are modelled in the built version with actual dimensions, shape, location and geographical reference at a corresponding level of information need (see LOIN annex). The as-built model is often created from the relevant specialist models from the detailed design phase by incorporating the deviations from the actual built structure. In addition, it can be checked via digital survey. It is assumed that the executing companies provide their own models to generate the as-built model.	At the end of the service phase	IFC, Native, DGN
Material lists, product lists	Essential detailed design information and documents, such as materials and products used, must be linked to the appropriate elements of the as-built model.	At the end of the service phase	CSV, ODS
Derived plans, final quality reports and other information	Derived plans of the executing contractors' work and installation planning. These are to be evolved based on the model provided with the tender in SP 7. Details that have not yet been modelled in this service phase will be added as 2D plans.	At the end of the service phase	DWG, PDF
Visualizations of the work statuses	Visualizations to be derived from the BIM model form a basis for project meetings in the course of planning and execution and are not subject to photorealistic post-processing (e.g. visual highlighting of components).	At the end of the respective service phase and at the respective planning meetings	PNG, PDF
Updated BIM execution plan	The BEP includes the contractors' implementation strategy to meet the EIR during the contracted service phases and ensures the implementation of the targets it describes. In the service phase, only the executing companies are affected by potential updates to the BEP.	At the end of the service phase	DOC, PDF, XLS

5. Organization and roles

5.1 Project organization

When introducing BIM, BIM-specific roles with specialist knowledge are assumed on the part of both the contracting entity and the contractor. For service provision, the contractor must fill specific BIM roles with competent personnel. The contractor must ensure that the BIM capabilities named in the employer information requirements are in place. The contractor must name the persons who are to fill specific roles.

The working relationship of the project stakeholders (designated BIM roles) is illustrated by the following graphic and described in more detail in the following chapter.

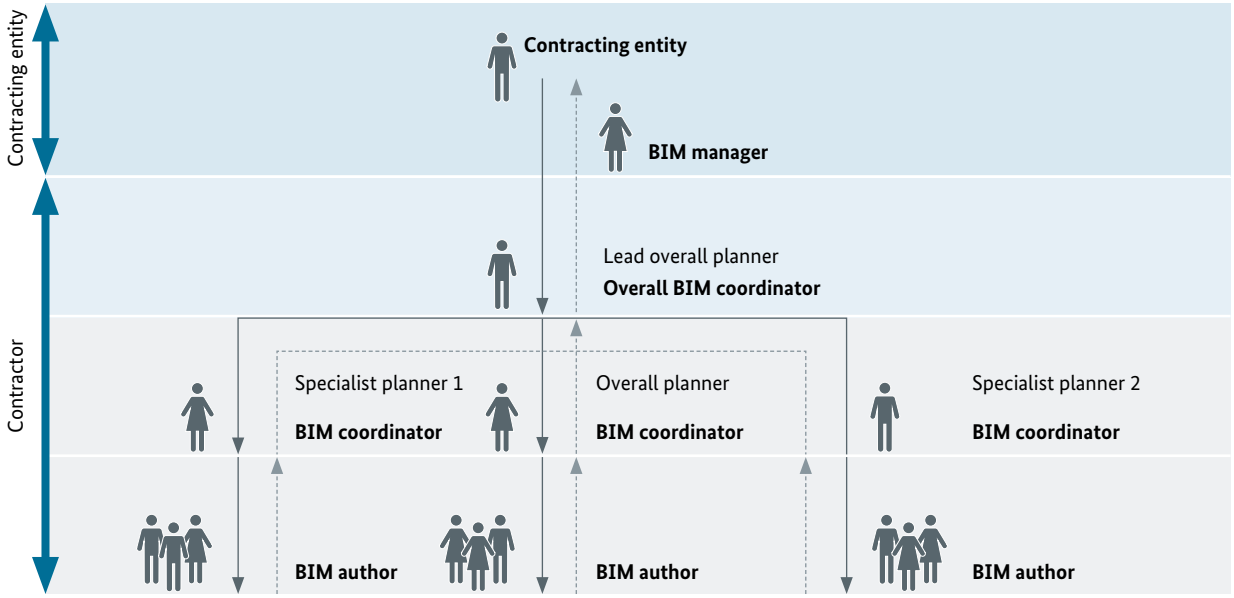


Figure 11: Project organizational chart

5.2 BIM roles and responsibilities

The contracting entity defines the following BIM roles and responsibilities as part of the project:

Table 38: Description of individual BIM roles

BIM role	Role description	Responsibility
BIM manager	▪ Acts as a point of contact for questions regarding BIM-based project management ▪ Controls the management processes around digital project management ▪ Develops project-specific EIR with the contracting entity's project management team ▪ Organizes and manages the common data environment ▪ Ensures compliance with agreed rules, standards and processes ▪ Based on samples, reviews and documents the quality of the digital deliverables to be provided with respect to the requirements for structuring and attribution in the EIR document ▪ Participates in the coordination and updating of the BEP	Contracting entity
Overall BIM coordinator	▪ Assists with the quality control of the digital deliverables to be provided ▪ Assists with the clearance of digital deliverables ▪ Takes responsibility for the coordination models, which are composed of individual specialist models. The respective creators remain responsible for the individual specialist models. ▪ Responsible for coordinating the different trades ▪ Checks and documents the technical accuracy and completeness of the coordination models for the BIM contents required; the technical responsibility remains with the respective creators	Contractor
BIM bridge coordinator	▪ Coordinates the creation of digital deliverables for overall planning ▪ Acts as the primary point of contact for the overall BIM coordinator and BIM manager ▪ Supports the overall BIM coordinator in the creation of superordinate coordination models ▪ Monitors compliance with the required information qualities for overall planning ▪ Prepares regular reports on the quality of digital deliverables to be provided ▪ Responsible for the digital provision of deliverables for overall planning ▪ Is available as a contact for the BIM section coordinator and other specialist planners for questions on overall planning	Contractor
BIM section coordinator	▪ Coordinates the creation of digital deliverables for overall planning ▪ Acts as the primary point of contact for the overall BIM coordinator and BIM manager ▪ Supports the overall BIM coordinator in the creation of superordinate coordination models ▪ Monitors compliance with the required information qualities for overall planning ▪ Prepares regular reports on the quality of digital deliverables to be provided ▪ Responsible for the digital provision of deliverables for section planning ▪ Is available as a contact for the BIM bridge coordinator and other specialist planners for questions on section planning	Contractor
BIM author	▪ Creates BIM specialist models (modelling and attribution) in coordination with the BIM coordinator ▪ Imports BIM models from other specialist areas for its own planning ▪ Exports files for BIM coordination	Contractor

6. Cooperation strategy

6.1 Information management

The technical coordination between the contracting entity and the contractor is implemented based on digital deliverables, which are to be stored in the CDE (Common Data Environment). The procedures for cooperative collaboration in DIN EN ISO 19650-1 and VDI Standard 2552 Part 5 must be taken into account. The mutual coordination processes, their frequency and information management processes using a CDE must be defined in the BEP.

Progress on the deliverables is described in the CDE by means of a status. At transitions between levels (status), the contractor must conduct a quality control (clash detection, EIR and BEP compliance, file and naming convention) and the contracting entity must clear it. The status names include:

- In progress – data with this status is not exchanged between the disciplines or with the contracting entity
- Shared – this data is exchanged between disciplines, models are merged into a coordination model for conducting quality control, or referenced as read-only for own planning. These two steps (processing and sharing) are iterative.
- Published – authorization from the contracting entity and prior quality control are required for clearance of the planning. Once published, data is no longer modified.
- Archived – the project data is archived for further potential use.

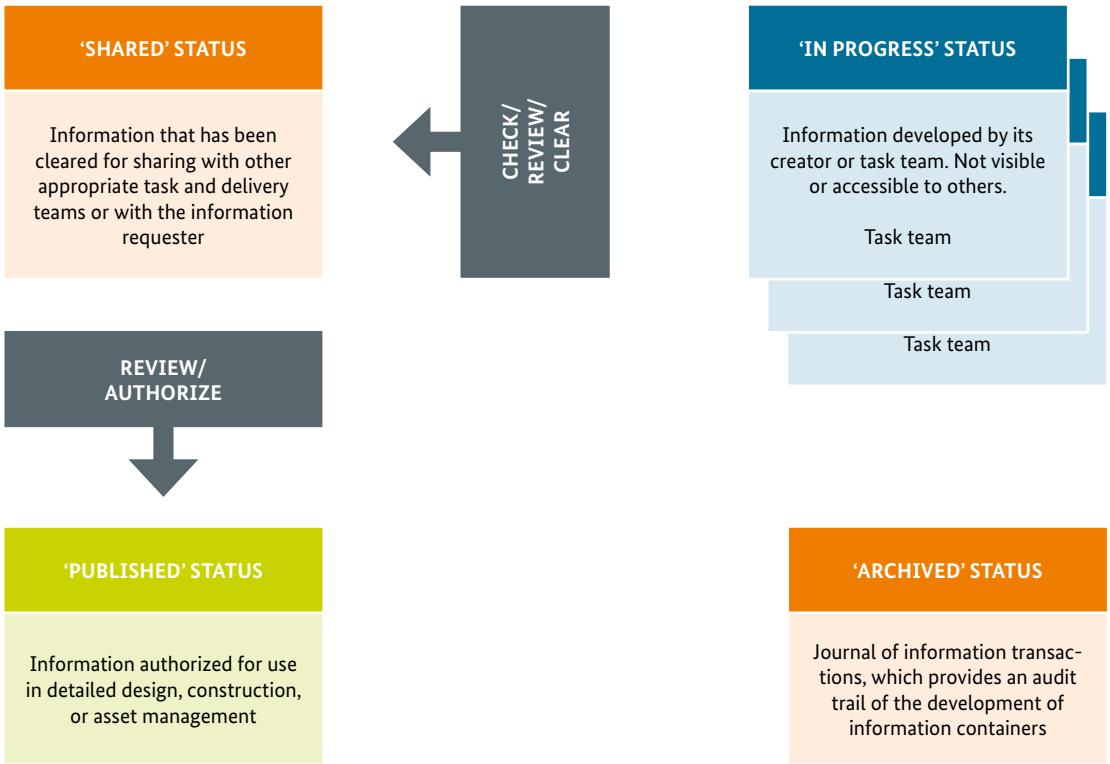


Figure 12: Common data environment scheme (source: DIN EN ISO 19650-1:2019-08, image: BIM D)

6.2 Creating a coordination model and BIM coordination

The overall BIM coordinator is responsible for compiling the coordination model. Only quality-assured digital deliverables (see chapter 7 Quality assurance) may be used to build coordination models. The respective specialist planner is responsible for the quality assurance of the specialist models. The contractor must document exactly which digital deliverables have been merged in a given version for a specific coordination model, and the purpose for doing so. The individual deliverables that define a coordination model must be archived. The contractor is free to choose the software and hardware for creating, preparing and presenting its own digital deliverables and coordination models. Compliance with the contractually specified security standards must be ensured.

6.3 Planning meeting

During the planning meetings, the specialist digital models (specialist models) created by the respective specialist planner are compiled in a coordination model in BIM review software. Depending on the subject of the meeting, appropriate views of the coordination model are generated. The overall coordinator and the BIM coordinators discuss conflicts documented during the review process based on the coordination model. The person responsible for the specialist model is tasked with eliminating the conflict, with documentation and based on the model where possible. If possible, a BCF-based task management system should be set up for entering, importing, reviewing and tracking model-based tasks, updates for planning changes, model coordination comments and conflicts based on coordination models. The anticipated frequency of planning meetings is defined in chapter 4. The final number of meetings will depend on the open conflicts that need to be worked through before the final overall model can be generated.

7. Quality assurance

7.1 Quality assurance by the contractor

The contractor is responsible for quality assurance of the required digital deliverables, which must be specified in the BEP in accordance with the contractual requirements of the EIR. The contractor is asked to explain its approach to quality assurance and generation of coordination models in the bid. Quality reports must be generated independently for each digital deliverable and stored in the common data environment. The reports must be prepared in such a way that the quality of the digital deliverables can be checked on a random basis. The template for the quality reports is prepared by the contractor in coordination with the contracting entity as part of the BEP.

In particular, the contractor must ensure that the digital deliverables contain the required information as efficiently as possible. Checks for compliance with the requirements in the EIR and BEP should be IT-backed where possible. If necessary, the contractor must consolidate the digital deliverables to minimize their file size.

The various responsibilities for quality assurance as well as the quality assurance steps on the contractor side are assigned to the BIM roles in the following table.

Table 39: Responsibilities for quality assurance and quality assurance steps on the contractor side

BIM role of the contractor	Quality assurance
Overall BIM coordinator	▪ Checking the generated BIM coordination models for compliance with the required technical data quality (such as modelling rules and LOIN definitions) in accordance with the EIR and the BEP ▪ Review of the status designations ▪ Checking the provided BIM specialist models for compliance with the required data technical quality and the required information depth, continuously, at the latest before each change of status from 'shared' to 'published'. ▪ Quality assurance of the coordination process, documentation of test results and tracking of changes as processing of the model continues
BIM coordinator	▪ Checking, handover and clearance of own BIM specialist models to the overall BIM coordinator for BIM-based coordination ▪ Ensuring that own BIM specialist models are in place and checking them in accordance with LOIN definitions and consistent application of modelling guidelines, at the latest before each change in the status from 'in progress' to 'shared' ▪ If responsible for several BIM specialist models, additional checking of the models before handover to the overall BIM coordinator
BIM author	▪ Continuous quality control of own BIM specialist models ▪ Compliance with modelling rules and LOIN specifications when creating BIM specialist models ▪ Checking of the BIM specialist models to be provided and, in particular, validation of the export files for provision for coordination and other use

7.1.1 Clash detection

Clash detection assesses whether there are any clashes in the progress statuses as well as the deliverables at the end of the respective project phase within the agreed tolerances. Clash detection is performed by the overall BIM coordinator using coordination models.

Conflicts that can be identified using clash detection include:

- Geometrical clashes between specialist models as well as between specialist models and the existing structures
- Duplicate or incorrect element entries
- Entry of objects that are not part of the plans (e.g. existing buildings and general objects)
- Elements that do not interact with each other (e.g. clashes due to the door swing direction)

If possible, BIM review tools should be used to perform clash detection. The criteria for selecting the appropriate software are listed in chapter 9.2.

The required changes must be communicated in the BIM Collaboration Format (BCF), including the assignment of responsibility. The following contents are to be mapped in the BCF message:

- Author, responsibility, object, problem, solution, status, due date
- Viewpoint if possible directly showing the problem area in the model

7.1.2 Checking for compliance with the EIR and BEP requirements

Compliance with the EIR and BEP requirements is reviewed based on the coordination model by the overall BIM coordinator and, for individual examples, by the BIM manager. This entails an analysis of a potential absence of compliance of information with guidance for objects, models and documentation. The primary test is evaluating whether

- the modelling criteria (e.g. requirements for structuring the model) are met;
- the information required in the EIR, such as properties or components, is contained in the specialist model at the agreed level of information need (LOIN);
- the model elements are classified as specified in the LOIN annex;
- the defined file naming convention, data formats and maximum file sizes, if applicable, are observed; and
- the derived plans match the digital models.

In addition to verifying the model's compliance with the EIR and BEP, the requirements of other technical rules or regulations may also be incorporated in the review process.

7.2 Review and clearance by the contracting entity

Only after quality assurance has been carried out by the contractor, and samples have been reviewed by the contracting entity with the involvement of BIM management, are the digital deliverables cleared by the contracting entity and set to the 'Published' status. The clearance is not equivalent to the legal acceptance of the service.

The responsibilities for quality assurance and the quality assurance steps and criteria on the contracting entity side are explained in more detail in the following table.

Table 40: Responsibilities for quality assurance and quality assurance steps on the contracting entity side

BIM role of the contractor	Quality assurance
BIM manager	▪ Checking the agreed handovers of the BIM models to the contracting entity for the required technical data quality in accordance with the EIR and the BEP ▪ Definition and review of milestones for BIM data handovers in coordination with project management

8. Model structure and model contents

Naming, classification, composition and structuring of the digital models are crucial for the contracting entity's use. The contractor must ensure that the specifications laid out below for modelling the digital deliverables are met.

The contractor may propose additional requirements for modelling, structuring and attribution necessary to provide its service, but these requirements must not conflict with the requirements of the contracting entity. The contractor's additional requirements for the model structure and the model contents are set forth in the BEP in coordination with the other project stakeholders and do not have to be submitted separately to the contracting entity.

8.1 Modelling principles

The specialist models must be modelled in such a way that they ensure compliance with the objectives and specifications for data requirements defined in the individual BIM use cases. Consequently, modelling rules must be observed when creating the individual objects in the digital models. This simplifies quality assurance and increases reusability. The following general requirements, which are explained in more detail in the following chapters, must be observed:

- The structure agreed and specified for the specialist models must be adhered to, see also chapter 8.2.1.
- The file sizes of individual models are to be kept as small as possible. The models should be subdivided where this makes sense. Subdivisions of models must be agreed with the contracting entity and documented in the BEP.
- Agreed and specified units of measurement should be observed. A coordinate reference system (position system, elevation system) that has been agreed with the contracting entity must be used, as must an agreed position of the model relative to the coordinate system.
- Model elements are to be created as closed solids. Terrain and soil layers, alignment lines and spatial data are exceptions to this.
- Each model element has a globally unique name that may not be changed. The specified naming convention for file names and contents of the models as well as the naming of structures and construction stages should be adhered to.
- Model elements in a specialist model must be created without overlaps. If overlaps cannot be avoided, they must be documented accordingly.
- Model elements are to be created in an object hierarchy according to the contracting entity's model structure specifications.
- Model elements should contain the required and necessary details (see level of information need). Model elements are to be consolidated, where applicable, before they are submitted to the contracting entity.

Additional detailed or project-specific modelling guidelines can be described in a Modelling guideline annex.

8.2 Level of information need

8.2.1 Project and model structure

Each specialist discipline involved in the planning process creates its own BIM specialist model in the respective BIM planning software. The BIM specialist models can be divided into sub-models in the course of the project, e.g. based on the individual buildings and building sections. Both this and the maximum file sizes of the individual models are agreed in the BEP. Each specialist model or sub-model must be saved in a separate file and managed in line with the file naming convention. At regular intervals, coordination models are combined separately for all trades from the respective BIM specialist models.

The following BIM models are part of the BIM process:

Table 41: Compilation of superordinate model types

Responsible person/discipline	Model type	Purpose
Overall planning	BIM coordination model	Model-based coordination
	Derived visualization models	Model-based visualization
	5D model (cost model)	Model-based cost estimation and tendering
	As-built model	Model-based structure documentation
	Traffic model	

Table 42: Compilation of specialist and sub-models

Responsible person/discipline	Specialist model	Sub-model
Geotechnical engineering	Geotechnical engineering/subsoil	▪ Subsoil/soil layers sub-model ▪ Subsoil explorations/drilling profiles sub-model ▪ Homogeneous areas ▪ Groundwater/hydrological data sub-model ▪ Contaminated sites sub-model
▪ Line construction ▪ Traffic facility ▪ Civil engineering ▪ Technical equipment ▪ Surveying ▪ Environment ▪ Surveying ▪ Geotechnical engineering	As-built	▪ Line construction as-built sub-model ▪ Traffic facility/section as-built sub-model ▪ Civil engineering/structure as-built sub-model ▪ Technical equipment as-built sub-model ▪ Surrounding area ▪ Environment ▪ Surveying ▪ Geotechnical engineering/subsoil
Civil engineering	Civil engineering	▪ Bridge ▪ Retaining walls ▪ (Noise) barriers
Traffic facility	Traffic facility/section	▪ Alignment ▪ Superstructure ▪ Earthworks/substructure ▪ Drainage
Technical equipment	Technical equipment	▪ Traffic signs ▪ Signposting ▪ Road markings ▪ Vehicle restraint systems ▪ Traffic signals/light signals ▪ Street lighting ▪ Protection systems
Line construction	Line construction	▪ Water pipelines ▪ Wastewater pipes/sewage systems ▪ Gas pipes ▪ Power lines ▪ Telecommunications lines
Environment	Environment	▪ Species protection ▪ Nature conservation ▪ Water management ▪ Immission control
Surveying	Surveying	▪ Structural survey ▪ Terrain survey/digital terrain model (DTM) ▪ Scatter diagrams/laser scans
Surveying	Surrounding area	▪ Digital terrain model (DTM) ▪ City model ▪ Digital orthophotos (DOP) ▪ Official Land Register Information System (ALKIS) ▪ Digital maps/specialist maps

To map the selected project or model structure, the following IFC classes or their subclasses can be used for identification based on the IFC standard:

Table 43: Project structure with classification

Project and model structure	Classification (e.g. IFC class)
Project	IfcProject
Building site	IfcSite
Bridge	IfcBuilding
Structural element assembly	IfcElementAssembly
Structural element	IfcElement

The contractor can also propose additional structuring elements. However, the structuring elements must not conflict with the guidance in these EIR. The final structure is defined in the BEP.

8.2.2 Information need

The Level of Information Need (LOIN) defines a structure for requesting and delivering information for BIM models and their elements, which are to be used in the project. In the project, the level of information need is mainly based on DIN EN 17412-1 'Building Information Modelling – Level of Information Need – Part 1: Concepts and principles' and is described in the following information categories:

- Geometrical information
  - Including information on details, dimensionality, location, appearance, parametric behaviour
- Alphanumerical information
  - Identification information: such as name, type, classification
  - Information content: list of property sets and properties
- Documentation

The level of information need is defined in the project depending on the following conditions:

- Delivery deadline (milestone in information provision)
- Use objective (purpose of information delivery)
- Actor (information requester and provider)
- Granularity of the breakdown of the deliverables in question (per model, per model element)

Section 8.2.1 shows the breakdown of the deliverables. Property sets, properties and potential values can be assigned to each deliverable. A detailed list and description of the building models, model elements and their properties, as well as the assignment to project milestones and use cases, can be found in the LOIN annex.

8.2.3 Classification

Different classification systems can be used to classify an object. The contractor must implement the following classification(s).

Table 44: Compilation of classification systems

Classification system	Description and application	Models/objects
ASB-ING 2013	Use of the key tables based on the 'Instructions for road information database for engineering structures (ASB-ING), structural data subsystem'. A separate property value is defined for the corresponding objects: ▪ Name: ASB-ING2013 Value: 15-digit integer according to ASB-IB 2013	Applies to all digital models that contain main structural elements that can be structured according to ASB-ING 2013.
AKVS 2014	Use of the 'Instructions for costing and estimating road construction schemes (AKVS)'. A separate property value is defined for the corresponding objects: ▪ Name: AKVS2014 ▪ Value:	Applies to all digital models that contain main structural elements that can be structured according to AKVS 2014.

8.2.4 Nomenclature

The file naming specifications for the digital deliverables are critical to allow the contracting entity to easily filter and evaluate items within the common data environment. The digital deliverables are named by the contracting entity according to geographical and technical criteria to facilitate a clear spatial and technical classification.

Table 45: Nomenclature for plan and model coding

Nomenclature
▪ Tender lot ▪ Section ▪ Construction phase or zone ▪ Trade/specialist model ▪ Service phase ▪ Structure ▪ Element assembly ▪ Level of detail ▪ Number ▪ Index

8.3 Coordinate systems

A project origin, north and a main coordinate system are defined. This ensures that all digital deliverables are in the correct position, modelled in the same geodetic reference system and exchanged correctly. All digital models to be delivered must include the specified project origin in a verifiable form and the predefined north. In the project start phase, the BIM coordinator for overall planning must create a project-specific BIM reference file in the IFC format using the defined coordinate and elevation system and the project origin and stores it in the CDE.

Table 46: Coordinate systems and project origin

Coordinate system	ETRS89/UTM		Location status (Lagestatus) 489
EPSG Code	25832		
Elevation system	DHHN2016		Elevation status (Höhenstatus) 170
Project origin in world coordinates	East value/x coordinate	North value/y coordinate	Elevation/z coordinate
	461344.000	5481745.000	0.000

8.4 Units

In order to be able to verify models efficiently and avoid incorrect calculations and inaccuracies, appropriate units should be used when attributing model elements. The specifications for this are compiled in the following tables.

Table 47: List of units

Model unit	Unit	
Length	Metre	m
Area	Square metre	m2
Volume	Cubic metre	m3
Degrees	Degree	Degrees
Time	Second	s
Mass	Kilogram	kg
Geodesic angle	Gon	Gon
Quantity	Piece	Pc
Temperature	Degrees Celsius	°C
Costs	euros	€
Speed	Kilometres per hour	km/h
Force	Newton	n
Plane angle	Degree	Degrees

9. Technologies

9.1 Common data environment

The project uses a common data environment (CDE) to centrally manage digital deliverables. The common data environment is based on DIN EN ISO 19650-1 and VDI Standard 2552 Part 5. Individual users are set up with specific roles for the individual project stakeholders. The access data may not be passed on. All activities to access the common data environment are documented and saved in compliance with data protection requirements. Once data has been transferred, it can no longer be deleted. The contractor must ensure that the employees working on the project have the basic skills required to use a common data environment and implement data security and data protection.

The common data environment provides the following basic functionalities in particular:

- Management of all file types (models, reports, plans etc.) and linked data
- Documentation distribution and division of responsibilities
- High data security with a cloud-based solution
- User management, group, permission and role assignment with the corresponding access management
- Workflow definition, collaboration and clearance processes according to ISO 19650
- Visualization and coordination of building information models
- File versioning

The contracting entity provides a common data environment and general information on the use of the common data environment.

9.2 Software tools and licences

The contractor is free to choose the software tools it uses to implement the individual BIM services. The contractor must ensure that the software tools used can create and export the digital deliverables in the required data formats. At the beginning of the project and in the event of any subsequent changes to the software products, these must be coordinated between the project stakeholders and the data exchange must be tested and documented using an example. This example-based test is initiated by the BIM manager and implemented by the overall BIM coordinator with the involvement of all BIM coordinators. It is recommended that the contractor should only use software tools that are certified for the required data formats. During the project, the software solution agreed with the other project stakeholders and the contracting entity, which is specified including the relevant version in the BEP, must be used where possible. Software changes must not be made without prior coordination with the contracting entity and a BEP update.

9.2.1 BIM planning software

BIM planning software is used to model geometrical, three-dimensional objects and describe them alphanumerically by means of properties. The selected specialist BIM planning software for creating the BIM specialist models must provide at least the following functionalities:

- Creating database-backed model elements as three-dimensional configurable objects with the assignment of arbitrary alphanumeric information using appropriate object tools in the Cartesian coordinate system
- Defining logical dependencies between the model elements and tracking changes
- Creating logical structural elements, such as the storey and site structure, and assigning model elements to this structure
- Supporting dynamic plan derivation from the model so that plans can be generated as documentation and tracked in all kinds of views without requiring additional work, if possible
- Generating lists, quantity statements and other calculations from the BIM model
- Integrating other BIM models via the IFC format

9.2.2 BIM visualization and review software

The BIM visualization and/or review software must be suitable to display, review and coordinate the BIM specialist models in accordance with the requirements of the BIM use cases. Functioning interfaces between the BIM planning software used to create the model and the evaluation and simulation software must be ensured. To review the BIM coordination model (including checks for clashes), a BIM model checker that supports IFC and BCF formats is required. The selected BIM visualization or review software must provide the following functionalities, among others:

- View geometrical and alphanumerical object information, specialist models and coordination models
- Display, filter and dimension sub-models and objects
- Combine models by referencing sub-models or specialist models
- Create sections and views
- Perform clash check
- Display, comment and edit clashes (e.g. using a BCF format)

9.3 Data exchange formats

Data exchange in the project is based on the openBIM concept, i.e. as a rule, all digital deliverables are transferred using open and neutral (non-proprietary) data exchange formats. At the start of the project, a sample data exchange between the contracting entity and the contractor is tested based on the defined formats (see chapter 9.4.).

Table 48: Compilation and description of data formats

Data format	Version	Description
Industry Foundation Classes (IFC)	4.0.2.1	Model View Definition, IFC4 Design Transfer View
OKSTRA		
LandXML		
BIM Collaboration Format	2.1	
XLSX, DOCX, PDF		
Comma-Separated Values (CSV)	7-bit ASCII code	Comma-Separated Values (CSV) with semicolon separation ▪ Quantity ▪ Unit ▪ IfcGUID model element Optional description
GAEB data exchange XML (X31)	3.2	
Portable Network Graphics (PNG)	ISO 15948	
Portable Document Format (PDF/A)	ISO 24517	
DWG		
DGN		

9.4 Test run specifications

In order to ensure effective and project-wide implementation of the BIM methodology and the selected use cases as well as use of appropriate IT solutions and successful and smooth data exchange, also across disciplines, the following test cases must be implemented during the start phase in the period to be defined in the BEP or EIR:

Table 49: List of test cases

No.	Test case
1	BEP introduction
2	Data exchange and workflows in the CDE
3	Clash detection
4	openBIM collaboration including workflow
5	Costing

Table 50: Detailed information on individual test cases – Test case 1

Test case	BEP rollout: Kick-off meeting and qualification
Objective	The BIM methodology represents a fundamental innovation in German construction projects. The comprehensive approach means that a large number of structures, workflows and IT solutions have to be adapted. The BIM execution plan (BEP) in particular serves to clarify these aspects. To ensure project-wide implementation of the BIM methodology and its project-specific application in accordance with the BEP, all project stakeholders must be qualified and involved. Therefore, the contractor must present a strategy for implementing this as part of the BEP. The corresponding kick-off meetings, qualification measures etc. are to be implemented based on a rapid rollout schedule after commissioning.
Scope/processing step	

Table 51: Detailed information on individual test cases – Test case 2

Test case	Data exchange and workflows in the CDE
Objective	In order to ensure that the CDE can be used efficiently for data exchange in the project, a test case for data exchange must be successfully completed within the time period defined in the BEP or in the EIR.
Scope/processing step	▪ Generating three native and IFC files each of different version statuses for sub-models of earthworks and civil engineering with the contractor's modelling tools ▪ Verification that models have been generated true to the coordinates ▪ Uploading the model files to the CDE ▪ Generation and consideration of a coordination model from the sub-models ▪ Export of the entire coordination model from the CDE

Table 52: Detailed information on individual test cases – Test case 3

Test case	Model verification on the coordination model
Objective	To ensure that the IT solutions can be used efficiently to verify the model in the project, a test case for verifying a coordination model must be successfully completed within the time period that is to be defined in the BEP or in the EIR. This comprises:
Scope/processing step	▪ Manipulation of the sub-models from the 'Data exchange in the CDE' test case so that at least three different errors/conflicts occur. ▪ Identification of the errors/conflicts in the coordination model using the software solution(s) for model verification ▪ Creation of a shared file with entries for the errors/conflicts and ▪ Decisions on how to resolve/rectify them

Table 53: Detailed information on individual test cases – Test case 4

Test case	openBIM collaboration including workflow
Objective	In order to ensure that the CDE can be used efficiently for workflow-based collaboration in the project, a test case for the workflow must be successfully completed within the time period defined in the BEP or in the EIR.
Scope/processing step	▪ Uploading the file from test case 2 to the CDE and storing it together with the files of the coordination model ▪ Monitoring of BCF issues

Table 54: Detailed information on individual test cases – Test case 5

Test case	Costing
Objective	Test case 4 is to be completed in preparation of the preliminary design in the period to be defined in the BEP or in the EIR after clearance of the BIM preparation and is to be conducted on a sample civil engineering model at the LOIN defined by the contracting entity.
Scope/processing step	▪ Deriving a quantity based on a model ▪ Determining a position based on an object ▪ Linking with cost parameters for costing ▪ Feedback of the results of the costing to the model objects for model-inherent documentation

9.5 Data security

A suitable data protection and data security strategy must be developed and implemented throughout the entire project. The relevant standards that must be complied with for this purpose are listed in the next chapter. All project data is confidential. By providing its data, the contractor transfers its rights of use to the contracting entity. More detailed information on data protection and data security can be found in the additional agreement on confidentiality, data security and data protection.

10. Applicable standards and guidelines

Table 55: List of relevant standards and guidelines

Number	Standard/Guideline
	DIN EN ISO 19650 - CDE
	ISO 16739 - Industry Foundation Classes
	ISO 29481 - Building Information Models
	ISO 29481 - Information Delivery Manual (IDM)
	ISO 12006-3 (Definition of properties)

Annex

A. List of abbreviations and glossary

B. LOIN annex

C. Other annexes

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