

Federal Ministry for Digital and Transport

Federal Trunk Roads BIM Masterplan

Framework document: BIM Execution Plan (BEP) - version 1.0

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Overview of the framework documents

This framework document, the BIM Execution Plan (BEP), 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.

The framework documents are developed in 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 federal states on BIM. In these groups, various technical experts – employees of the Federal Ministry of Transport and Digital Infrastructure, the Federal Trunk Road Authority (FBA), 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 Transportation Research Association (FGSV) – are working together 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

"Building Information Modelling is a cooperative work method which makes it possible, based on digital models of a building, to consistently collect, manage and exchange, for further processing, by way of transparent communication between those involved, information and data relevant to its lifecycle."¹

This framework document is aimed at every party involved in the planning, construction and

operation of federal trunk roads - including both public sector contracting entities and contractors. This guidance document describes the structure and procedure of the BIM Execution Plan (BEP) and explains the necessary framework conditions. This document is also intended to support the processes of tendering, awarding contracts and handling BIM-related services. The document is based on the BIM4INFRA2020 toolkit Part 3 "Guidance and model for BIM Execution Plan".

¹ Source: Road Map for Digital Design and Construction, p. 4

Document information

1. References to other documents

The framework document builds on the previous, already recognized BIM4INFRA2020 toolkit "Guidance and model for the BIM Execution Plan" and the framework document on the topic of "Employer Information Requirements (EIR)" and thereby on the results of the activities within the scope of work package 4.3b of BIM Germany.

Compared with the BIM4INFRA BEP toolkit, the following additions or adjustments were made:

- Specialist aspects for federal trunk roads are described in more detail.
- Where necessary, previous contents were updated and supplemented.
- The implementation recommendations concerning the BEP were structured on the basis of the new model EIR to ensure the compatibility of the EIR and BEP documents.

2. Structure of the document

The document consists of the following two main sections, which contain the fundamentals and implementation recommendations for the BEP:

Section I: BEP in general

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

• Section II: BEP in detail

This section provides an answer to the questions of what content a BEP needs to have and what details need to be taken into consideration in preparing a BEP. 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 (see the implementation recommendations for EIR) and are a starting point for compiling the document. Pertinent recommendations (highlighted in yellow) for preparing and implementing the BEP are explained here based on the model EIR for each designated chapter.

Using the information indicated here and the proposed document structure, a sample BEP can then be developed. It can be developed in a similar way to the BEP which has been filled out as an example in Section III of the BIM4INFRA2020 (BEP) toolkit.

Section I BEP in general

1. Fundamentals

When BIM is used, the Employer Information Requirements (EIR) specify what the contracting entity wants to have delivered as part of the contract (see framework document entitled "EIR"). The EIR are the basis of the BIM Execution Plan. As an alternative, a preliminary BEP can be prepared by the contracting entity or the contractor on the basis of the requirements. This will roughly outline what information/deliverable needs to be delivered at a given time and the form in which it is to be delivered. The BIM Execution Plan will be specified in detail once the contract has been signed. Only then will precise details be formulated on how the use cases specified by the client will be implemented. It will also be possible to update the contracts between the service provider and the client during the implementation of the project to incorporate new experiences, findings and technological innovations.

The explanations in this document are based on the assumption that the BEP or preliminary BEP drawn up by the contracting entity and the contractor will outline the way in which the EIR are to be implemented in the project. The core function of a BEP or preliminary BEP consists in determining how the parties involved in the project will work together when BIM is used by providing information and specifications for individual processes. The level of detail in the descriptions can increase as the project progresses. Despite the difference in requirements during the various project phases, the BEP is required and of a similar structure for both planning and construction.

The EIR and BEP need to be developed depending on the project at issue. The focus will be on

individual specific characteristics of the relevant client structure and project needs. There are no regulatory requirements in terms of a BEP's layout and content. They are instead driven mainly by expediency considerations and will be handled in practice on a case-by-case basis.

It is thus recommended to define in a BEP only the data granularity and the types of data formats that the client actually needs and is able to process. Considering whether the requirements are reasonable and proportionate is advantageous in this context. However, there should be no deviations from the EIR in general, as the BEP is based on the Employer Information Requirements.

This is why the contracting entity needs to think beforehand about EIR. It is possible, for example, to create a several kilometres long "as-built" model for a segment using laser scanning. This will, however, produce data volumes in the two- to three-digit terabyte range, which can neither be processed nor displayed using ordinary hardware and software. This applies especially to coordinating the geometric details of construction elements, because too many geometrical details will often make handling and exchanging models more difficult.

The BIM method cannot leverage its full potential unless all project stakeholders are included in this method. This means that the contracting entity requires that everyone contributing to the BIM application participate in the BIM-based project management. This applies in particular to those parties directly commissioned to deliver services.

2. Boundary conditions

In Part 1 "Fundamentals and overall BIM process", the BIM4INFRA toolkit describes in detail how the BEP is 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 updated in 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 and BEP are part of the contract. Adapting the EIR and updating the BEP generally 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.

As the BEP is a precise description of the BIM method, it can contain further project-specific points to improve the handling of the BIM process that are not mentioned here. The selected use cases thus differ from one another in the examples provided in the construction projects. It is also possible to hand over a template, a so-called model BEP, together with the Employer Information Requirements, which will then be filled in by the bidders. This offers the contracting entity the benefit of better control and at the same time it makes it easier to compare bids. Potential content for a BEP or a model BEP can be found below.

3. Challenges

Preparing a BEP that refers clearly and accurately to the EIR is a fundamental task for the contractor if the contracting entity calls for a BEP bid, or for the contracting entity if it pre-defines a preliminary BEP. A balance must be struck in the EIR between too many detailed requirements and too few non-specific ones. The more detailed individual subjects are included, the more precisely a contractor can respond to them using a BEP. 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.

Section II BEP in detail

Based on the contents of a (model) BEP shown in the section below, recommendations (highlighted in orange) for how to word individual BEP sections are explained in greater detail.

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 the Federal Ministry of the Interior for the implementation of the BIM methodology in one's own projects in a structured and uniform manner, it is generally recommended to use the structure outlined here and the notes on preparing and implementing one's own (preliminary/model) BEP.

1. Introduction

1.1 Scope and content

Please note: 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, nonproject-specific documents can be drawn up and be referenced in the EIR and the BEP. It is important that the document version numbers are managed properly.

It is also possible to hand over a template, the so-called model BEP, together with the Employer Information Requirements. This offers the contracting entity the benefit of better control and at the same time makes it easier to compare bids. You will find potential content below for a BEP or a model BEP; they refer to a model EIR (see EIR framework document).

1.1.1 Employer Information Requirements

The Employer Information Requirements (EIR/ formerly also BIM requirement specification) "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." 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 the 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 (in this document contracting entity and contractor, respectively) 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, projectrelated 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".1 The BEP applies to all project stakeholders and needs 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.

1.1.3 Document structure

This BEP was drawn up based on the following relevant documents:

1 BEP objectives according to VDI 2552 Part 10, p. 7

| able 1: Relevant documents | | | | |
|---|---|--|--|--|
| No. Document title Version/date | | | | |
| | | | | |
| | | | | |
| Please note: The diagram contained in the EIR (see EIR framework document) is intended to show project-relevant documentation and links | between the individual documents. Of these documents, the ones used in preparing the BEP need to be specified in the table. | | | |

1.2 Project overview

Please note: The BEP must always be tailored to the specific project, with reference to the EIR. Each section needs to relate to the respective topic. This document serves as a model and, as such, it cannot take into account all projectspecific aspects. The model serves as a guide for the structure and content formulation of project-specific BEPs. It is advisable to list all the relevant project information that is known at the beginning of any BIM project in the BIM Execution Plan.

For the project:

Table 2: Project details

Project nameContract number/Project numberDescription/Project specificsContracting entityContact person

Please note: A model BEP will differ from project to project and needs to be adapted individually. In this process, the contracting entity needs to review each section before the call for tenders. Not all project-specific aspects that are part of the model BEP can be taken into consideration for each BIM construction project. A suitable contact person of the contracting entity who can provide informative answers to questions must be named for the BEP.

Before awarding the contract:

Table 3: Details of the intended commissioning

Schedule(s) of services

Project phase(s)

Please note: The BEP must be drawn up individually for each project. In case of individual classifications of services, only the service profile to be assigned, e.g., overall planner, is specified here. Only selected services in certain service phases are addressed by the BEP. It is not mandatory to classify the work phases according to the Statutory Fee Schedule for Architects and Engineers (HOAI). Project phases may be subdivided on any other basis.

For the project areas:

Table 4: Structure/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 contain basic information on all 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 5: Disciplines involved

Disciplines

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 deliverables. The list is part of the EIR. Should adaptations or additions be needed here, these shall be submitted immediately as a proposal for coordination.

2. BIM objectives and use cases

2.1 BIM objectives

Please note: The objectives to be achieved by BIM are usually stipulated by the contracting entity in the EIR. As a first step, the objectives defined by the contracting entity in the EIR should be incorporated into the BEP. Should additions or adaptations become necessary as the project progresses, these need to be documented in the following section.

In the initial BIM phase, it can be expected that the client wishes to achieve additional

Table 6: Project-specific BIM objectives

No.

BIM project objectives

results, for example, to increase acceptance or efficiency or to gather experience. These sub-objectives should be specified in the BEP, but need to be differentiated from the client's main goals. The table shown below should be reproduced as needed for the contractor to specify the objectives.

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

2.2 BIM use cases

Please note: The use cases to be processed by the contractor are defined in the EIR. 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 defined by the contracting entity or the deliverables. If these affect the cooperation between the planners, they must be supplemented here. The contractor's use cases need to be labelled accordingly.

All the use cases identified in the EIR that the contractor needs to implement when working on the BIM project are listed in sequence. The system described in the individual use cases (see framework document entitled "Use Cases") needs to be complied with.

Table 7: Standardized use cases as defined by BIM Germany

| Use case (UC) no. | Use case title | 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.

Besides the contracting entity's simple list of use cases and their characteristics (see table below), additional project-specific arrangements made by the contractor to implement the BEP

Table 8: Description of the selected BIM use cases

can be specified. For this purpose, the use of the field "Project-specific additions" in the table is recommended:

| Use case (UC) no. | Detailed description of use in the project |
|-------------------|--|
|-------------------|--|

Project phases Grouping Project-

Project-specific additions

Please note: If the contracting entity requires specifications that are as detailed as possible at the outset of the project, the preconditions for this must already be described precisely in the EIR, and the requirements for the implementation of the use case according to the EIR must be outlined in detail. 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. Project-specific adaptations can be made to the use cases in the BEP. The preliminary BEP usually contains very general descriptions for the implementation of the use cases. Once the contract has been concluded, the descriptions will be updated regularly and adapted and specified accordingly to the evolving methods, software products and interfaces in the scope of updating the BEP as the BIM project progresses. The BEP needs to define in detail how the technical coordination is to be specifically implemented. If the contracting entity has already provided definitions in the EIR, these need to be specified in the BEP. If this has not occurred, it is recommended to propose additional options.

3. Groundwork provided

For the service provision and implementation of the BIM use cases, the following groundwork will be provided by the contracting entity and reviewed by the contractor:

Table 9: Compilation of groundwork provided by the contracting entity

| Groundwork | Description | Data format | Contractor comments | |
|---|--|-------------|---------------------|--|
| | | | | |
| For the service pr the BIM use cases be additionally re | rovision and implementation of s, the following groundwork will equired by the contractor: | | | |
| Table 10: Compilation c | of groundwork needed by the contractor | | | |
| Groundwork | Description | Data format | Contractor comments | |

Please note: In the EIR, the contracting entity specifies in detail what groundwork will be provided by the contracting entity. In particular, the groundwork required, processed and integrated in the context of the use cases should be listed here (e.g. digital 2D plan, information on piping and cables, raster DTMs from the geoportals, subsoil reports). If digital models have been created for these structures or infrastructure 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 models are handed over for planning purposes 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.

In any case, the contractor needs to review whether this groundwork is suitable for implementation of the use cases and, where necessary, provide feedback to the contracting entity accordingly. Furthermore, the contractor should inform the contracting entity if further groundwork is required or 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.

4. Digital deliverables and delivery deadlines

The digital deliverables must be specified in this section in such a way that they are identifiable by all parties involved – to a maximum of designating the required specialist models or more

Table 11: List of digital deliverables and delivery deadlines

if needed. The deliverables will be supplemented by additional details during the BEP updates. The contractor will provide the following deliverables to the contracting entity:

| Project phase | | | |
|---------------|------------------|-------------------|-------------|
| Milestone | | | |
| Deliverable | Description/LOIN | Delivery deadline | Data format |

Please note: The deliverables and delivery deadlines, including their allocation to project phases or milestones, will generally be defined by the contracting entity in the EIR (see exact description in the EIR framework document), whereby this may be described in greater detail in an agreement on the BEP between the contracting entity and the contractor. This additional information agreed upon can be supplemented in the table from the EIR. Besides describing the deliverables requested by the contracting entity, the contractor can also indicate here the steps towards implementing additional use cases. The level of information need (LOIN) needs to be specified for the digital deliverables necessary for the additional use cases, particularly if multiple service providers are involved in creating and implementing

them. During the BEP updates, further information can be added, such as type of plan, colour scheme, classification IDs.

The contractor itself may also be asked to provide feedback on scheduled deadlines as part of its bid or to define deadlines or the frequency of exchanging this information. 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. If necessary, an additional schedule for the entire project can be prepared as an annex.

5. Organization and roles

5.1 Project organization

The working relationship of the project stakeholders, designated BIM roles and the assigned persons are illustrated in the following graphic and described in more detail in the following chapter.

Field for organizational chart

Figure 1: Project organizational chart

Please note: An organizational chart is included to better structure the various roles. If the contracting entity stipulates a BIM project organization and an organizational chart in the EIR, these need to be applied and the roles defined there assigned to persons. A sample project organizational chart that is based on the model EIR and has been specified can be found in the following graphic. If necessary, the project organizational chart may be updated by the contractor in the course of the project.



Figure 2: Sample project organizational chart according to the EIR

5.2 BIM roles and responsibilities

The following BIM roles with the specified responsibilities according to the EIR exist in this project and have been filled as follows:

Table 12: Characterization of individual BIM roles and their assignments

| BIM role | Role description | Respnsibility | Name | Contact data | Company |
|----------|------------------|---------------|------|--------------|---------|
| | | | | | |

Please note: When introducing BIM, BIMspecific 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 name the persons who are to fill specific roles. The BIM roles and responsibilities are derived from the EIR (see framework document on EIR for more information). If not all BIM roles are described in the Employer Information Requirements, this can also be done by the contractor in the BEP. If one or multiple BIM roles from the EIR cannot be assigned to the parties involved in the project, additional proposals are needed as to who will fill this role or these roles. It is necessary to specify the roles and responsibilities. To this end, the individual BIM roles need to be described in the BEP.

Project-specific educational or training measures, if they exist, can also be explained in this field.

6. Cooperation strategy

6.1 Information management

The section below describes a cooperation concept (description of processes and frequency) using a common data environment based on the specifications in the EIR. The procedures for cooperative collaboration in DIN EN ISO 19650-1 and VDI Standard 2552 Part 5 must be observed.

Please note: The common data environment (also called CDE) plays a significant role in the cooperation. Pertinent requirements from the EIR need to be incorporated into the BEP and the cooperation needs to be specified through the common data environment. Should other platforms be used as well (e.g. project or work platforms), they need to be listed and described here. Additional project-specific definitions such as project stakeholders on the contractor's side or contact persons on the contracting entity's side can be indicated here.

6.2 Creating a coordination model and BIM coordination

Based on the requirements in the EIR, this section describes the principles of cooperation on part of the contractor for both the coordination within each specialist area and as an overall model, if one contractor is responsible for the overall coordination.

Please note: The responsibilities for creating the coordination models as well as the requirements of what the contractor is expected to contribute are explained in the EIR. This is a starting point in creating the coordination concept. In the BEP, the contractor as a rule needs to 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 need to be archived. If a contractor is responsible for overall BIM coordination and this is included in the call for tenders, the contractor should be requested at this point to submit a concept for the overall coordination.

6.3 Planning meeting

The process of cooperation in project meetings is defined below. This includes organizational as well as technological, spatial and time-related aspects that will be specified accordingly in the table.

Table 13: Specifying the cooperation strategy and planned project meetings

Please note: A successful cooperation strategy is crucial for the success of a BIM project. This is why the concept outlining the process of cooperation with the contracting entity in terms of time, space and technology needs to be described in detail. The exact implementation of the technical coordination needs to be regulated in detail in the BEP. If the contracting entity's requirements are available in the EIR, these need to be specified. If not, cooperation possibilities should be proposed in the BEP.

The following examples can be part of a meeting plan (type of meeting):

- BIM kick-off discussion
- Project meetings
- BIM coordination meetings

It is possible to combine project meetings and coordination meetings in one project session, particularly in the early phases of project planning. In doing so, it is important to ensure that the BEP includes details about the frequency of the meetings, participants including their roles, type, place and objectives as well as topics and content. If the contracting entity requires the use of a virtual data room (VDR), the implementation of a VDR with its technical means needs to be explained. The details mentioned can be specified, for example, in the form of the table shown above.

7. Quality assurance

Quality assurance aims to ensure that the models provide the required or agreed data and information to implement the use cases. Two different types of monitoring are differentiated in quality assurance. Self-monitoring is conducted by the contractor, and third-party monitoring is conducted by the contracting entity or an authorised representative. The two types of monitoring are specified in the following chapters outlining the focus and criteria of reviews. Responsibilities and selected methods and software are also specified below.

Please note: Information from other parts of the BEP such as "Organization and roles", "Cooperation strategy" and "Digital deliverables and delivery deadlines" needs to be linked for the purposes of quality assurance.

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 the geometrical and alphanumerical 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 specialist trades are reviewed first, before the contractor's assessment on the coordination level and the contracting entity's check during acceptance. Self-monitoring thus takes place already when the contractually defined services are drawn up. Third-party monitoring is conducted when the contractually agreed services are delivered to the contracting entity.

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 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

Quality assurance by the contractor is specified with the most important information in this section.

Table 14: The contractor's specification of quality assurance

Please note: The contracting entity may ask the contractor to describe a general quality assurance strategy and, where appropriate, update it within a document.

In addition to the general notes on quality assurance (see chapter 7) that need to be considered, it is recommended to provide the following information:

- Overall quality assurance process
- Description of "self-monitoring and thirdparty monitoring" procedure (on the part of the contractor/contracting entity)
- Review methods and tools
- Review cycle (how often will reviews be conducted?)
- Characteristics of quality assurance (what properties will be reviewed?)
- Requirements for the characteristics (what do the properties need to fulfil in the review?)
- Responsibilities

The table with the most important information on quality assurance is to be drawn up based on the table included in the EIR containing the focus and steps of quality assurance, and needs to be supplemented with the information mentioned above. The focus of quality assurance and the requirements need to specify both the points that are reviewed in the scope of clash detection and the criteria deployed for checking compliance with the EIR and the BEP requirements. These have been compiled in the model EIR (and the framework document on EIR) in the chapters "Clash detection" and "Checking for compliance with the EIR and BEP requirements". The table for specifying quality assurance is shown as an example in the lower table.

7.2 Review and clearance by the contracting entity

The section specifies the most important information for quality assurance by the contracting entity.

Table 15: The contracting entity's specification of quality assurance

| Contractor's BIM role | Quality assurance focus/ Characteristic | Details of requirement | Method/Tool | Frequency |
|--------------------------|--|------------------------|-------------|-----------|
| | | | | |

Pleace note: The table with the most important information on the topic of quality assurance needs to be drawn up in a similar way by both the ontracting entity and the contractor, namely based on the table from the EIR, and needs to be supplemented with the information mentioned above (quality criteria, frequency and time for conducting the review process, methods and software). Reference can be made here to additional relevant information, such as the existence of a quality manual. 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.

8. Model structure and model contents

In general, the specifications from the EIR on the model structure and the model contents – naming, classification, composition and structuring of the digital models – need to be observed. Any other requirements and coordinated agreements with the other project stakeholders need to be documented in the following sections.

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. If there are no general specification for modelling (e.g. in the form of a modelling guideline), further information on structuring the digital deliverables must be provided fully in the EIR. If deviations from the modelling specifications are to be expected, these need to be described clearly and justified here.

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. If the contracting entity expects the contractor to submit proposals of its own, this must be made clear in the invitation to tender.

8.1 Modelling principles

The modelling principles specified in the EIR can generally be implemented using the modelling tools. The following modelling requirements from the EIR need to be complied with:

Table 16: Modelling principles

Modelling principles

If adaptations become necessary in the course of creating a model, a pertinent proposal must be submitted for coordination. The coordination and agreements will then be described and documented in the BEP updates.

Please note: 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. The contracting entity needs to specify general modelling guidelines in the EIR (see examples in the framework document on EIR). If the contractor sees a need for adaptation, the information is to be documented in the BEP updates. In general, the contracting entity should not define too many restrictive modelling rules in the EIR. The contractor must be able to create the models in accordance with the specifications included in the EIR.

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 chapter on the level of information need.

8.2 Level of information need

Please note: The contracting entity should develop general specifications for the structure of digital deliverables. 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.

8.2.1 Project and model structure

The basic project and model structure will be defined by the contracting entity in the EIR. If the contractor has proposals for the model structure, these need to be documented here and approved by the contracting entity.

The following BIM models are part of the BIM process:

Table 17: Compilation of superordinate model types

| Responsible person/ Discipline | Model type | Use case | | |
|---|------------------|-----------|--|--|
| | | | | |
| able 18: Compilation of specialist and sub-models | | | | |
| Responsible person/ Discipline | Specialist model | Sub-model | | |

Please note: 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. 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 submodels of the federal trunk roads sector (e.g. traffic facility specialist model – alignment or surfacing sub-models or the civil engineering specialist model – bridge or retaining walls sub-models). For more information on model structure, see the framework documents on specialist models and 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 19: Project structure with classification

Project and model structure

Classification (e.g. IFC class)

Please note: The project and model structure will be defined by the contracting entity in the EIR. 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.

Currently, the IFC schema with the hierarchy IfcProject, IfcBuilding and optional

8.2.2 Information need

The Level of Information Need (LOIN) is implemented according to the specifications defined in the EIR. Because of their quantity, a detailed list 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. If additional attributes or adaptations of existing requirements for the level of information need are required by the contractor, this information needs to be documented accordingly.

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 (see breakdown of the deliverables using a bridge as an example in the framework document on EIR). 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.

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 will be 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.

For further information on the level of information need and the LOIN annex, see the framework document on EIR.

8.2.3 Classification

Different classification systems can be used to classify an object. The following classification(s) as agreed with the contracting entity need(s) to be implemented in the project.

Table 20: Compilation of classification systems

| Classification system | Description and application | Models/objects |
|--|--|---|
| | | |
| Please note: The condevelop general specification of more specifications usual. The contractor may an appropriate class elements to satisfy the specification of specifications are specifications to satisfy the specification of the specifica | ntracting entity should cifications for the del elements. These ly apply across projects. v be asked to propose sification for the model the use cases. 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 classification is finalized and contractually agreed in the BEP. |
| | | |

8.2.4 Nomenclature

The naming of the models and plans needs to be based on the coding rules as specified by the contracting entity. The coding must be strictly adhered to by the project stakeholders.

the models and plans in accordance with the requirements in the EIR:

The following nomenclature is suggested for

Table 21: Nomenclature for plan and model coding

| Nomenclature | Potential characteristic | Explanation |
|--------------|--------------------------|-------------|
| | | |

Please note: 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 nomenclature includes all file types, both models and a range of documentation, and needs to be coordinated with the common data environment.

The contracting entity names the digital deliverables according to geographical and technical criteria to facilitate a clear spatial and technical classification. The scheme drawn up in the EIR is implemented in the BEP. If deviations from the regulations in the EIR are necessary, these need to be explained here in the BEP. If the contracting entity does not specify a general nomenclature for files, the contractor shall propose a file naming convention. The nomenclature must be uniform, unambiguous and plausible for users. The basis for formulating model coding should be as interdisciplinary as possible. Where possible, one example should be named in addition to the general form of coding.

8.3 Coordinate system

The coordinate system, elevation system and project origin to be used, which has been agreed with the contracting entity for all project stakeholders and models, contain the following specifications:

Table 22: Coordinate system 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 | у.ууу | Z.ZZZ |

Please note: Information on the coordinate system or systems is part of the general requirements. It is also important to ensure that a common coordinate system is used by multiple models and that the models are combined. Special information is needed for this, which depends on the model authoring tools, coordinating tools and the size of the project. It may also be expedient to develop a local coordinate system. 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 check 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 23: List of units

Model unitUnit (name)Unit (symbol)Please note: A list of units can be specified by
the contracting entity in the EIR. Additional
units necessary are to be defined in the BEP.
If the units are compiled in the model EIR
in the form of a generic list, they need to besupplemented 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

This section specifies in detail the BIM technologies the contractor uses to implement the deliverables required in the EIR.

9.1 Common data environment

The following common data environment will be provided with the boundary conditions and specifications outlined in the EIR.

Table 24: Information on the common data environment

Common data environment

| Person responsible for provision | |
|----------------------------------|--|
| Description and specifications | |

Please note: In general, it is recommended that the contracting entity provide the common data environment, as not every contractor can offer one. The contractor may, however, offer a common data environment, including instructions and information, if the contracting entity does not specify them in the EIR.

Important aspects are:

- Access rights
- Workflow management
- Contact persons of the parties involved in the project
- Data security and proof of conformity with the General Data Protection Regulation

Backup system

- Permission and role assignment within the common data environment analogous to the specification in Section 5
- Versioning with structure and storage
- Notification when data is created or modified
- Status of model processing to describe progress

More detailed information on this topic can be found in the framework document entitled "Data Management".

9.2 Software tools and licences

The following section of the BEP explains the software products that need to be used to process the use cases, including the interaction between them. Due to the use cases, this goes beyond the use of pure model authoring tools and coordination tools.

Please note: It is recommended to categorize the software tools by use case/intended use and/or depending on the version of the tool. Information on the software needs to be provided in the bid and updated in the course of the project. If additional types of BIM software are to be used (e.g. tender, award and invoicing software, simulation software), more subchapters need to be added and pertinent information be recorded in tables similar to the ones described in chapters 9.2.1 and 9.2.2. More detailed information on this topic can be found in the implementation recommendation entitled "Software".

9.2.1 BIM planning software

The following BIM planning software will be used in the scope of the project:

Table 25: Compilation of the BIM planning software to be used

| Software | Version | Intended use/use case |
|--|--|--|
| | | |
| | | |
| Please note: It is im the software to be u provides the functi | portant to ensure that used fulfils the criteria and onalities defined in the EIR. | More detailed information on this topic can be found in the implementation recommendation entitled "Software". |
| | | |
| 9.2.2 BIM visualiza | ation and review software | |
| Γhe following BIM vi software is to be used | sualization and review l in the scope of the project: | |
| Table 26: Compilation of the | BIM visualization and review software | |
| Software | Version | Intended use/use case |
| | | |
| | | |
| | | |

9.3 Data exchange formats

Before the model is delivered, the required original and delivery formats should be specified in the form of a table.

Table 27: 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. The list contained in the EIR may be supplemented in consultation with the contracting entity and, upon documentation, in the BEP.

A uniform, open transfer format should generally be aimed for to simplify the contracting entity's data management processes. In most cases, open transfer formats use a fixed sequence and structure with regard to model element types and semantic information, or provide a reference to an external classification of model element types. If the transfer format and/or hierarchy and structure has not already been defined in the EIR, these need to be proposed here and expanded upon by the contractor and described in the form of a table or a text. 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 manufacturerspecific 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.

9.4 Specifications for the test

run

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-up phase:

Table 28: List of the 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 required test cases are described in more detail in the tables below.

Table 29: Detailed information on individual test cases

| Test case | |
|-----------------------|--|
| Objective | |
| Scope/processing step | |
| Time period | |
| Miscellaneous | |

Please note: The timing and deadline for completion of the test runs must be defined in the EIR or BEP. If this information is not contained in the EIR, it needs to be supplemented accordingly in the 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 projectspecific 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. Minimum requirements need to be defined and described for a project template. The quality of the results of the test runs needs to be documented by the contractor and coordinated with 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.

Annex

A. LOIN annex

Please note: The LOIN documents will be attached to the BEP as an annex.

B. Additional annexes

Please note: Additional annexes may be attached as part of the BEP such as BIM process diagrams.

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