

Nordic perspective on

BIM



Yearbook 2024

Nordic Road & Rail BIM Collaboration



NyeVeier



Statens vegvesen

BANE NOR



Väylävirasto
Trafikledsverket



Vejdirektoratet
DANISH ROAD DIRECTORATE

BANEDANMARK



TRAFIKVERKET

Foreword

Welcome to NBC's (Nordic Road and Rail BIM Collaboration) annual review, a comprehensive report that explores the latest trends and directions in Building Information Modelling (BIM) for infrastructure. NBC is a BIM collaboration between Nordic public infrastructure owners.

The infrastructure industry has been and is undergoing a significant digital transformation. As new opportunities for efficiency through digitalization continue to emerge, it becomes increasingly important for us to understand how to collaborate digitally across different project parties and throughout the infrastructure lifecycle.

BIM is an internationally recognized approach that addresses this digitalization. It organizes information during the delivery of investments and the management of assets, as defined in EN ISO 19650.

The digitization according to BIM involves improved management of structured, lifecycle-oriented data and information through infrastructure projects and asset management. This is based on open standards and model-based work processes. It provides a reliable foundation for decision making in our business processes, driving the digitalization of our industry.

In this annual review, we delve into these topics, and take a look at what the future may hold for BIM in the Nordic infrastructure industry. We hope you find it informative and inspiring.

2024-12-20

Workgroup: Susanne van Raalte (editor), Kristin Lysebo, Marion Schenkwein, Johan Zacharias Egholm and Iris Matteoni

Summary

NBC is a BIM collaboration for the Nordic Rail and Road authorities that has been active for about 10 years. The members share the same market and challenges and through sharing of knowledge and experiences they strive towards the same approach to BIM that will give the market the possibility to plan for the long term.

The purpose for this yearbook is to give an overall status of central BIM topics for the four Nordic countries and seven organizations that make up the NBC. The yearbook is both for internal use in NBC, and for the overall market as consultants, contractors and software vendors. We have a goal to update the yearbook each year.

Through a yearly communication the Nordic Rail and Road authorities will share developments that are essential, such as the implementation of IFC 4.3, influence and promote initiatives to try and recommend important communities, such as buildingSMART International.

NBC aim to meet four times a year with a mixture of physical and digital meetings. We also set down workgroups when cooperation on specific topics. In 2024 a workgroup with representatives for each country has worked on this yearbook.

The yearbook will give each organisations status and activities for each country and organization. A summary on this is given as a table in the yearbook in addition to a more detailed status and description on ongoing processes in each organization.

Future works and tendencies show that each organization has ongoing processes on IFC 4.3 for infrastructure, are involved in openBIM workflow, is strengthening BIM competence in their organization, focusing on improving data quality and security.

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Nordic Collaboration for BIM in Road & Rail

Nordic Road & Rail BIM Collaboration

Background to NBC

For over a decade, the Nordic countries have been implementing Building Information Modelling (BIM) in both the public and private sectors. BIM facilitates open communication, cost savings, and efficient construction projects by addressing challenges related to project communication across different phases.

The Nordic Road and Rail BIM Collaboration group (NBC) are made up of the road and rail public owners in the Nordic countries; Sweden, Denmark, Finland and Norway in total of seven organizations. NBC have been actively promoting BIM adoption and standardization throughout the region with a Nordic baseline for BIM, and the need and potential for a common Nordic standard for BIM. The focus has also been on improving information requirements and BIM data utilization throughout the lifecycle.

The members of NBC signed a Memorandum of Understanding in 2017 and are now working on an updated version of its Charter. We share information on projects and processes among the organisations and have a goal to meet four times a year. An overall goal is also to cooperate where we can and share openly results for projects and processes. The chair position is on a rotating bases between the countries and organizations. We aim to have a common approach to BIM and to be predictable for the market and our suppliers.



A common Nordic baseline for BIM is crucial to ensure consistent use of BIM tools and standards across the countries. Standards serve as a key driver for competency development and BIM process enhancement. To achieve high-quality information requirements and data utilization, standards need to be complemented with specifications that support various use cases. Increasing awareness and understanding of these standards among all stakeholders in the construction industry is equally important. ISO 19650 certification can play a positive role in promoting BIM competency and standard adoption. In the coming years, the focus will be on realizing all the potential benefits of BIM and integrating it as part of the digital twin throughout the building lifecycle.

The year of NBC 2024

The goal of the NBC is to meet at least three times a year. This was achieved by meetings in Copenhagen in March, Stockholm in June, and Oslo/Online in November.

The participants in the NBC are the public rail and road clients in the Nordic countries Sweden, Denmark, Norway and Finland.

Finland	Väylävirasto	Finnish Transport Infrastructure Agency
Norway	Bane NOR	Norwegian Rail Authority
	Statens vegvesen	Norwegian Public Road Authority
	Nye Veier	Norwegian Road Authority
Denmark	Banedanmark	Danish Rail Authority
	Vejdirektoratet	Danish Road Directorate
Sweden	Trafikverket	Swedish Transport Administration

Activities & discussions

A focus during the year 2024 has been the creation and completion of the first Yearbook of NBC, the result of which is before you. Another important activity has been to develop and establish a charter for the NBC. This was finished during November of 2024.

The NBC aims to host workshops when there is a need. This year, there has been one workshop where ISO 19650, AIM/CDE in Nye Veier and CDE at FTIA were presented and discussed within the NBC. There has also been a workshop and information meeting held by Norway on their projects KIM and KIM (requirements for information modelling) and approval project BIM/FDV (standardizing model-based delivery to maintenance).

Central happenings during the year

At the international level, the most significant milestone of the year was in April 2024 as IFC 4.3 was formally approved and published as an international standard by the International Organization for Standardization (ISO) ([read more](#)).

IFC 4.3 is a result of a series of development projects that aimed to advance the use of Industry Foundation Classes (IFC) by extending its utility to encompass horizontal assets, such as roads, railways, and associated infrastructure spread across landscapes.

Another noteworthy event was in June 2024 as the bSI Information Delivery Specification (IDS) v1.0 reached final standard status ([read more](#)). The definition of [OpenBIM Workflow](#) has also been refined and related services further developed.

Contact

Väylävirasto:, Tarmo Savolainen

Bane NOR: Kristin Lysebo, **Statens vegvesen:** Alen Begic, **Nye Veier:** Emil Hagen,

Banedanmark: Stine Krogh Dahlstrup, **Vejdirektoratet:** Johan Zacharias Egholm,

Trafikverket: Ingemar Lewén



NBC meeting, Copenhagen 2024: From left: Johan Zacharias Egholm, Rasmus Lyng Fuglsang, Joakim Fenigsen Lockert, Karin Anderson, Kristin Lysebo, Jenna Ikonen and Eivind Pagander Tysnes, Bottom row: Iris Matteoni and Susanne van Raalte



Status of BIM at Nordic Road & Rail Clients

In this chapter, the BIM status of the NBC member organisations is reviewed from the perspective of BIM related standards, processes and other related topics.

In order to facilitate an overview, a table has been drawn up to indicate the status of the member organisations with regard to the topic or standard in question. The table is not exhaustive but brings together the most interesting and topical issues from the perspective of the member organisations.

There are ongoing developments and initiatives outside the list presented in this documentation. The table is intended to provide information not only on the active measures under way, but also on topics where no action has yet been taken but where progress is being monitored.

Each member organisation has also provided a comprehensive overview of the issues examined. These reviews follow the structure of the status table and report in more detail on the status of each theme and any further plans, as well as on participation in international developments or standardisation. This allows the reader to form a complete picture and to compare the current status of capabilities and activities of different organisations. In the "Future work" section, each organisation also highlights their plans and priorities for their short- and medium-term BIM development.

Nordic BIM overview

I = Implemented, D = in Development, N = Not at this point

Active work & Followed standards	Väylävirasto	Bane NOR	Statens vegvesen	Nye Veier	Vejdirektoratet	Banedanmark	Trafikverket
ISO 19650 (BIM)							
OIR (Organizational Information Requirements) / BIM Strategy	D	D	N	D	I	D	D
PIR (Project Information Requirements)	D	D	N	D	I	I	D
AIR (Asset Information Requirements)	D	D	N	D	I	D	D
EIR (Exchange Information Requirements)	D	D	N	D	I	I	D
PIM (Project Information Model)	D	D	N	I	I	I	D
AIM / BIM in maintenance (Asset Information Model)	D	D	N	I	D	N	D
CDE (Common Data Environment) (incl. BIM viewer)	I	D	N	I	I	D	I
openBIM workflow (bSI)							
IFC 4.3 (ISO 16739 - Industry Foundation Classes)	D	I	N	D	D	D	I
IDS (Information Delivery Specification)	D	D	N	N	N	N	D
MVD (Model View Definition)	N	N	N	N	N	N	N
BCF (BIM Collaboration Format)	D	D	N	N	N	N	D
IDM (Information Delivery Manual)	N	N	N	N	N	N	N
Service: UCM (Use Case Management)	N	N	N	N	N	N	D
Service: bSDD (buildingSMART Data Dictionary)	D	N	N	N	N	N	N
Service: IFC Validation Service	N	N	N	N	N	N	D
Service: Professional Certification	N	N	N	N	N	N	N
Service: openAPI (openCDE)	N	N	N	N	N	N	N
Related Topics							
Level of Information Need (ISO 7817)	N	D	N	D	N	N	N
LOD (Level of Development/Detail)	N	N	N	N	I	I	N
LOG (Level of Geometry)	N	D	N	N	N	I	N
LOI (level of Information)	N	D	N	N	N	D	D
MMI (Maturity Model Index / Status)	N	I	N	I	N	N	N
Object Type Library (OTL)	I	I	D	D	I	N	D
Requirement Database (other than bSDD)	N	D	D	D	N	N	D
Model Uses (defined)	N	N	N	N	I	I	I
Maturity Model	I	N	N	N	N	N	D
BIM-GIS Integration	N	D	N	D	I	D	D
Digital Twin	D	N	D	D	N	N	I
Classification ISO 12006-2	N	N	N	D	D	D	D
Classification ISO/IEC 81346	N	D	N	I	D	D	D
BIM LCA	N	N	N	D	I	D	N
BIM AI	D	N	N	D	N	N	N

FINLAND

The Finnish Transport Infrastructure Agency (Finnish: Väylävirasto, Swedish: Trafikledsverket), shortened to FTIA, is responsible for carrying out national road, railway and waterway projects. Infrastructure investments improve the functionality, safety, environmental friendliness and efficiency of the transport network. With permanent personell of approximately 490 and indirectly contracting 18.000 people FTIA is the largest client organisation in Finland.

www.vayla.fi

Väylävirasto

The Finnish Transport Infrastructure Agency (FTIA) has required a BIM-based project delivery since 2014. Currently the requirements for the hand over material are based on the use of open data formats such as IFC, LandXML (in it's Finnish extension [Inframodel](#)).

InfraBIM classification and national as well as FTIA's guidelines. FTIA has released guidelines for roads, railways, waterways as well as bridges and engineering structures.

A key principle for FTIA is to continue to rely strongly on international standardisation work. With this in mind, FTIA is exploring opportunities to link concepts such as IDM, IDS, bSDD, etc. to project delivery, maintenance systems and asset management.

ISO 19650

OIR (Organizational Information Requirements) / BIM Strategi

In 2020, FTIA has published a policy paper on infrastructure BIM, recommending short and long-term measures. In 2020, the FTIA has published a policy paper on infrastructural modelling, recommending short and long-term measures.

The guiding principle for FTIA is that every project should be carried out using BIM and open data exchange standards.

PIR (Project Information Requirements)

FTIA has general requirements for the use of BIM in infrastructure projects. The core elements of the requirements remain the same for all projects but some of the requirements are project specific.

AIR (Asset Information Requirements)

FTIA has an ongoing development project to explore the use of bSDD (buildingSMART Data Dictionary) in combination with BIM in asset information requirements. The work takes into account aspects of maintenance, information management as well as construction and design.

EIR (Exchange Information Requirements)

The exchange information requirements are to some extent described in [the infrastructure BIM requirements of FTIA](#). However, they do not take a definitive position on for example the information production methods and procedures.

PIM (Project Information Model)

PIM for FTIA is formed in Projektivelho, FTIA's design and as-built data repository. The information it contains serves as a source for numerous services and analytical tools such as Suomen Väylät (Finnish Fairways).

AIM / BIM in maintenance (Asset Information Model)

Instead of a single AIM, FTIA maintains a number of fairway-specific AIMS. However, these do not currently include 3D geometries of the assets. The medium-term goal is to automate the transfer of data, including 3D models, to asset management systems.

CDE (Common Data Environment) (incl. BIM viewer)

All FTIA projects from Q2/2024 onwards are processed in our CDE solution, Project Portal, based on the BIM Project Management platform. A BIM tool based on the Vektor.io service is integrated into the Project Portal to visualise BIM data.

The CDE solution is used in all project phases and harmonises practices and enables a unified management of data, access rights and roles, and includes features such as file comparison and sharing of tendering files.

openBIM workflow

IFC 4.3 (ISO 16739 - Industry Foundation Classes)

FTIA has not yet implemented IFC 4.3 but it is planned to do so in 2025. During the transition period, the Finnish Inframodel XML and .dwg will be allowed as delivery formats alongside IFC.

IDS (Information Delivery Specification)

IDS is essential for the implementation of bSDD and is being studied in the ongoing bSDD project.

buildingSMART Services

UCS is not formally implemented. However, general use cases are described in the InfraBIM requirements of FTIA.

The possible implementation of the bSDD has been studied from 2021 onwards. POCs for bSDD are conducted in 2024, after which a decision on deployment will be taken. FTIA has published three libraries: rod, rail, and bridge. Also, a Finnish InfraBIM classification is published under FTIA's domain.

FTA's bSDD can be accessed here:

[FTIA Bridge](#) [FTIA Rail](#) [FTIA Road](#) [InfraBIM Classification](#)

Related topics

Level of Information Need

The infrastructure BIM requirements of FTIA are not aligned to a named LOD/LOG/LOI standard or framework. The level of information for geometrical and non-geometrical content is defined both in FTIA's requirements for the BIM delivery of road- rail- and waterway projects and at a more general level in the national InfraBIM requirements (YIV). FTIA's requirements include all project phases from preliminary design to as-built models.

LOD (Level of development/detail)

[FTIA's requirements for LOD](#) - described as a part of our general BIM requirements

LOG (Level of geometry)

[FTIA's requirements for LOG](#) are described as a part of our general BIM requirements

LOI (Level of information)

[FTIA's requirements for LOI](#) are described as a part of our general BIM requirements

Maturity Model Index (MMI)

FTIA has not implemented MMI.

Object Type Library (OTL)

FTIA has set up an 3D-object library for railway objects such as signalling, turnouts and catenary system components. The library has been in use since 2020 and contains over 600 individual objects now. As the objects are made available as 3D dwg, the possibilities of including rich metadata are limited. However, with the transition to IFC in close future, the possibilities of carrying more relevant metadata with the objects expand significantly. The library will be extended and updated from Q4 / 2024 onwards.

[The FTIA Rail OTL](#)

Requirement DB (other than bSDD)

FTIA has not implemented a specific requirement DB - please see Open BIM Workflow / bSDD.

Model Uses (defined)

FTIA has not implemented a standard description for Model Uses.

Maturity Model

The Nordic Maturity Model is in use after being slightly modified to better suit the use as an evaluation tool for FTIA projects. Interviews that use the MM as a discussion and evaluation basis are carried out every two to three years. The evaluation covers all types of fairways and project phases, from preliminary design to construction. Based on these analysis, future development measures to improve the BIM maturity of projects and processes can be targeted in the most effective way.

BIM-GIS Integration

BIM and GIS integration is not a high priority for FTIA at the moment, but it is being followed up.

Digital Twin

The potential and targeting of the digital twin from an FTIA perspective has been extensively studied. The scope and tasks required for the development of the Digital Twin have been identified and work is continuing. FTIA is participating in the buildingSMART International Digital Twin Working Group

Further work in Finland

Information management is at the heart of FTIA's activities and the quality of information is therefore crucial. Whether it is our ambition to create a digital twin for the corridor network, our desire to improve the quality of the information produced in planning, or our aim for efficient maintenance, it is essential that the information produced is harmonised, consistent and verified. Our view is that to achieve this, we need to make extensive use of modern processes and technologies and rely on international standards such as IFC 4.3.

NORWAY

Norway has three organization in NBC. **Bane NOR** is responsible for operating, maintaining and building the railways as well as the infrastructure on the railway throughout the country. **Norwegian Public Roads Administration** (NPRA) is responsible for building, operating and maintaining national and European roads in Norway. **Nye Veier** is a transformative force in Norwegian transportation. Our mandate is to plan, construct, and operate the roads within our portfolio. Established by the Ministry of Transport, our mission is to deliver more road infrastructure for the money while enhancing the socio-economic profitability of all our projects. We strive to be the most efficient organisation in the planning, construction, and operation of transportation infrastructure.

www.banenor.no | www.vegvesen.no | www.nyeveier.no

Bane NOR

ISO 19650

OIR (Organizational Information Requirements) / BIM Strategi

Bane NOR approved our first BIM strategy in 2017. The last two years we have worked on project KIM which is Requirements for Information Modelling. Our goal is to systemize all requirement for all disciplines, all object for all plan phases in on requirement database. The first version was released July 1st 2024.

[Project KIM](#)

PIR (Project Information Requirements)

Bane NORs has general requirements for all our new projects, and is in the process of adapting the requirement for all projects. We also have a template for project specific requirements. We are in the process of updating the requirements for all new procurements for projects for both consultants and contractors.

The general BIM requirements is accessible on www.banenor.no/bim

AIR (Asset Information Requirements)

For the last year and a half Bane NOR has had a development project for defining the asset information requirement for the use of BIM. This has been developed in cooperation with our maintenance division.

The first version of this requirements is planned for October / November 2024 and will be available on www.banenor.no/bim. We plan to implement this in our KIM database during Q1 2025.

EIR (Exchange Information Requirements)

From KIM it is possible to extract EIR for specific milestones and more will come as KIM is developed further. Available today is Track, Signalling, Telecommunications, OCS, Electrical systems for early design phase, detailed design phase, procurement and construction.

PIM (Project Information Model)

Bane NOR has in April 2024 procured the software Novorender that we are in the process of implementing. Novorender will be our software for PIM when it is operational in January 2025.

AIM / BIM in maintenance (Asset Information Model)

Bane NOR has in April 2024 procured the software Novorender that we are in the process of implementing. Novorender will be our software for AIM when it is operational in January 2025. The first goal in using Novorender as our AIM is to use it as a BIM archive and standardize information flow to and from our maintenance database, Maximo. The next step is to define and standardize the process of updating the models as changes are made to the railway infrastructure. How BIM can support maintenance operations task will be started in a couple of years to align with development processes in our maintenance division.

CDE (Common Data Environment) (incl. BIM viewer)

Novorender together with Omega365 and our maintenance database Maximo will be our CDE for design and build as well as the maintenance phase. All software will be connected to Bane NORs internal integrations platform, Kafka. Contractor and consultants can connect to Novorender by a multitude of API connections.

openBIM workflow

IFC 4.3 (ISO 16739 - Industry Foundation Classes)

Bane NOR has late 2023 implemented IFC 4.3 in our BIM requirements as the main format for delivery of discipline models. Bane NOR is co-chair in Railway Domain in buildingSMART International.

IDS (Information Delivery Specification)

Bane NOR have the possibility to publish the requirements from KIM into IDS. This is still under development since KIM is still undergoing development.

BCF (BIM Collaboration Format)

BCF import and export is a requirement in our new BIM solution, Novorender. A function for model-based case handling is currently being implemented in Novorender and we plan to implement that in all our projects and soon it is completed. The use of BCF is part of our standard BIM requirement.

buildingSMART Services

UCM (Use Case Management). We do not have any plans to implement this at the time being.

bSDD (buildingSMART Data Dictionary) Bane NOR has a plan to convert KIM (Requirements for information modelling) to bSDD with the release of version 2.0.0. The most likely scenario is 2026.

Related topics

Level of Information Need

In developing our requirements for information modelling (KIM) we have read the ISO standard but have not implemented it completely.

LOD (Level of Development/Detail) Bane NOR has a written description of our requirements for Level of Detail. The requirements are a part of our general BIM requirements on www.banenor.no/bim

LOG (Level of Geometry) Bane NOR has a written description of our requirements for Level of Geometry. The requirements are a part of our general BIM requirements on www.banenor.no/bim

LOI (level of Information) Bane NOR has a requirement database for all information requirements, www.banenor.no/kim

Maturity Model Index (MMI)

Bane NOR has been an active partner in developing MMI, Model Maturity Index version 2.0 which is now a standard in all our projects. This is a Norwegian standard and is described on www.mmi-veiledere.no

Object Type Library (OTL)

Bane NOR has a generic object type library based on AutoCADs DWG format. There is an idea to update the OTL but the plans are not fixed. Our OTL is accessible here: <https://proing.banenor.no/wiki/objektbibliotek/start>

Requirement Database (other than bSDD)

Bane NOR has developed our first version of our requirement database, KIM. The first version of KIM was released July 2024 and can be found on: www.banenor.no/kim

Model Uses (defined)

We have not implemented a standard description for Model Uses.

Maturity Model

We have not implemented a standard description for Model Uses.

BIM-GIS Integration

BIM and GIS are organized in the same department in Bane NOR (BIM and geomatics) but we have not gotten the full effect of combining the two disciplines yet. Bane NOR has a GIS system, Banekart which is based on ArcGIS and other ESRI software. Our new PIM/AIM software, Novorender has an API connection to ArcGIS and we will look into further connecting BIM and GIS as soon as the software has been approved and implemented.

Digital Twin

Digital twin is and has been discussed in several parts of our organization but we have not defined what a digital twin is for Bane NOR or made a common plan for implementations.

Classification

Bane NOR has no standard for classification, each system has its own classification. Lately we have started looking into RDS (Reference Designation System) based on the work Nye Veier has done with this. RDS may be our solution to classification for our many software systems and we will continue the work I 2025

Statens vegvesen

ISO 19650

The Norwegian Public Roads Administration does not require the use of ISO 19650. However, both internal and external resources may choose to apply this standard in their projects if it helps to meet the requirements for outcomes and deliverables specified in the project order

openBIM workflow

The Norwegian Public Roads Administration does not require the use of buildingSMART International's Open BIM Workflow in our road projects. As a public authority, we set requirements for outcomes and deliverables, but not for the specific methods or processes to be used. By avoiding such requirements, we encourage innovation within the industry and avoid limiting ourselves to specific solutions that may hinder development.

However, this does not mean that Open BIM Workflow cannot be used. Both internal and external resources can choose to apply this workflow in their projects if it contributes to achieving the defined deliverables.

For internal resources in the Norwegian Public Roads Administration's roadprojects: Open BIM Workflow is not part of the Norwegian Public Roads Administration's standard work process. However, certain projects may choose to test this method, but it will apply only to the specific project in question, not as a general practice.

For external resources in the Norwegian Public Roads Administration's roadprojects: If external suppliers wish to use Open BIM Workflow to meet the requirements for outcomes and deliverables, it is up to project management to decide. This is often determined during contract negotiations and will apply only to the specific project, not as a common service.

IFC 4.3 (ISO 16739 - Industry Foundation Classes)

The Norwegian Public Roads Administration requires the use of open file formats. IFC 4.3 is considered such a format and can be used in our road projects for various purposes, such as collaboration.

Related topics

Level of Information Need

The Norwegian Public Roads Administration does not require the use of LOIN (ISO 7817-1:2024). However, both internal and external resources may choose to apply this in their projects if it helps to meet the requirements for outcomes and deliverables specified in the project order.

Maturity Model Index (MMI)

The same comments apply as for the remark under LOIN (ISO 7817-1:2024).

Object Type Library (OTL)

The same comments apply as for the remark under Requirement DB (other than bSDD)

Requirement Database (other than bSDD)

UML models can be used for this, so it can be said that we have begun the process. In R110 and the contract templates, UML models are referenced as the basis for determining which object types need to be delivered. The same applies to the OTL. Essentially, the UML models represent the OTL.

Maturity Model

The Norwegian Public Roads Administration does not set specific requirements for this. However, Handbook R110 does set requirements for progress, stating: "Progress based on completion percentage can be used when attribute data in UML models are defined in a way that supports the calculations."

BIM-GIS Integration

The Norwegian Public Roads Administration does not require the use of BIM. In this regard, we also do not require the integration of BIM and GIS.

Digital Twin

Several development projects are underway within the Norwegian Public Roads Administration to explore the challenges and opportunities related to the use of digital twins. BuildingSMART likely has a different definition of a digital twin, but NVDB is probably the service within the Norwegian Public Roads Administration that most closely aligns with BuildingSMART's definition.

Nye Veier

ISO 19650

Nye Veier has established a new working group within the organization called Information Management. This group primarily consists of BIM, Systematic Completion, and Document Control. These three disciplines have developed a strategy for information management with the aim of ensuring the information management function that Nye Veier is to maintain at both the organizational level and within the projects.

ISO 19650 serves as the foundation for the group's work on information management. Terms, principles, information requirements, CDE, PIM, AIM, and processes are gradually being aligned with the standard. This is to ensure standardized and comprehensive information management. Nye Veier aims to be a clear client and commissioner of information. The work ahead will reflect this goal and ensure unambiguous and comprehensive requirements.

Nye Veier intends to avoid overly detailed requirements regarding information production methods and procedures, allowing the industry to develop and mature at its own pace. This may result in our requirements appearing somewhat simplified, which necessitates clearly describing intentions and expectations. The overall goal is to encourage potential information providers to accelerate their own development, thereby generating more value within our projects.

Our understanding, as it is expressed through the requirements, is that there should be a single source of information. The expected benefits include ease of access and the possibility to establish relations between model, map, and document deliverables. These include some core disciplines like production planning, cost, environmental and health and safety aspects.

There are specific requirements where experience has shown that concrete specifications better serve the intended purpose. These requirements are, among others:

- Naming conventions and classifications based on IEC/ISO 81346.
- Open file formats, preferably *.ifc as of today.
- Terms and definitions aligned with the EN ISO 19650 Standard.
- Processes and activities based on the EN ISO 19650 Standard.
- Third-party deliveries, such as NVDB data, based on Nye Veier's data catalog and object specifications.
- Documentation according to OIR and AIR.

CDE (Common Data Environment) (incl. BIM viewer)

The lead appointed party is responsible during the planning and construction phases of the projects for establishing a CDE that provides the necessary software, APIs, RPAs, and tools to ensure efficient information flow of PIM within the project. The information must ensure status, quality, and deliveries in accordance with the project requirements and ISO 19650. The lead appointed party must ensure that the CDE is integrated with Nye Veier's CDE and compatible with the programs required to enable information delivery to AIM.

The lead appointed party is also responsible for delivering quality-checked and approved as-built data. Additionally, Nye Veier's AIM will perform a final validation of the information deliveries based on the information requirements. This serves as a concluding validation to ensure that everything has been received.

BIM-Viewer: During the construction phase, the lead appointed party must provide an BIM-viewer for PIM. There are several explicit requirements in the contracts regarding the viewer and its functionality. We require the viewer to be capable of displaying model and GIS data together, even though we recognize that solutions must be developed to meet this requirement. Furthermore, there are several other requirements for the viewer, such as the ability to function offline, the capability to stay updated without any action required from the users, and the ability to display cross-sections and longitudinal profiles when necessary.

Nye Veier has its own viewer representing information from AIM. This viewer is a powerful tool designed to show as-built models, documentation, LiDAR scans, drone images, object photos, properties, and much more accessible. It also supports analysis and automatic validation of information deliveries.

There is special focus on deliverables to the Operational Department with regards to format, content, and relationship between different deliverables. The classification is integral to that approach since it is a common identifier across types of information. The Operations Department is also interested in the delivery of LiDAR scans, drone images, and photographs of all objects within the projects. This type of data will facilitate efficient access to information when needed by the maintenance contractors. This is reflected in the information requirements for the projects.

PIM (Project Information Model)

Nye Veier considers all information used to plan, design, and construct projects as information represented in the PIM. This information is made available in the lead appointed party's CDE and is their responsibility to establish, manage, and share. The information should be represented in their viewer and made accessible to all parties involved in the project.

AIM / BIM in maintenance (Asset Information Model)

Nye Veier considers all information delivered from the projects as having a purpose linked to our assets, with increased value during the operation and maintenance phase as AIM. This information is made accessible through Nye Veier's CDE, viewer, digital operational support systems, and Enterprise Asset Management System (EAMS).

openBIM workflow

IFC 4.3 (ISO 16739 - Industry Foundation Classes)

Nye Veier has few requirements for the model and its format, except that the format must be based on an open standard. In most cases, .ifc is delivered, as this format, as of today, has the best prerequisites to cover the information needs of all parties. Apart from this, Nye Veier has requirements for naming and attributes that must be added to the objects. These requirements are described in an annex provided to the lead appointed party as part of the tender documentation.

Models must, in addition, be delivered in the proprietary format of the design tools. This is to ensure that the model can be modified if needed in the future.

The current AIM relies on open format, IFC, as information bearer for model data. In conjunction with the classification, we can access documentation through the model and vice versa. Another point of access is through a national system for road assets (NVDB) where our project specific identificatory can be used to access data delivered in hand over.

Related topics

Level of Information Need

ISO 19650-1 and -2 are requirements in Nye Veier's contracts. It is a prerequisite that the delivery team has good knowledge of the standard. ISO 19650-1 introduces the term Level of information needed (LOIN) in order to define the need for information in the context of information management. There are several ways to

measure LOIN in a project and Nye Veier wants to be open to the solutions the delivery team presents.

Maturity Model Index (MMI)

The lead appointed party is required to assign status to the models. This process should align with systematic completion. MMI is the method predominantly used by the lead appointed party for assigning status to the models, and it works perfectly well for this purpose. Nye Veier contributed to the process by providing input to Norway's MMI Guide 2.0.

Object Type Library (OTL)

Nye Veier have requirements for classification according to NEK IEC 81346-1, -2 and ISO 81346-12, which also describe standardized naming convention, in relation to the classification. This is possibly the closest requirement seen in context of Object Type Library (OTL).

Nye Veier have previously had a requirement that the breakdown of objects must be in accordance with Statens vegvesen handbook V770, Brutus and NVDB. This means that structure and definitions of objects was done in accordance with this breakdown. The delivery team must also deliver information to NVDB and Brutus's systems and in that context must do so in accordance with the requirements set for naming, properties and object breakdown.

Requirement Database (other than bSDD)

Nye Veier is in the process of defining all information needs, at organizational level and at project level, we will further define the information requirements. This is work that must mature over time to ensure that we get the information we need. In the long term, it may be relevant to implement some form of information requirements database.

Model Uses

Nye Veier's projects are model-based. Drawings shall only be made as a supplement to the model in cases where the need dictates it. This could, for example, be for a third party who is not mature enough to receive models. This must be revealed when the information needs are described in the early phase of the project.

It has been proven that working model-based contributes to efficiency, cost savings and has a risk-reducing effect.

Models are used in the construction phase (PIM) and are later used to describe as-built, before it's implemented in Nye Veier's AIM and as part of the Enterprise Management system (EAMS). The models will be implemented and made available

in a viewer and a dashboard. The models will also act as a supplement to the information used by the operating contractor in his work with inspections and maintenance.

Models must be object-based. Properties, identification, classification and maturity must be linked to the object and not just inside the model file. Nye Veier wants, in the long term, that geometry is related to an object register that contains all relevant information. This should make it possible to change properties without having to open the model after the geometry has been locked.

Maturity Model

Nye Veier has previously demanded that the delivery team strive for BIM Level 3, described in "UK Government Construction Client Group - BIM Working Party Strategy paper", March 2011, pages 16-17.

Today, Nye Veier demands ISO 19650 in its projects. The standard itself must contribute with processes that will ensure that one reaches "BIM Level 3" through its own stages of maturity.

Digital Twin

Until "Digital Twin" becomes a standardized term, Nye Veier refers to what we call digital representations.

The Operations and Maintenance Department at Nye Veier views data from AIM in conjunction with data from IoT, sensors, and the maintenance contractor.

Sensor data and IoT-data contribute to better decision-making. For example, Nye Veier has "dirt-sensors" in tunnels that provide an indication of how dirty they are and when they need to be cleaned. This means we no longer wash based on manuals but reactively. Through the digital operational support system, we aim to ensure even better decision-making based on data and work predictively — staying ahead of maintenance needs. Well-structured data, made accessible through robust systems, will enable Nye Veier to work towards eventually having digital twins.

Further work in Norway

The three public infrastructure owners in Norway have their own plans for developing BIM in their organization, but we also have a very close and active BIM cooperation. We meet up for six workshops a year. The overall goal is to share information on ongoing processes in our organization and to decide on what standardization we will support and cooperate on.

Some ongoing topics are:

- contract templates for turn-key contracts
- new version on BIM report for barriers and challenges for BIM in Norway across the Norwegian market
- discussion on how the new Norwegian strategy for digitalisation will influence us as infrastructure public owners
- Discussing common innovation initiatives, e.g., AI
- Participating in buildingSMART

We also have a quarterly information meeting with the organizations for consultants and contractors where we share information and discuss areas for cooperation. The last topic we actively cooperated on is information requirements between consultants, contractors and public owners.

DENMARK

Vejdirektoratet oversees the planning, construction, operation, and maintenance of Denmark's national road network. Vejdirektoratet works collaboratively to ensure balanced, innovative, and high-quality road projects that ensure the safe and effective connection of people and goods.

Banedanmark is responsible for the Danish public owned rail network. We keep the trains on track 24 hours a day, all year round. We make sure the tracks, signals and safety systems are properly maintained, renovate the network and build new lines. We monitor rail traffic and steer trains in and out of stations and across the entire rail network.

Vejdirektoratet & Banedanmark

Guided by the Infrastructure Agreement 2035, both organizations are committed to providing Vejdirektoratet and Banedanmark contribute to developing digital standards and innovations, ensuring Denmark's infrastructure remains modern, interoperable, and competitive.

Both organisations have implemented BIM workflows, national standards and practices have been implemented to support projects. While international standards like ISO 19650 have not been formally adopted, many of its practices already align with ISO 19650 principles. Tools and processes are in place but remain at a lesser maturity stage, with ongoing efforts to refine and further align them.

ISO 19650

OIR (Organizational Information Requirements) / BIM Strategy

Vejdirektoratet has developed a comprehensive BIM Strategy has been developed to streamline processes and meet the information needs of all infrastructure projects, aiming to achieve BIM Level 3 compliance in line with leadership's vision. The organisation recognises the need for further standardisation, particularly in adopting OpenBIM and ISO 19650 practices.

Banedanmark are focusing on having a more "standard" projects. e.g. for better basis of comparison across projects, when it comes to prices and quantities, and a more automated process for data to asset management. This requires much more standardised PIR, EIR and model uses. The implementation and use of this across all sizes of projects is the current focus. Banedanmark is working on developing better links of data between tools and parties, and what the requirements need to be to make the link work.

PIR (Project Information Requirements)

PIRs are included in tender document templates, such as service and work descriptions, tailored to align with contract type, scope, and specific project requirements

AIR (Asset Information Requirements)

Handover information is defined in the service and work descriptions, as well as in the EIR, to align with project delivery requirements.

EIR (Exchange Information Requirements)

Vejdirektoratet and Banedanmark use ICT-specifications in projects to clearly communicate EIR, the structure of which is based on the Description of Services adopted in Denmark's industry ([Frinet Publications](#)). These EIR are tailored to meet project-specific needs and are included in all contracts, clearly defining requirements for the appointing party's CDE, shared resources, and information standards (digitalvej.vejdirektoratet.dk) ([CAD | Banedanmark](#)). Vejdirektoratets EIR is available in the following link: [IKT-Specifikationer](#).

PIM (Project Information Model)

Vejdirektoratet categorizes projects into smaller and larger ones, and its PIM framework helps align internal roles and responsibilities with each project's scope. Each project is assigned a dedicated BIM manager to ensure that the PIM is developed in accordance with the EIR. This approach streamlines workflows, standardizes information, and supports collaboration.

Banedanmark adapts its PIM framework to the project size, complexity, and the number of interfacing projects. Most projects are assigned an ICT manager to ensure the PIM is developed in accordance with the EIR and to coordinate the PIM of interfacing projects. This approach streamlines workflows, standardizes information, and supports effective collaboration.

AIM / BIM in maintenance (Asset Information Model)

Discipline models developed during the PIM phase are converted into geospatial systems, forming the foundation of both organisation's respective AIMS. Upon project completion, all data, including drawings, and documents, is archived in asset management systems. This ensures updated information is available for ongoing management and maintenance.

CDE (Common Data Environment) (incl. BIM viewer)

Vejdirektoratet manages and delivers all projects, regardless of size, through its Common Data Environment (CDE) powered by Bentley ProjectWise. This platform supports all project phases, from initial planning to final construction documentation. During the design stage, the federated model is visualized using iModel, providing an integrated view of project data. During construction, Synchro Control is used as both a viewer and a management tool for Request for

Information (RFI) and all project communications, ensuring seamless workflows and consistent data management throughout the project lifecycle.

Banedanmark manages general project documentation through SharePoint Online, while Bentley ProjectWise is used to handle all CAD data in projects involving 3D production. For third-party projects delivering 3D models, these files are also stored in ProjectWise to coordinate with Neighboring and Interfacing Projects (NIP).

openBIM workflow

OpenBIM workflows are still under development. Both organisations actively monitor developments and plan to adopt OpenBIM practices as workflow maturity and systems evolve. Participation in buildingSMART Denmark's OpenBIM collaboration domains supports the integration of OpenBIM standards throughout the industry.

IFC 4.3 (ISO 16739 - Industry Foundation Classes)

Vejdirektoratet is conducting a pilot project to convert openRoad files (.dgn) into IFC 4.3 using utilizing custom scripts. The project focuses on extracting quantities directly from IFC models, providing valuable insights into their practical applications within infrastructure projects.

Banedanmark is working on a project to import discipline models into Speckle, where it is possible to add more properties to the data, and export the data in different data structures and file formats such as IFC 4.3 and .ifc. This project also works with the linking the data to Asset Management System and Life Cycle Analysis.

Related topics

Level of Information Need

Both organisations have adopted the LOD DK standard from DiKon (www.dikon.info), tailoring it to meet specific needs. Additional requirements and information needs have been incorporated, with digital requirements available through the respective organisation's information standards.

OTL (Object Type Library)

Following appointment, Vejdirektoratet provides access to shared CAD resources through the appointing party's CDE. Layer libraries are under development, including property sets that describe objects and can be used as attributes in GIS systems.

Model Uses

In Denmark, the appointing party must specify model uses in contract agreements, as outlined in AB 18 – General Conditions for Building and Construction Works and Supplies. These model uses are detailed in the EIR for each resource and discipline model required for the project. The model uses include Planning, drawings, design basis, visualizations, setting out, quantity takeoff, clash detection, consistency check, production, simulations, execution, maintenance, and further design.

BIM-GIS Integration

Data from CAD models is integrated into GIS by automatically converting CAD data into GIS-compatible formats. This enables accurate mapping and analysis of project information in a geospatial context. While integration operates at a lower maturity level, workflows and software capabilities are being developed to adopt openBIM formats like IFC and enhance integration. In Banedanmark, automatic conversion is still under development.

Classification

Both organisations have decided to adopt the CCI (Construction Classification International) system, based on international standards such as EN ISO 12006-2 and EN IEC 81346, to provide a structured framework for classifying construction elements, systems, and components.

In collaboration with BIMinfra.dk, new road type codes have been proposed to the CCIC (Construction Classification International Coalition), to align CCI with Danish needs and contribute to its international development.

In collaboration with BIMinfra.dk, Vejdirektoratet has proposed new classification codes for road types to the CCIC (Construction Classification International Coalition), ensuring that CCI aligns with Danish infrastructure needs while contributing to its international development.

InfraLCA

InfraLCA is used to assess the environmental impact of infrastructure projects throughout their lifecycle. By calculating carbon emissions and resource use, the tool provides consistent data for decision-making. It supports early project phases and detailed planning, contributing to sustainable goals.

Further work in Denmark

Vejdirektoratet's focus for the coming years is to refine the scope, implement established goals, and streamline processes for rapid development. The priority will be data enhancement and interoperability. As part of this effort, Vejdirektoratet is developing a BIM strategy for 2025.

Banedanmark is working on developing a strategy across project and maintenance departments for systems and data interoperability in the vision of creating a BIM lifecycle. The scope is still to be defined.

Furthermore, Vejdirektoratet and Banedanmark are working with buildingSMART Denmark and industry partners to drive OpenBIM initiatives forward.

SWEDEN

Trafikverket, The Swedish Transport Administration (STA) is responsible for long-term planning of the transport system for all types of traffic (rail, air, sea and road), as well as for building, operating and maintaining public roads and railways.

The Swedish Transport Administration is the largest client organisation in Sweden.

Trafikverket

ISO 19650

SS-EN ISO 19650 is regarded as a supplement to the STA management system standards to control the organization of information about infrastructure and facilities in their common life cycle for all actors involved. ISO 19650 is also the main guiding principle for the new Strategy for information about assets including BIM, that was published in March 2024. As for now, parts of the standard are being implemented through STA adoption of openBIM and IFC.

OIR (Organizational Information Requirements) / BIM Strategi

Information requirements for a strategic level are being addressed in the strategy above, published in March 2024.

PIR (Project Information Requirements)

Several ongoing investment projects have specified information needs. This work is not coordinated and needs to be harmonised in a near future.

AIR (Asset Information Requirements)

For railway, a development project for defining an OTL is ongoing. For road, tunnel and bridge this work is remaining.

EIR (Exchange Information Requirements)

The ambition is to publish a first version of common, basic requirements regarding the IFC structure and attributes during Q1 2025. These common requirements will be part of contracts when procuring projects.

PIM (Project Information Model)

Since 2015, the STA has a BIM strategy and requirements for a basic level of digital models for investment projects. A lack of understanding and difficulties to see the full benefits of using digital models has led to a low level of implementation. An initiative to define clear benefits and goals is ongoing and needs to be finalised before taking the next steps including openBIM.

AIM / BIM in maintenance (Asset Information Model)

The use of digital models during the asset and facility management phase is currently being evaluated.

CDE (Common Data Environment) (incl. BIM viewer)

The STA has a long experience in using data management systems. New ways of working, like openBIM workflow will need these well-established systems to be further developed.

openBIM workflow

The STA has supported and participated in the development of IFC for Infrastructure for the last 10 years. In 2024 some important prerequisites for implementation have fallen into place:

- ✓ IFC 4.3 is published as an ISO standard
- ✓ IDS is available in a first version
- ✓ IFC for Railway Manifesto is signed by several client organisations
- ✓ STA policy decision to use IFC for exchange of structured asset related data
- ✓ STA updated strategy for BIM
- ✓ IFC classed as suitable for long term archiving
- ✓ National guidelines for openBIM and IFC
- ✓ National procurement templates updated with digital models (in process of public hearing)

openBIM is to STA an approach to use open standards and a process for workflows. The implementation of openBIM and IFC is gradual and we intend to continue until 2030.

IFC 4.3 (ISO 16739 - Industry Foundation Classes)

In 2022, the STA made a joint policy decision where IFC was pointed out as the central standard for the exchange of data of the physical road and railway facility. The decision refers to the ISO standard SS-EN ISO 16739-1, as an open format for deliveries and exchange of structured asset-related data in order to obtain uniform information deliveries and eventually machine-readable delivery requirements and automated delivery control.

The policy decision applies to all activities where structured data about the physical facility is to be communicated with internal systems, external suppliers and users, e.g., production of procurement / requirements documents, IT systems and business development

IDS (Information Delivery Specification)

The need for several delivery specifications have been identified. The ambition is to publish a first version of some basic requirements in Q1 2025.

BCF (BIM Collaboration Format)

BCF is a part of the plans for openBIM workflow implementation.

buildingSMART Services

STA are working with some of the buildingSMART services. Within UCM (Use Case Management) use cases for bridges has been defined and made but not yet evaluated. As the IFC Validation Service is a part of the openBIM workflow trials for off-line validation is being prepared for. Concerning Professional Certification, STA is waiting for results from bS Sweden who is exploring the need and possibilities of a national program.

Related topics

Level of Information Need

STA has not yet adapted a common LOD/LOIN standard. As for today there are only a few requirements for defining levels for details and information. There is therefore a need for a common specification. Various pilot projects are running today but there are no common requirements.

Maturity Model Index (MMI)

MMI is not a widely used standard in Sweden today. STA will, during the development of the IDS requirements, evaluate the MMI as defined in the Norwegian guide lines. Currently, status in models is usually placed on CAD-layers and as metadata. Moving forward, this will change when implementing requirements for object-based properties and the IFC-format.

Object Type Library (OTL)

STA is developing a common object type library for railway facilities. The OTL will be available for future projects and for multiple systems.

Requirement Database (other than bSDD)

STA have collected almost all requirements in requirements databases where the requirements also is managed. Systematic Requirements Management as a method are used in all large projects. Today, however, not all the possibilities that a database can support are applied or used. This is for example following-up on projects, control of compliance between design and requirements and analysing, tracing, prioritizing and agreeing on requirements.

Model Uses (defined)

STA have defined 10 main applications for model uses. They are quality assurance, collaboration, visualization, sustainability evaluation, cost estimation, time planning, design documentation, build documentation, maintain documentation, analysis & simulation. The input for this work is taken from bSI IFC 4.3 projects requirements analysis phases, the Model Maturity matrix work, Penn state, DiKon and many more.

Maturity Model

The Nordic maturity model has been used as a base for a new adjusted maturity model. The suggested model has five levels and the categories are process, organization, product, information exchange and applications or theme. The framework (POPIT) with the matrix will enable to identify the current within a specific project or within an organization. It will also provide an overview of the possible steps that needs to be taken for a future desired situation.

BIM-GIS Integration

The BIM-GIS integration is becoming a hot topic both internationally as well in the Nordic countries. STA is engaged in a strategic BIM-GIS group that is a cooperation between bSI (buildingSMART International) and Open Geospatial Consortium (OGC). STA is investigating how to use and integrate IFC-models into GIS. An internal project (E4 - hand over 24 km tunnels) is testing this.

Digital Twin

To some extent, STA already uses digital twins (DTw) for certain projects and applications. It is not always in 3D and is not always related to the common field of BIM. However, the term digital twin means different things to different people. As

for now STA has no common definition of what it means for us. The use of DTw can be seen as part in STA ongoing digitization.

Classification

STA has as a long-term strategic goal that all assets are classified according to specified standards and a common administrated taxonomy that clearly group and describes asset information. Specified standards for classification are ISO 12006-2 and ISO/IEC 81436. The development and application of classification have two mains but overlapping business directions: delivery and operating phase of assets. Harmonization works between these directions as well as related information standards are ongoing. This also includes the Classification system CoClass, of which STA is a major owner.

Further work in Sweden

The STA adoptions of openBIM and IFC will continue to enable STA to be more open and independent, more automated and which will increase quality in deliveries and make more confident decisions. STA will carry on with preparation for maintenance to be able to receive data in IFC and for a better and more automated quality assurance. In 2025 STA will start require IFC 4.3.

Further work
& Tendencies

Further work & Tendencies

Further work

This chapter highlights emerging trends among NBC members. An increasing emphasis on international standards is driving greater consistency and interoperability in information management. By aligning national practices with global benchmarks, organisations can streamline system integration and optimise project delivery throughout an infrastructure asset's lifecycle.

A key development is the move towards clearly defined information requirements, ensuring stakeholders can access the right data at the right time. In tandem, common data environments support the management and sharing of information, maintaining quality and fostering collaboration.

Simultaneously, the integration of asset management, maintenance systems, and digital twins is evolving, emphasising predictive maintenance and data-driven decision-making. Alongside this, BIM-GIS integration is on the rise, advancing geospatial analysis and infrastructure mapping.

Though there might be unique national approaches, standardisation ensures these efforts align, promoting knowledge sharing and producing cutting-edge solutions. Ultimately, this collaboration continues to standardise practices, drive innovation, and future-proof digital solutions across the region.

Tendencies

As BIM evolves, the infrastructure sector is preparing for future requirements at both EU and national levels. Although no formal mandates exist yet, ongoing EU discussions about digital product passports, machine-readable data, and Environmental Product Declarations (EPDs) could introduce new mandates by 2030 in the European Union. These priorities underscore a growing focus on sustainability, transparency, and digitalisation, prompting organisations to remain proactive and align with emerging frameworks.

Strategic Priority for IFC 4.3

IFC 4.3 represents a significant step forward in BIM, addressing infrastructure project needs and enabling seamless data exchange across platforms. Public organisations in the Nordic region are prioritising IFC 4.3 in tender processes to enhance interoperability and streamline data management, paving the way for future open data standards.

ISO 19650 as the Foundation for Information Management

ISO 19650 continues to serve as the core framework for managing information through OpenBIM workflows. The standard is under revision, with updates due in 2026. These changes aim to align with newer standards (e.g., Level of Information Need), incorporate guidance from CEN, and reflect practical experience gained from current use.

Strengthening Competence Development

Building expertise in ISO 19650, IFC 4.3, and OpenBIM workflows is essential. Ongoing training ensures stakeholders can adapt to evolving standards and technologies, fostering collaboration and best practices.

Enhancing Data Quality and Security

As BIM workflows expand, maintaining data quality and security becomes increasingly critical. Automated validation tools aligned with ISO 19650 help uphold consistent data standards, while robust cyber-security measures safeguard sensitive information as digital processes and IoT adoption grow.

Emerging BIM Trends and Technologies

Digital Twin Integration:

Linking models to real-time data for lifecycle management and predictive maintenance, improving oversight of infrastructure assets.

BIM-GIS Integration:

Combining geospatial and design data to boost spatial context for planning and analysis, supporting better infrastructure decision-making.

AI-Driven Parametric Design:

Improving design optimisation through advanced simulations, enhancing material efficiency and aligning with structured information management principles.

Lifecycle Carbon Tracking:

Extending tools such as LCA for comprehensive carbon assessments, aiding sustainability goals and regulatory compliance.

Circular Economy in Infrastructure:

Designing infrastructure for reuse, recycling, and sustainability, aligning with future environmental objectives.

Appendix A

International Standards

Overview International Standards

This chapter provides an overview of key international standards related to information management, offering insights into aspects of standardisation that impact public stakeholders such as NBC members.

International standardisation bodies, including ISO (International Organization for Standardisation), IEC (International Electrotechnical Commission), and CEN (European Committee for Standardisation), develop standards, specifications, and reports across various disciplines. The standardisation process is typically carried out by volunteer experts from different fields and funded through membership fees, standard sales, and, in some cases, government support.

Standardisation efforts must remain independent of political agendas to ensure objectivity and global applicability. Compliance with standards provides a structured approach to managing information, enhancing collaboration, improving efficiency, and ensuring regulatory alignment across jurisdictions.

CEN and ISO Collaboration: The Vienna Agreement

To streamline efforts and prevent duplication, CEN and ISO established the Vienna Agreement in 1991. This agreement facilitates technical cooperation by:

- Reducing duplication and shortening development time.
- Aligning international and European standards with regulatory and market needs.
- Promoting a unified approach for global adoption.

A successful example of this collaboration is the ISO 55000 (Asset Management Series), developed in parallel by CEN and ISO. The technical work is conducted by various ISO and CEN committees to ensure the standards meet both international and European needs. Once developed, CEN publishes these standards as European Norms (EN), which public stakeholders in the EU are encouraged to adopt.

Collaboration under the Vienna Agreement enables organizations to align their processes with international standards, ensuring consistency and interoperability across borders.

Overview of Standards Related to BIM

The landscape of international standards for Building Information Modelling (BIM) and information management is continuously evolving. Overview of related BIM standards from Danish Standards provides an overview of existing standards and standards in development (see image page50).

Overarching frameworks, such as the EN ISO 19650 series, define how to manage and deliver BIM information, ensuring consistency in structuring and sharing project data. Data classification standards and exchange schemas, such as Industry Foundation Classes (IFC), support interoperability between different software platforms and stakeholders.

Additional guidelines establish the Level of Information Need, specifying the required detail at each project stage, and standardise product data templates to facilitate data sharing between BIM and GIS systems.

Developed primarily under committees such as ISO and CEN, these standards provide a structured approach for both public and private entities. Adhering to them helps organisations harmonise practices, enhance collaboration, and comply with evolving regulatory and market requirements for digital construction.

Guidelines developed by CEN offer a common framework for applying these standards throughout Europe, ensuring a consistent approach across various national contexts.

Understanding these standards helps stakeholders align processes with international best practices and emerging regulatory frameworks.

Understanding ISO 19650

A Guide to Managing Information using BIM

The EN ISO 19650 series is an international standard for managing information throughout the lifecycle of built assets. It provides a framework to ensure project data remains consistent, accessible, and reliable across all stages through planning, design, construction, and operation. The ISO 19650 series consists of several parts, each addressing specific aspects of information management.

Key Components of ISO 19650

ISO 19650-1: Concepts and Principles

ISO 19650-2: Delivery Phase of the Asset

ISO 19650-3: Operational Phase of the Asset

ISO 19650-4: Information Exchange

ISO 19650-5: Security-minded Approach to Information Management

ISO 19650-6: Health and Safety Information (under development)

Key Concepts of ISO 19650

Information Requirements

Assessment and Need

Models & Tools

Tendering & Appointment

Planning & Delivery Documents

Planning & Mobilization

Production & Information Delivery

Close-Out & Handover

Information Management workflow

Information Requirements

ISO 19650 defines clear information requirements to ensure project success by specifying what data is needed, who needs it, and when it should be delivered. These include:

Organizational Information Requirements (OIR):

Defines strategic-level data required to meet long-term objectives.

Project Information Requirements (PIR):

Specifies essential data for project delivery.

Asset Information Requirements (AIR):

Outlines information necessary for post-construction asset management.

Exchange Information Requirements (EIR):

Specifies data formats, quality, and delivery expectations.

These requirements ensure the right information is collected and shared effectively.

Models and Tools

A Common Data Environment (CDE) is central to ISO 19650, serving as the single source where project data is stored, shared, and updated in real time. Two primary information models help manage data across project phases:



Project Information Model (PIM):
Used during design and construction to support delivery.

Asset Information Model (AIM):
Maintains essential data for asset operation and long-term maintenance.

CDE facilitates efficient collaboration by providing stakeholders with access to accurate and consistent project information.

Key

- A start of delivery phase — transfer of relevant information from AIM to PIM
- B progressive development of the design intent model into the virtual construction model (see 3.3.10, Note 1 to entry)
- C end of delivery phase — transfer of relevant information from PIM to AIM

Generic project and asset information management life cycle (shows how Information Management is embedded in ISO 55000 and ISO 9001) (Source: ISO 19650-1:2018)

Planning and Delivery Documents

To facilitate efficient information flow, ISO 19650 relies on essential planning documents:

BIM Execution Plan (BEP):

Outlines how project information is structured, managed, and delivered.

Task Information Delivery Plan (TIDP):

Specifies responsibilities and timelines for data deliveries.

Master Information Delivery Plan (MIDP):

Consolidates all TIDPs into an overarching project-wide plan.

These documents provide a structured approach to defining roles and responsibilities in information management.

The ISO 19650 Information Management Workflow

ISO 19650 follows a structured workflow to ensure effective information management from project initiation to handover.

Assessment and Need

The appointing party defines project objectives, expected outcomes, and key stakeholders. Organisational, Asset, and Project Information Requirements (OIR, AIR, PIR) are established to align with strategic goals. The EIR is prepared to outline specific data needs, formats, and delivery expectations.

Tendering and Appointment

The appointing party issues the EIR to potential suppliers, who provide proposals detailing how they will meet information needs. A pre-contract BEP is developed, outlining proposed information management methods. Once the lead appointed party is selected, roles and expectations are formally agreed upon to align with project objectives.

Planning and Mobilization

Following contract agreements, the post-contract BEP is created, defining how data will be structured and delivered. The CDE is established as the central repository for managing project data. Task and master information delivery plans (TIDP/MIDP) are developed to outline responsibilities and timelines, ensuring a well-coordinated and collaborative project environment.

Production and Information Delivery

Project teams generate, verify, and deliver structured data in line with the BEP and EIR. The PIM is continuously updated within the CDE to maintain data accuracy and accessibility. Regular validation and issue resolution processes ensure compliance and smooth collaboration across disciplines.

Close-Out and Handover

In this final phase, validated project information is compiled and transferred to the appointing party for operational use. The AIM is finalised to support asset management and maintenance. Knowledge transfer and training ensure stakeholders can effectively utilise the delivered information to maintain asset performance.

Why ISO 19650 Matters

ISO 19650 improves collaboration, decision-making, and risk management by ensuring the right data is available when needed. The Level of Information Need helps balance data detail, preventing overload while maintaining accuracy.

Adopting ISO 19650 enables organisations to streamline processes, boost efficiency, and maximise the long-term value of their assets.

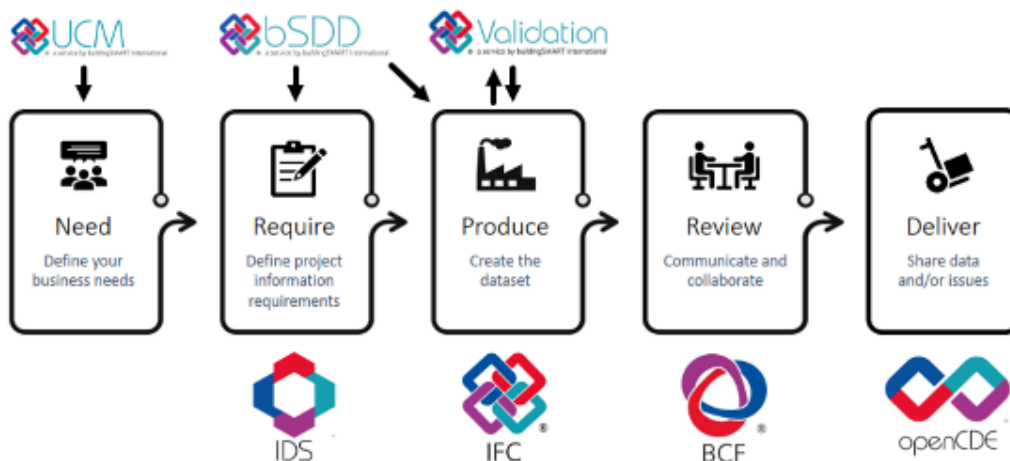
buildingSMART Standards

The buildingSMART openBIM workflow offers a standardized approach to managing digital information in the built environment. It promotes the use of open, interoperable standards that enable seamless collaboration and data exchange across various platforms and stakeholders.

By leveraging key tools such as bSDD, IDS, IFC, BCF, and openCDE, project teams can improve data consistency, enhance collaboration, and align with recognized frameworks such as ISO 19650.

Key phases of the openBIM workflow

The openBIM workflow consists of four key phases, aligning with information management best practices to support structured project delivery



I. Require

In this phase, the appointing party (client) defines the project's information needs using IDS and referencing standardised terms from bSDD to establish clear data

expectations. This ensures that project objectives are aligned with stakeholder requirements from the outset.

2. Produce

Appointed project teams generate datasets and BIM models using IFC, while leveraging the structured data framework provided by bSDD. This phase focuses on producing consistent, standardised data that aligns with project requirements and compliance expectations.

3. Review

Stakeholders validate and review project data using BCF, ensuring that issues are tracked and resolved efficiently. This phase plays a critical role in maintaining data accuracy, quality control, and compliance with project standards before final delivery.

4. Deliver

Approved information is securely shared via openCDE, ensuring long-term accessibility and operational readiness. The integration of openCDE APIs allows seamless collaboration across different CDE platforms, improving information sharing and compliance with frameworks such as ISO 19650.

bSI openBIM workflow tools

Information Delivery Specification (IDS)

IDS is a machine-readable format that defines project-specific information requirements, ensuring structured and validated data based on predefined criteria. It supports automated compliance checks and is planned to be developed within the Level of Information Need standard, prEN ISO 7817-3, ensuring that required information is neither excessive nor insufficient.

buildingSMART Data Dictionary (bSDD)

bSDD is a centralised dictionary providing standardised definitions for construction-related terms, classifications, and properties. It ensures consistency across platforms by offering a common reference framework for industry standards such as CCI, Uniclass 2015, and IFC property sets.

bSDD facilitates automation and interoperability by harmonising terminology across projects and software systems, enabling stakeholders to maintain consistent data structures throughout the project lifecycle.

Industry Foundation Classes (IFC)

IFC (EN ISO 16739-1:2024) is an open data schema that facilitates the exchange of building and infrastructure information across different software platforms. It ensures interoperability by structuring 3D models and associated data, enabling efficient access and use across the asset lifecycle.

IFC is fundamental for design, construction, and operational workflows, providing a common language that allows different disciplines to collaborate effectively.

BIM Collaboration Format (BCF)

BCF is an open format that enables issue tracking and communication within BIM models without modifying the underlying data. It allows teams to exchange comments and assign tasks, facilitating efficient coordination and improving transparency in project decision-making.

BCF is widely used for design reviews, clash detection, and issue resolution across various software platforms, ensuring streamlined collaboration and preventing data loss.

Common data environment (CDE)

openCDE enables secure, cloud-based data sharing and collaboration within a CDE, providing a single source of truth for project information. A key feature of openCDE is its API-driven approach, which allows seamless integration between different CDE platforms, ensuring cross-platform interoperability and data consistency.

With openCDE APIs, organisations can run all buildingSMART open tools, including bSDD, IDS, IFC, and BCF, within a connected ecosystem. This enables automated workflows, real-time data exchange, and improved project coordination while maintaining data security and controlled access.

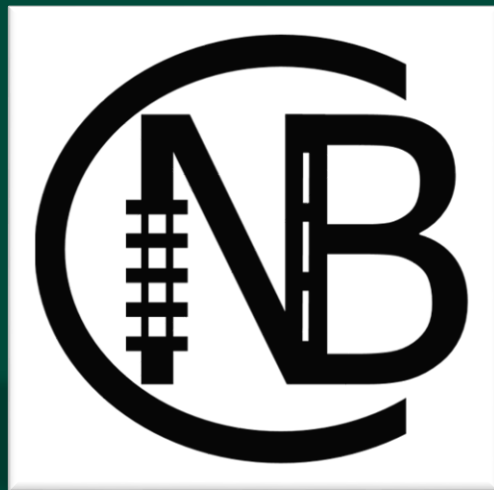
openCDE ensures long-term data availability and supports efficient collaboration throughout the project lifecycle.

Appendix B

Nordic Organisations

Nordic Organisations & Industry Initiatives

EU	EU BIM Task Group	EU BIM Task group consist of representatives from public clients and the public sector. The mission is to support public clients responsible for the built environment to implement digital transformation in practice. See https://eubim.eu/
	EOF	The role of the European Forum of openBIM (EFO) is to support the development of a standardization strategy centered on openBIM and integrated with the European policies. EOF includes the European buildingSMART Chapters and is supported by EU BIM Task Group.
Nordic	Nordic Hub	Nordic buildingSMART chapters
Finland	buildingSMART Finland	
Norway	buildingSMART Norway	Bane NOR is a member of the board. All infrastructure public owners participate in several domains. Statens vegvesen lead the infrastructure domain and work 40% as the leader of this domain.
	Infrastructure council	A meeting point for the CEO of the three infrastructure public owners and the CEO of the organisations for consultants and contractor. We have a BIM cooperation group where BIM responsible from the public owners, consultants and contractors meet four times a year to share information on ongoing processes and projects. The BIM responsible from the three public owners meet 6 times a year to share information and cooperation.
Denmark	BIMinfra.dk	A collaboration between major Danish infrastructure stakeholders to align and coordinate BIM development for the infrastructure sector.
	Molio	Denmark's knowledge center for the construction industry, supporting sustainability, productivity, and digitalization through tools, standards, and education. buildingSMART Denmark is part of Molio.
	DiKon	A Danish network fostering collaboration and transparency to develop and implement digital standards and publications, including the LOD DK framework.
Sweden	buildingSMART Sweden	Trafikverket is member of the board
	BIM Alliance Sweden	BIM Alliance Sweden is a nonprofit organization working for a better built environment by maintaining seamless information flows in the design, construction and maintenance processes.



Nordic Road & Rail
BIM Collaboration
2024