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BIM v infrastrukturi - Potreba po standardizaciji in priporočila

BIM in infrastructure - Standardization need and recommendations

BIM in der Infrastruktur - Normungsbedarf und Empfehlungen

Modélisation des informations de la construction (BIM) applicable dans les infrastructures - Besoin de normalisation et recommandations

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BIM in infrastructure - Standardization need and recommendations

Modélisation des informations de la construction (BIM) applicable dans les infrastructures - Besoin de normalisation et recommandations

BIM in der Infrastruktur - Normungsbedarf und Empfehlungen

This Technical Report was approved by CEN on 30 January 2023. It has been drawn up by the Technical Committee CEN/TC 442.

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European foreword

This document (CEN/TR 17920:2023) has been prepared by Technical Committee CEN/TC 442 “Building Information Modelling (BIM)”, the secretariat of which is held by Standards Norway.

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Introduction

CEN/TC 442 is the European technical committee for standardization in the field of structured semantic life cycle information for the built environment. CEN/TC 442 has published numerous European standards for BIM in recent years, and many others are in development. Most of this standardization effort has been in collaboration with international organizations, especially ISO/TC 59/SC 13, the international standardization committee for organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM).

There is a perception that the information requirements of stakeholders in the infrastructure (3.1) domain are not as well served by European and international standards as the requirements of those in the buildings domain. CEN/TC 442 Working Group 6 (WG 6), Infrastructure, was established to identify stakeholders in the infrastructure (3.1) domain, ascertain their needs in relation to standardization for BIM, review if those needs are met by current and forthcoming standards, and, accordingly, make recommendations for the development or revision of standards.

This document presents the findings and recommendations of CEN/TC 442/WG 6. The report is intended to inform future work of CEN/TC 442. In its current work-in-progress state, this report is also intended to support consultation by WG 6 with other working groups within CEN/TC 442 on the basis that those working groups are more familiar with the standards for which they are responsible and the associated standardization efforts.

The process for identification of relevant stakeholder groupings and the results of engagement with selected stakeholders are presented in Clause 4. Engagement included discussions with stakeholders at a national level and survey of stakeholders across Europe. Selected current initiatives for standardization of BIM for infrastructure (3.1) are discussed in Clause 5. Clauses 6 through 13 are structured to correspond to EN ISO 19650-1:2018, Clauses 5 through 12. Based on the analyses conducted by Working Group 6, each clause discusses the characteristics of BIM for infrastructure (3.1) relative to those of BIM for buildings, in the context of the relevant standards. The key question asked in each case is if the standards suitably meet the needs of infrastructure. Key findings are then presented in each case.

The findings are summarized in Clause 14 and recommendations are provided in Clause 15. In addition to looking broadly across the range of BIM standards, Working Group 6 investigated some detailed use cases to enable contextualisation of analyses within real-life industry practice. Annex A presents details of selected case studies analysed. Annex B provides the questions fromt the industry survey.

As of August 2022, Working Group 6 is in the processes of final editing and refinement of this report. This should be borne in mind by those reviewing this work-in-progress report issued for the purpose of internal CEN/TC 442 consideration.

1 Scope

The scope of this document is as per the scope of CEN/TC 442/WG 6, that is:

— Identify key stakeholders.

— Investigate existing activities within standardization for BIM in infrastructure (3.1).

— Formulate the need for standardization related to the implementation of BIM for infrastructure (3.1) in Europe, not covered by existing standards and ongoing standards development.

— Make recommendation on whether standards are to be developed and if so, how this can be done.

For the purpose of this document, the term 'BIM standards' is a loose reference to standards available for the use of BIM, including those under the responsibility of CEN/TC 442, ISO/TC 211 and ISO/TC 59. It is not a defined term.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 19650-1:2018, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) - Information management using building information modelling - Part 1: Concepts and principles (ISO 19650-1:2018)*

ISO 6707-1:2020, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1:2020 and EN ISO 19650-1:2018 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
infrastructure
system of fixed assets needed for the operation of an organization

Note 1 to entry: For the purpose of this document, infrastructure is taken to cover civil assets and exclude building assets.

Note 2 to entry: Examples include a structure such as a dam, bridge, road, railway, runway, utilities, pipeline, or sewerage system, or the result of operations such as dredging, earthwork, geotechnical processes. [Adapted from ISO 6707-1:2004]

[SOURCE: Adapted from EN ISO 9000:2015 [1] and ISO 50007:2017 [2]]

3.2
class
category or division of things based on one or more criteria for inclusion and exclusion

[SOURCE: EN ISO 15926-1:2004, 3.1.1, notes removed]

3.3
classification
process of assigning **objects** to **classes** according to criteria

[SOURCE: ISO 22274:2013, 3.5]

4 Stakeholder engagement

4.1 Stakeholder analysis

The scope of work for this document included identifying key stakeholders and investigating existing activities. At the outset, a list of typical stakeholder types was identified, broadly grouped under organization types and professions. The stakeholder types were classified under two criteria with regard to international standardization of BIM for infrastructure (3.1) in Europe:

— Their power to influence adoption of standards.

— Their interest in the adoption of standards.

Refer to Figure 1 for a matrix of the analysis results. This represents a typical condition rather than that in any one country. Selected stakeholders were omitted or grouped for ease of presentation. Key stakeholders for engagement during the development of this document were identified as those with high power and high interest.

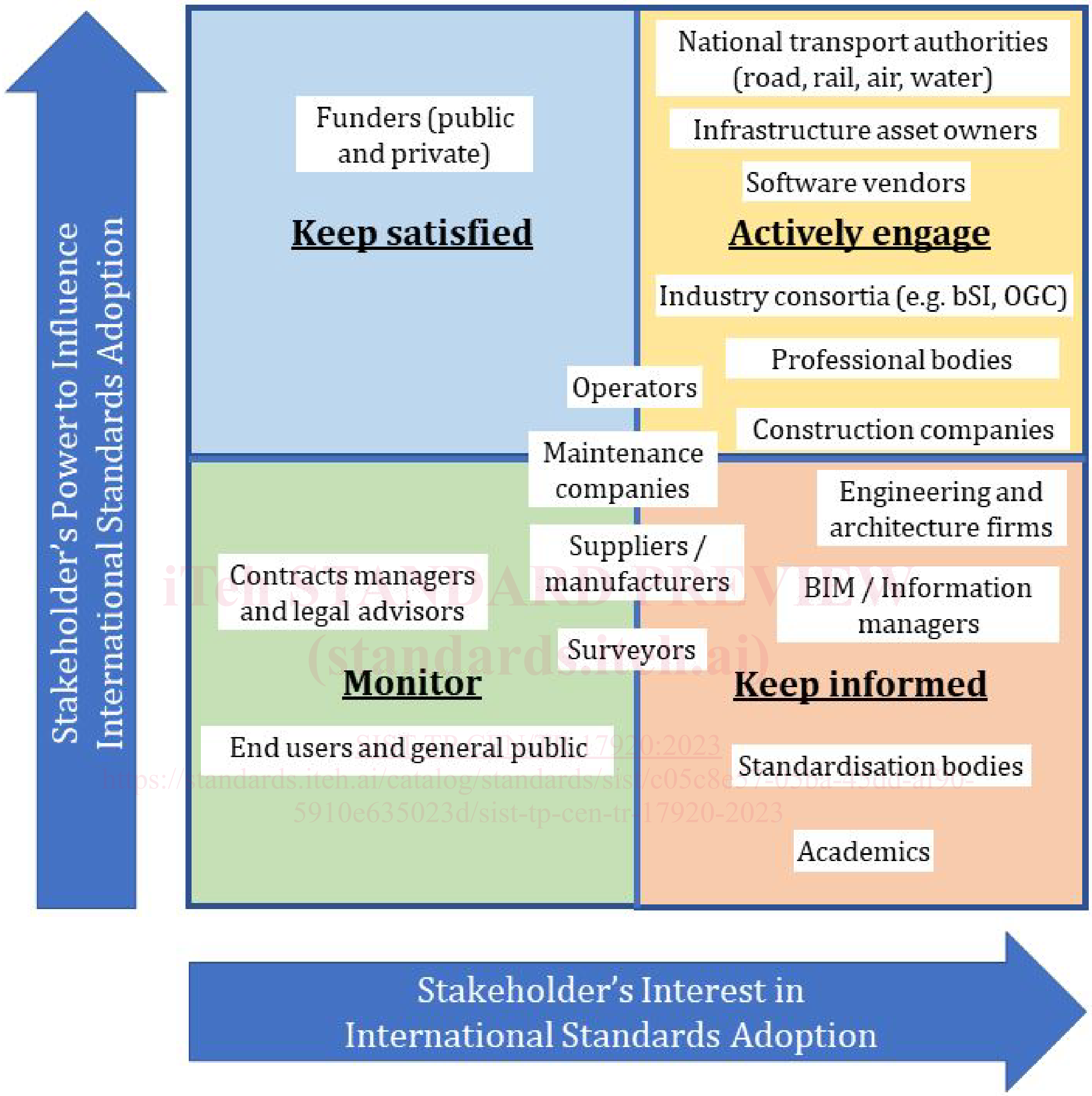

Figure 1 — Stakeholder analysis matrix

4.2 Stakeholder consultations

4.2.1 General

Based on the results of the stakeholder analysis, stakeholders were engaged as discussed below. This engagement was either direct as part of this study or indirect as part of the authors' activities with national standards organizations, industry bodies, research or professional work. The engagement considered the stakeholders' perspectives on the need for standardization related to the implementation of BIM for infrastructure (3.1) in Europe, and whether or not current European standards address that need.

4.2.2 Infrastructure asset owners

With reference to the clause on national transport authorities, the focal point of this part looks into different type of asset owners as road, rail, airports, waterways etc. Multiple asset owners from every country are managing their assets to the best of their ability but may be limiting active sharing of their management methods and structures, with the potential to benefit other asset owners of the same category. Figure 2 shows collaboration between infrastructure owners.

Infrastructure asset owners and operators are largely the same; the owners take over from the contractor after a new construction is done or when an ongoing operation task is done, by way of renovated/replaced assets, whereas the operators assume the responsibility for the on-going maintenance. Owners of infrastructure (3.1), being either state owned or privately owned (private networks, railways located on industrial production sites, etc.), usually focus on the return on investment (profit/service achieved) (ISO/TR 21245). Power supply companies are themselves infrastructure asset owners, e.g. owning their pipelines as well as network supply companies are owning their cables, where others telecom suppliers are renting to the infrastructure (3.1). Usually, infrastructure (3.1) as road, rail, runways are owned and maintained by the owners (national government authorities or agencies), while transport modes as (train/vehicle/heating/water/network) running on rail-tracks/roads/pipes, will be owned by private people or companies.

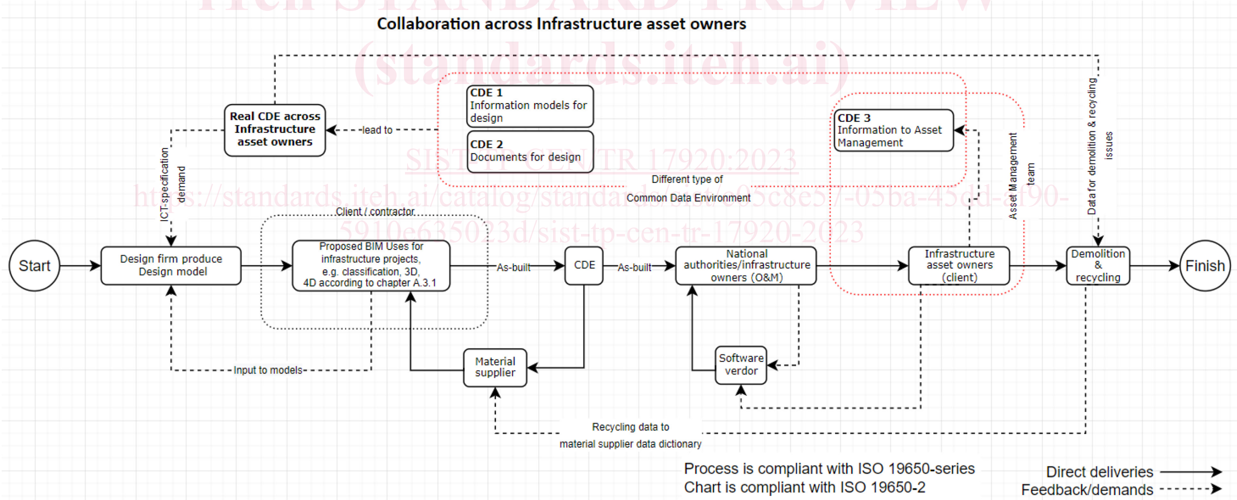

Figure 2 — Collaboration across infrastructure owners

In the life cycle of assets, we again look to the following succession of life cycle stages (Figure 4, 7.2) belonging to the infrastructure (3.1) asset owners: stage 1 is planning and, after construction in stage 4, when the asset owner takes over, they act in stage 5, which is handover. Stage 6, which is operation, and stage 7, which is demolition. The delivery period of an infrastructure (3.1) project is often extended and can have several starts and stops in the process, due to environmental, public involvement, political or economic reasons. As such, stage 2-4 can span several years, which is why the delivery of project data needs to be predictable, well-structured and can be applied to the handover and operations in a systematic way.

Asset ownership demands can be enforced from the very beginning of an early design phase and requires satisfactory deliverables in each subsequent stage. EN ISO 19650-3 [3] emphasizes the importance of setting up a clear information standard as well as information production methods and procedures. This entails the structuring and classification (3.3) of information between asset owners, to ensure that information is useful in a handover to any future operational phase delivery. A progressive delivery of information needs to satisfy, at any all stage, the infrastructure (3.1) asset owner. They need to be eligible to look back through the asset information, e.g. to analyse the purpose of the asset, executed pre-scheduled maintenance and activities as well as reasons for any unscheduled maintenance activities, in the prior life of the asset. It is very important in the delivery phase, that information not only describes the finished and delivered construction, but also provides critical information for owners to maintain their assets.

Industry collaboration

Infrastructure asset owners need a common toolbox that helps them align with each of their projects, allowing for easier collaboration with fewer misunderstandings. The required toolbox could include specialized software, Common data environments or organizational structures that lend themselves to integrated, knowledge-sharing practices in asset management, to incentivize new collaboration between asset owners, in the exchange of methods and processes for common, continuous improvement.

Collaboration across infrastructure asset owners could lead to multiple benefits by sharing integration and co-working solutions, or the appropriate way to apply the softwares they use to manage their project to execute a work order. One obvious development could be to engage in cross-organizational pilot projects with multiple asset owners, where they each provide input by sharing experiences. The diagram shown in Figure 2 above is a proposed workflow, potentially ensuring the collaboration of asset management ownership e.g. between national authorities/infrastructure owners and private companies (client/contractors), to benefit from each other's data.

On the basis of this process, retrieving classified object data according to the needs of other asset owners to compare work differences would be a valuable enhancement, e.g. by having an object library to benefit both asset owners, knowing the object by the same name, settling for a common syntax and name attribution. Infrastructure assets are not necessarily physical construction objects, but it can be virtual and that information, in and of itself, should be treated as an asset too. It can be represented by a part of or a collection or a derivative of physical components.

When looking at infrastructure asset owners who have their individual asset systems without collaboration, the individual initiatives can be useful on their own, but not across the several projects that make up national infrastructure. For this reason it is useful to make a common classification (3.3) library which indicates similar or equal classification (3.3) codes across projects. Infrastructure asset owners can benefit from using classification (3.3) to have control of information models, tender/bidding material, asset information model etc. The value for asset owners will be generated through modelling individual objects. When a classification (3.3) code is generated for an object, it will initially be placed in a three-dimensional model, after which it will be distributed to the correct hierarchical position in an asset management system. From the code, every infrastructure asset owner will be able to read the object due to common coding.

Moreover, as level of information need is a commonly used approach to simplify object understanding and delivery details, a designer can produce a model or its objects in the required level of detail, whereafter a contractor builds the component exactly, with respect to the designed detail and delivers a physical structure and its related information package to asset owners, so the infrastructure asset owner is able to continue maintaining their asset through as-built information.

Additional information can be found in the technical report produced on behalf of buildingSMART™: Infrastructure Asset Management and a report "Built environment data standards and their integration: an analysis of IFC, CityGML and LandInfra (bSI&OGC)".

4.2.3 National transport authorities

Engagement with national transport authorities (e.g. road, rail, airports and waterways) has shown that there is a need for consistently-adopted European standards for BIM for infrastructure (3.1). These authorities seek to procure and manage asset information to enable improved outcomes for transport network safety and efficiency. However, the wide variety of historical, current and forthcoming organizational, national and international standards leads to inconsistent approaches within and between organizations. Further, inadequate interoperability in legacy information management systems and data formats means that deriving value from historical and new information is very challenging.

Transport authorities wish to adopt standards when procuring and managing asset information. However, often they are concerned that adopting standards for which there is not yet a critical mass of industry adoption could lead to inefficient investment. As such, the authorities need suitable standards but also the associated use cases for application, data dictionaries / object type libraries, software applications and databases, and industry knowledge that facilitate effective adoption. Ironically, in the absence of consistent, wide scale demand from large public and private clients such as national transport authorities, the industry supply chain and software vendors are less likely to invest in adopting these BIM standards in a consistent manner.

4.2.4 Industry consortia

Working Group 6 engaged with industry consortia through liaison and through common representation across bodies. Major international industry consortia such as buildingSMART™ and Open Geospatial Consortium (OGC) develop standards, some of which progress to being international standards. Feedback showed that such bodies have ongoing activities addressing the needs of infrastructure domain stakeholders.

For example, The Infrastructure Room (commonly referred to as InfraRoom) within buildingSMART™ was established in 2013 to address the limited support for infrastructure (3.1) within the IFC data model. The InfraRoom is led by an elected Steering Committee with representation from industry, owner, academic and software stakeholders. The first project undertaken was known as IFC 4.1 that provided a general definition of an alignment such as the centreline of a road, track, kerb or other linear feature. This new entity was needed to support linear rather than coordinate referencing, which is typically adopted in infrastructure (3.1). The InfraRoom has extended the coverage to include IFC extensions for bridges (interim release as IFC 4.2), roads, ports and waterways, common schema elements and is working on tunnel entities. The InfraRoom works in close cooperation with the Railway Room who together have delivered IFC 4.3 as a new production standard for validation. Once finalized with core MVDs and available software certification, IFC 4.3 will form part of the next release of EN ISO 16739-1 [4], which is expected in 2023.

4.2.5 Professional bodies

Professional bodies represent the interests of their members. These bodies can be quite influential at a national level, both in relation to the professional practices of their members and through lobbying of government. Many such bodies have BIM committees that have supported and promoted the consistent adoption of BIM, often through collaboration with other professional bodies. Prior to the publication of international BIM standards, the work of professional body BIM committees often involved the development and publication of guidelines, templates and recommendation, which became de facto industry standards.

Now that international BIM standards are available, there is a risk that some professional bodies continue to promote the legacy national practices, which could impede the effective implementation of international standards. It is important to make sure that professional bodies have sound knowledge and understanding of relevant international standards within their field of expertise to avoid confusion and to support consistent adoption of open BIM.

4.2.6 Software vendors

Software applications used in the infrastructure (3.1) sector are fundamental to effective project and asset information management. Software vendors are considering the importance of developing and updating tools in accordance to open formats compatibility (e.g. Industry Foundation Classes – EN ISO 16739-1 [4], InfraGML, CityGML and LandXML) and information management processes. Typically, these implementations have required significant investment by software vendors. More recently, there is a trend towards sharing of open source software modules such that implementation of open BIM functionality within software applications is more financially viable, especially for smaller vendors.

There is a significant need for implementation of new open standards: for example, buildingSMART™ international is leading several Rooms (groups of specialists who work together to improve the built environment) for Infrastructure, Railway, Airport and more, to develop and deploy open digital information models for infrastructure (3.1). Further information about current initiatives are reported in Clause 5.

Considering the efforts around open BIM and the life cycle stages for infrastructure (3.1), it is critical that software houses develop and maintain applications according to every stage and stakeholder need. Ideally for software vendors, this would be in response to a clear market demand for such functionality. However, in some cases public clients are reluctant to adopt and specify open BIM until such a time as they are confident that appropriate software and industry capabilities are available. As such, software vendors may also push the market towards open BIM, as some vendors are already doing.

4.3 Survey

4.3.1 General

Working Group 6 decided it would serve the purpose of this document best if empirical data was available. To that effect a survey was developed with the aim of engaging with various actors in the delivery phase of infrastructure (3.1) assets to ascertain for the sample surveyed:

1) the extent of BIM adoption in infrastructure (3.1) projects;

2) the awareness and adoption of international BIM standards in infrastructure (3.1) projects; and;

3) the perceived suitability of international BIM standards to infrastructure (3.1) projects.

The French mirror committee proposed the first draft of a questionnaire which was thoroughly discussed and developed further by the Working Group members. The outcome was a questionnaire available in two languages and covering a wide range of aspects. The English version was circulated across Europe from December 2020 to March 2021, the French version from the end of March through to the end of April 2021.

Initial analysis of the survey results indicated some technical errors in the setup of the survey. For example, the software enabled some users to terminate the survey without having answered all questions. The errors were rectified for the French version. The survey sample size was not large