buildingSMART InfraRoom
Forethought Whitepaper

InfraRoom Roadmap Working Group

Document Information

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1 Celebrating our success

In 2013, the Infrastructure Room was established to serve the industry with open BIM standards for infrastructure, based on the buildingSMART standards for modelling buildings have been successfully implemented in the building sector for several years. At the time of establishment, data had been exchanged in various ways within the infrastructure sector, mostly based on national or regional sets of agreements; some of them with a focus on GIS. All participants agreed to develop information exchange and process standards to support effective management of the constructed built environment, including linking and integrating across BIM and GIS.

The first delivery was IFC 4.1, an extension of the IFC-schema to enable the exchange of alignment data. In addition to the building sector, the infrastructure industry has to deal a lot with horizontal assets, which has been incorporated to the IFC-schema since 2016 and been developed in strong cooperation with OGC.

After this first success, a lot of working groups started to develop IFC-extensions to cover the majority of infrastructure domains: bridges, roads, tunnels and ports and waterways. Railways started from here and was developed by a dedicated Rail Room to a candidate IFC standard in 2019. By 2021 the Infrastructure Room in cooperation with the Rail Room are going to deliver a harmonized set of IFC-extensions (IFC 4.3) that cover these domains, having been fully tested and validated by software vendors. Our mission to fill the gap of adding infrastructure functionality to a neutral data model and to provide exchange standards for Infrastructure has almost been accomplished.

2 Rethinking our strategy

We as the Infrastructure Room are still not finished because of changes in strategy, technology and methodology that are now driving the digital transition of the construction sector and other industries.

During the development process within the Infrastructure Room of buildingSMART, a whole set of BIM-standards within ISO and CEN have been delivered and continue to be developed on the following areas: strategy and planning, exchange of information, information delivery and data dictionaries; all standards apply to the whole construction industry and will affect the infrastructure sector as well.

Recently, a new technical roadmap and future strategy towards digital twins has been developed within buildingSMART that will have an huge impact on the methodology and tools that are currently being used to apply open BIM standards to enable process and data integration for infrastructure.

We, the Infrastructure Room, now have arrived at a point to reconsider our future state strategic goals, in order to:

- achieve a worldwide roll-out and successful implementation of the IFC extensions for the infrastructure domains that serve user requirements;
- understand the current and future requirements for IFC Infrastructure in order to achieve digital twins for infrastructure;
- maintain liaisons across buildingSMART and with OGC, ISO, CEN and other standards organisations in order to align our strategy and fill the gaps.

We need to do this by working together as an industry to establish and implement open standards for data interoperability and to achieve process and data integration across multiple domains.

In 2020 the Infrastructure Room Steering Committee is launching a Roadmap for 2020-2022 by setting up streams of activities that have to be accomplished in parallel to drive the digital transition of the infrastructure sector towards the development and usage of digital twins for effective management across the whole life cycle of an asset and associated supply chains.

3 Community interaction

This whitepaper is intended to be a forethought, outlining industry issues, infrastructure requirements, questions currently being asked and the areas that need clarification by the infrastructure community. The Steering Committee will issue a survey during the 2020 Q3 bSI Virtual Summit to further understand the questions that are currently being asked and that have to be addressed by undertaking next actions under the Roadmap. Feedback from this survey will be incorporated in a further whitepaper.

More whitepapers and surveys will follow in future, based on topics that our community wants to be addressed and discussed. This will be important in reviewing and rethinking our approach in more detail as has been outlined by the Infrastructure Room Roadmap.

Guidelines will be published based on accomplished deliveries, in order to support our community to implement buildingSMART open standards and methodologies.

4 Area of influence

In order to define our area of influence, we have to understand our position as the Infrastructure Room community within buildingSMART and beyond. First of all, we have to consider various technical and user focus domains e.g. the Airports Room, Railway Room, Construction Room, Product Room and Regulatory Room which might have overlap in requirements and interest. The Regulatory Room is helping project owners and regulatory authorities to achieve an automated regulatory process. The Construction Room is to advance construction site productivity. As a consequence, some user requirements within the Infrastructure Room might to be addressed across all of some of the different rooms, in order to align the user requirements to combined efforts in serving the buildingSMART community as a whole. The picture below (see figure) shows the Infrastructure Room together with all other bSI-rooms and its task in order to create a bSI-digital twin which apply to the industry requirements across all rooms.

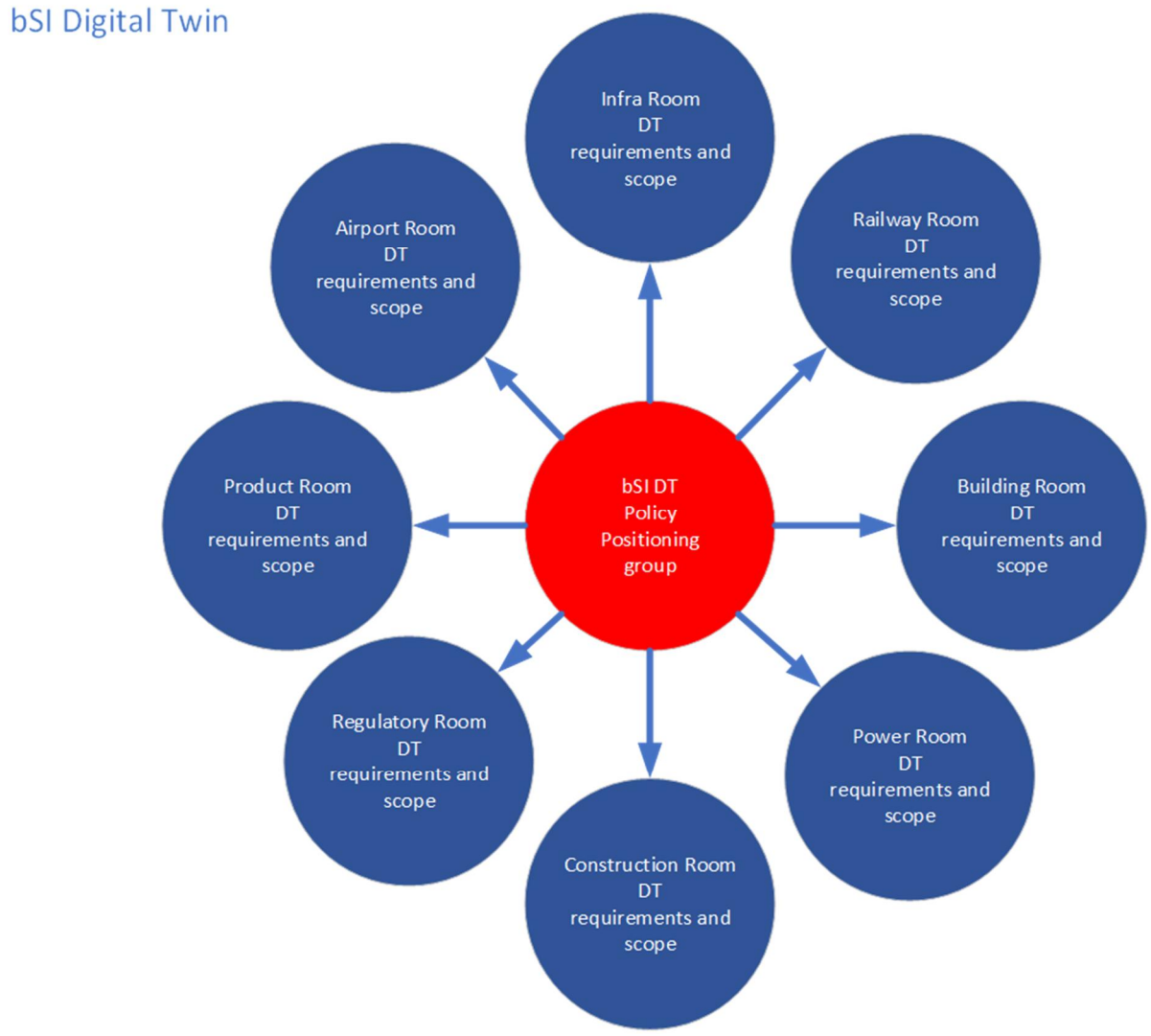

Figure 1: Position of InfraRoom to bring its digital twin requirements and scope

Secondly, we have to be aware that a technical roadmap has been approved recently by the buildingSMART Executive Board that affects all rooms. As an Infrastructure Room we will align our developments to this new approach. The Technical Room is tasked to support all Rooms to align technical efforts in the same direction and to prevent solitary technical projects.

As a consequence, the Infrastructure Room, will not put its efforts on the development of new methodology, tools or technical approaches. Other Rooms within buildingSMART are going to help us with this.

The Infrastructure Room will address its issues, requirements and questions from an industry and user perspective, in order to formulate its user requirements that:

- underpin our Infrastructure Room strategy, helping us to execute tasks along our roadmap in order to achieve our future state goals;

- are “SMART-formulated”, reflecting our place within buildingSMART, being clear and concise in communicating our user requirements within the context of our organisation and in liaison with other standardisation bodies;
- should be supported by methodological and technical innovations and solutions from the Technical Room, Product Room and Regulatory Room.

The Management Board of buildingSMART has put the bSI Process and its underlying Technology Roadmap along a balanced score card in terms of a balanced program (see figure below). We, as the Infrastructure Room, should understand our area of influence in the top-left quadrant, as well as in the down-right quadrant to work on liaison relationships from a user perspective.

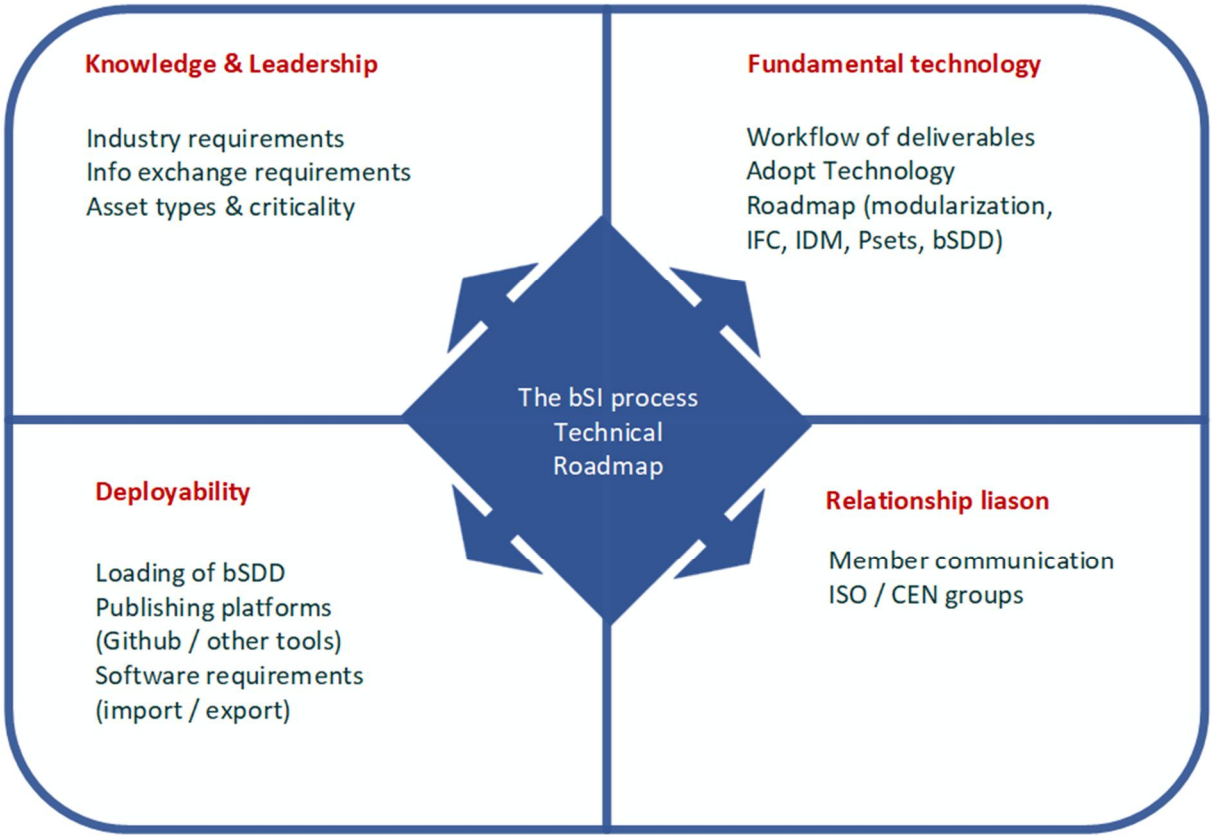

Figure 2: bSI balanced program

In order to achieve a bSI balanced outcome, we should formulate our user requirements so that the Technical can check and prioritize them along with other user requirements that have been brought in by other rooms. These user requirements will be worked out by the Technical Room into technical requirements and managed by them to initiate focussed technical working groups to deliver viable and deployable solutions.

Based on the bSI balanced program, we can distinguish between user and technical requirements accordingly:

User requirements:

- Mission:
  - Deliver “digital twin” requirements and scope
- Knowledge & leadership
  - Industry requirements for InfraRoom
  - Information exchange requirements (based on use-cases)
  - Identified asset types and their criticality / importance

Technical requirements:

- Fundamental technology
  - Adoption of the Technical Roadmap aspects
  - Definition of the workflow of deliverables
- Deployability
  - Ability to load the bSDD
  - Intended use of publishing platforms (Github etc.)
  - Identification of software validation requirements (import / export)

We, the Infrastructure Room, should verify and validate the technical solutions and products being delivered against our user requirements, and give feedback for continuous improvements in technical developments.

The following picture depicts this process of development and the area of influence of the Infrastructure Room accordingly. The orange coloured boxes depict the area of influence of the Infrastructure Room. The blue coloured boxes depict the responsibilities of the Technical Room in order to translate the user requirements across all rooms into technical requirements and translation of them into viable technical solutions. Of course, the Infrastructure Room should check if the technical requirements formulated by the Technical Room do meet the industry (user) requirements. If both are not aligned, the Infrastructure Room should ask the Technical Room to review and/or adjust these technical requirements.

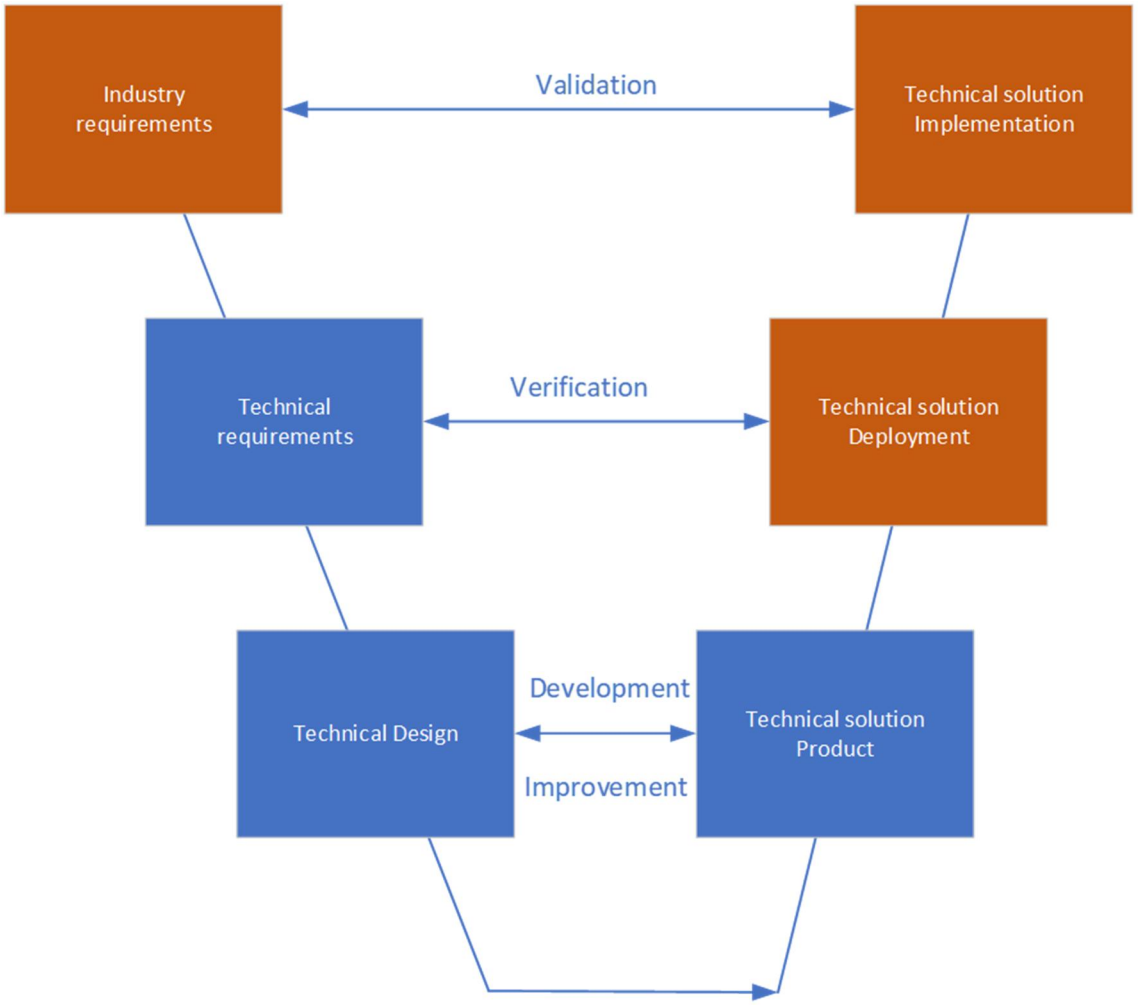

Figure 3: From industry requirements to deployable and viable technical solutions

Because our user requirements might change along a time-path, we should always be careful to check and adjust our value position if the industry requires us to do so.

5 Timeline of aligned objectives

All rooms are asked by bSI Management to align their Room strategies to the bSI Technical Roadmap and to bring in their requirements and scope in order to work together towards a common “digital twin” within bSI.

The Infrastructure Room roadmap helps the infrastructure community to organize itself along several streams in parallel to achieve our future stated goals and to align our efforts to common goals within bSI and in liaison with other standardization bodies.

Based on the roadmaps that are referred to, as well as to input from our community, the diagram below shows a timeline where first of all objectives are categorized as short-term and mid-term objectives, as well as long-term ambitions; aligned to both roadmaps and the bSI ambitions of a common “digital twin” development.

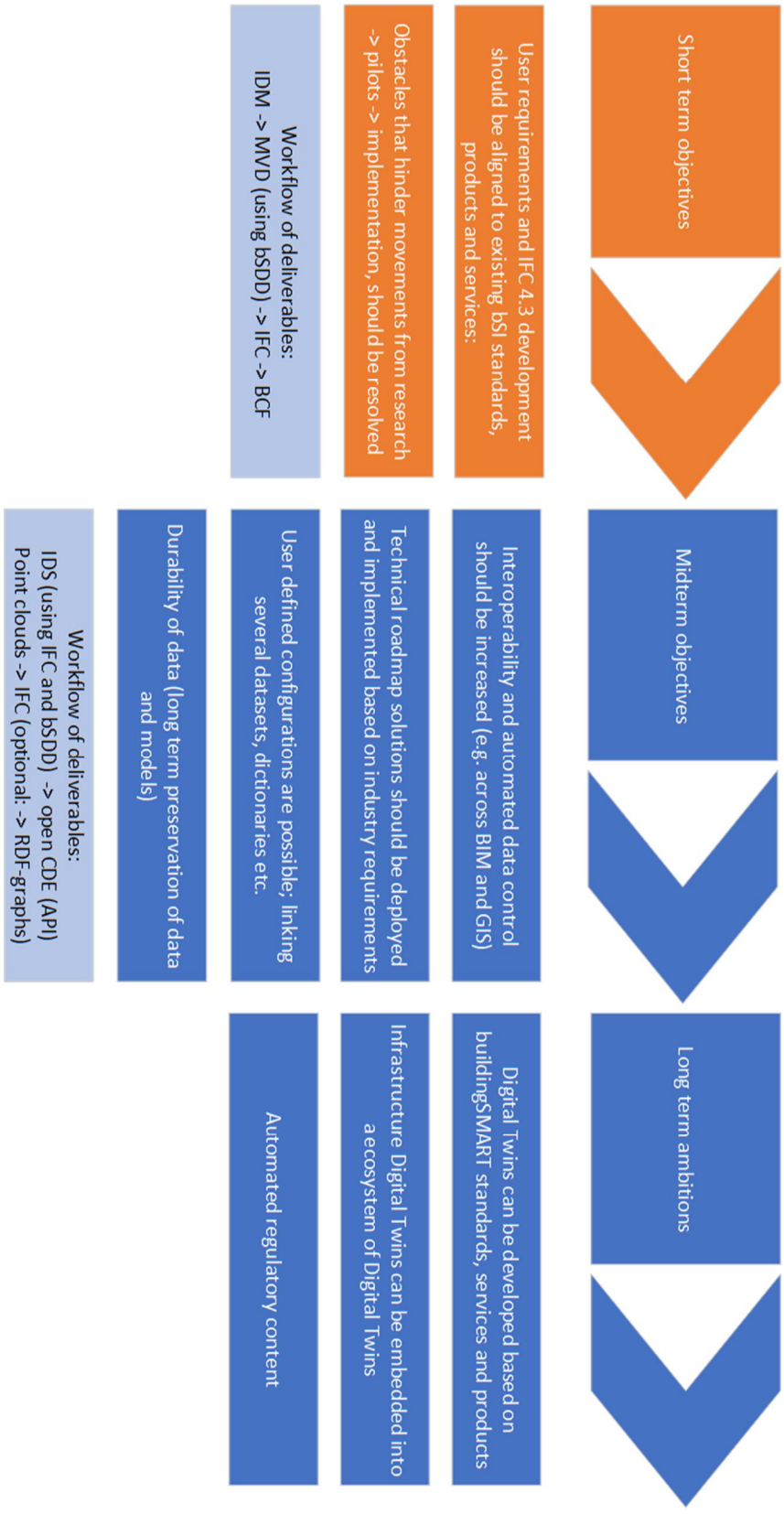

Figure 4: Infrastructure Room Roadmap objectives along a timeline

Based on these objectives, issues in the Infrastructure Room can be prioritized as immediate, while forthcoming issues are managed by the roadmap of activities. Of course, prioritization of objectives and issues may change based on discussions of the suggested time plan by our community.

6 Outline of short-term industry requirements

Taking into account the developments and changes that are needed along the technical roadmap, it is assumed that in the short term the Infrastructure community will be executing the deployment of IFC 4.3, including the harmonized infrastructure extensions, based on the current workflow of deliverables: IDM -> MVD (using bSDD) -> import of MVD's, modelling and creating IFC-exports -> clash detection in CDE and clashes reported by BCF -> import BCF, model improvements and creating improved IFC-exports; using this workflow during the entire lifecycle of an asset and its supply chain.

Based on this current workflow, the following industry needs have been reported:

- We need to achieve an ISO-approval of the IFC-extensions by 2022, to enable clients to mandate IFC 4.3 (including infrastructure extensions) in tenders.
- There is a need for common understanding of definitions, principles and methodology.
- We might refer to other norms and standards in order to bring the buildingSMART standards into a broader context, better understandable and/or applicable for our roadmap strategy and infrastructure community to explain.
- For our buildingSMART InfraRoom roadmap, we should focus on the buildingSMART standards and products (IFC, IDM, bSDD and BCF) and their relationships. This in order to make them easy to apply for actors in the infrastructure industry globally. The Infrastructure community should clarify its user requirements that are to be delivered by an integrated usage of these bSI standards and products (technical solution).

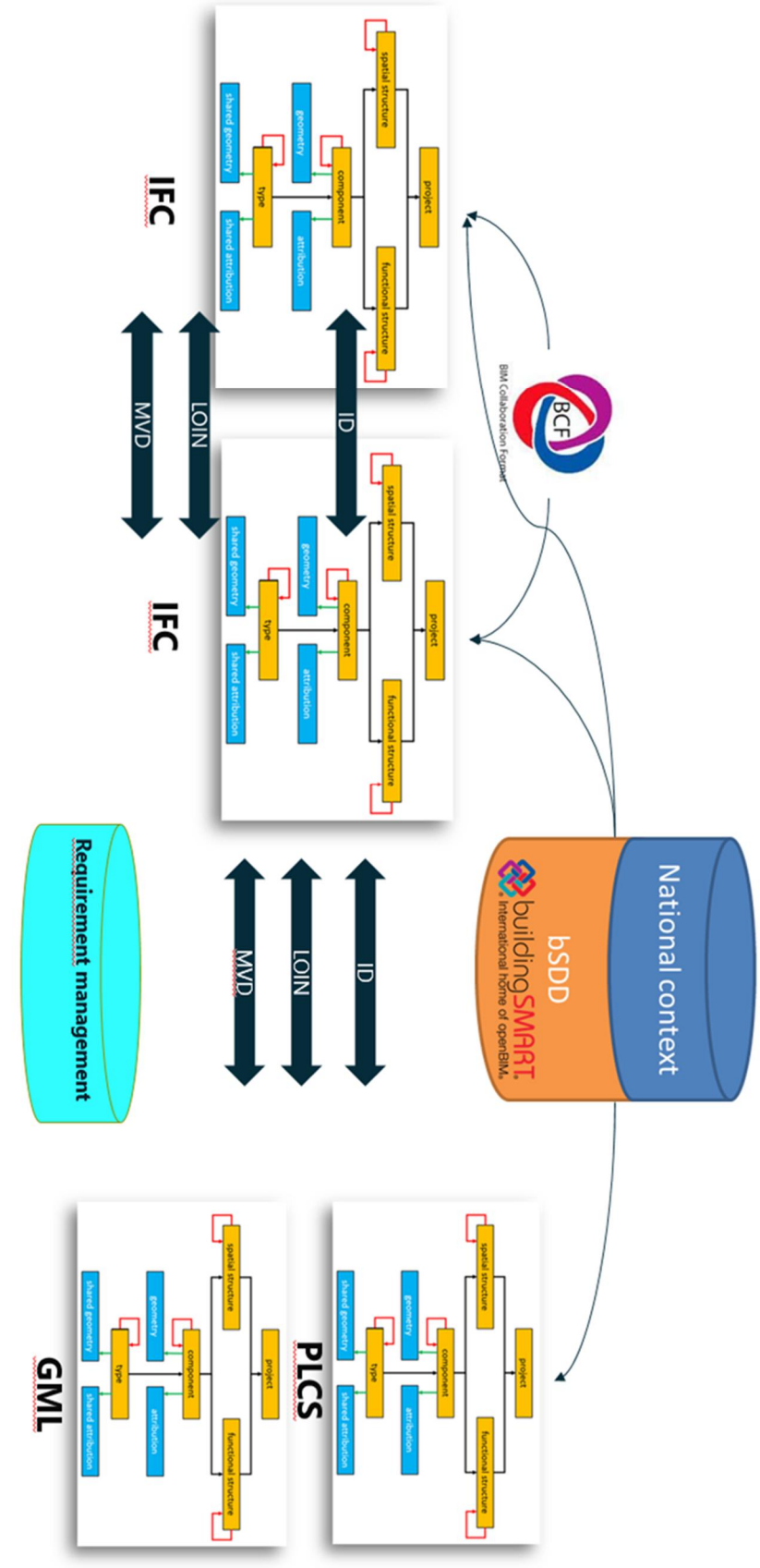

Figure 5: Example of the current and integrated application of bSI standards and products

- We need to clarify what kind of software functionality and technical environment is needed to support the application and maintenance of these standards. This includes formulating user requirements to encourage the development of tooling and to set up a certification process, for:
  - Tools to deploy IFC for end-users (to apply and to maintain IFC-extensions), that must be fit for the purpose (supporting use-cases);
  - Appropriate end-user tools to apply IDM for specifying their exchange requirements;
  - Appropriate end-user tools to apply bSDD to link data to IFC-extensions and their semantics.
  - Simple machine-readable tools to manage the process for the exchange of information by generating and applying MVDs.
  - bSI (certified) platform(s) for publishing standardized IDMs and MVDs to be selected and reconfigured by the end-user supported by its own tooling. This / these bSI (certified) platform(s) could also support automated model checking against bSI-published MVDs based on IFC-extensions.
  - User-friendly CDEs that are able to incorporate IFC, IDM, MVD, bsDD, BCF (and linked data) in an integrated application of linked bSI standards and products, to support the end-user by applying information management (based on ISO-19650) with respect to a digital twin.

7 Immediate and forthcoming issues

This whitepaper is intended to describe immediate and forthcoming issues that have been identified within our infrastructure community to be sure these issues will be dealt with by executing future projects and activities along our Infrastructure Roadmap.

Based on the timeline of aligned objectives of the Infrastructure and Technical roadmaps and an outline of the industry requirements for the short term as described in the previous chapter, the issues that refer to the short-term objectives are described first.

7.1 Sustainable tooling for publishing, managing and maintaining IFC

- Currently we are dealing with issues of tooling (IFC Doc) to publish and maintain IFC-extensions. IFC-Doc is obsolete and abandoned in the technical roadmap in order to create and harmonize IFC-extensions and to create MVD's. What kind of solutions are provided by the Technical Room in the short term to replace IFC-Doc for the functionality described?
- We need other tooling (UML-based) in order to publish, manage and maintain the IFC-standard in a sustainable way by buildingSMART; establishing a system of quality assurance.

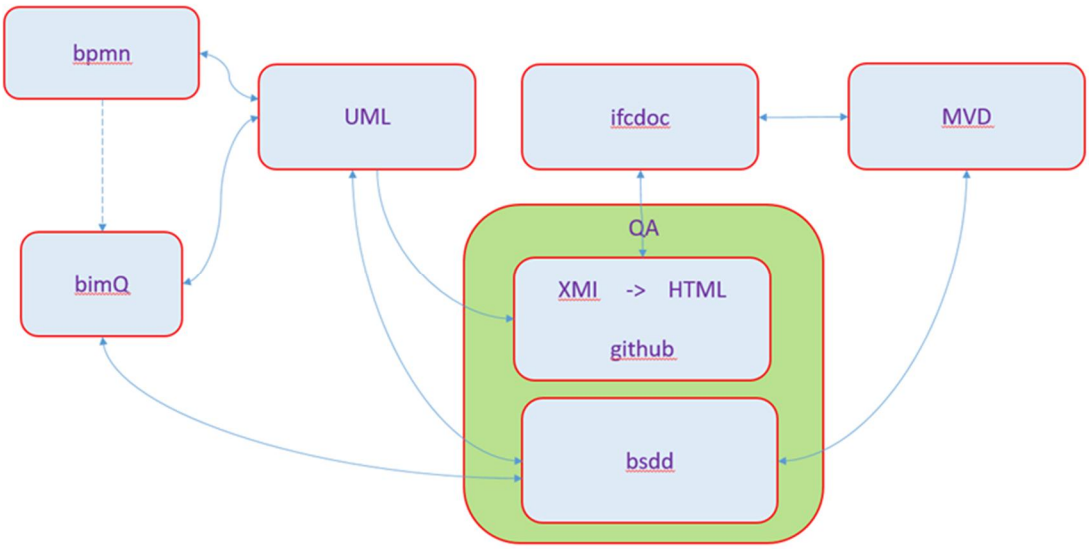

Figure 6: Current Architecture in Github

7.2 Usability of IDMs and MVDs

- How can a set of standardized IDMs and MVDs related to IFC-extensions and specific use-cases be published and managed that can be used to support end-users in adapting the IFC-standard during the period until the new IDS-standard (which is under development) is available.
- How can automated model checking against bSI-published MVDs and IDMs accordingly be provided to serve the short term objectives?
- Flexibility is needed for IDMs and MVDs to be (re)configured by the end-user. How are we going to manage that for the time being, since IDS hasn't been implemented yet.
- How are we going to support the end users to achieve the right extraction of information in the meantime?

7.3 bSDD

- What is needed to use bSDD for end-users to understand the semantics embedded in international standards, to be used for national / domains specifications?
- How can the end-user be supported to let them understand how semantics have to be organized?
- How can the end-user verify the correct use of semantics in information models.
- What are the benefits of bSDD published in linked data?
- Which use-cases are supported by bSDD published in linked-data format?

7.4 Managing and Controlling the Information Process (BCF)

It has become clear as BIM has become more mainstream that the process of capturing, creating and managing information is key to the success of its implementation. That process is one of collaborating across all the stakeholders and the tasks they carry out in delivering information requirements. Those stakeholders might be asset owners, surveyors, planners, designers, construction contractors,

fabricators, testers, and asset operators. The tasks are many and varied, the information requires controlled collaboration and development.

The ISO 19650 suite of standards have defined the concepts of the process of collaboration and federation of information and a Common Data Environment that holds and controls BCF is bSI methodology for communication across the process and its use is key to successful collaboration. To achieve this the BCF needs to be further developed and several issues on its functionality need to be resolved.

- How can the metadata on the process (ISO 19650) be managed using BCF?
- Holding unique IDs to objects throughout the process is an important factor.
- Can BCF (metadata on the objects / unique IDs) also be used for managing the metadata on the process? If yes, how?
- How can the metadata on the process (ISO 19650) be managed by implementing IDM Part 2 (ISO 29481-2)?
- How do BCF and ISO 29481-2 relate together?

We want to work with bSI technical and other rooms to open up discussion on these issues and develop solutions that we can take forward.