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xxx	IFC Infra Overall Architecture – Project Plan	TUM / André Borrmann	29/01/2016	final

1 Project Execution Plan

Having standardized infrastructure asset data available throughout the lifecycle of the facility is an important key to a higher efficiency in planning, constructing, operating and maintaining our infrastructure. A comprehensive neutral data model capable to present both semantic as well as geometric aspects is necessary for enabling data exchange and open data access in the context of planning, realization and maintenance of road and rail infrastructure.

Recently, a number of national standardization initiatives have emerged which developed proposals for standardized data exchange schemata. Examples are the Korean IFC-Road project, the Chinese IFC-Rail project and the IFC-Bridge project led by the French chapter. Due to the overlapping scope of the diverse national initiatives, partly concurrent data elements have been proposed.

In order to harmonize the diverse proposals and provide a sound foundation for the future international standardization of Road, Rail, Bridge and Tunnel data exchange formats, this project will provide a framework which will serve as common basis for all infrastructure activities. The framework includes commonly used data structures such as the spatial aggregation hierarchy for linear (horizontal) facilities as well as guidelines regarding the data modeling such as the maximum inheritance level or the use of enumeration types.

Particular attention is paid to enabling a future integration of GIS and InfraBIM systems by ensuring best possible compatibility between the proposed IFC-Infra extensions and the InfraGML data model. This is achieved by developing a joint conceptual model using UML class diagrams.

This project development plan describes the necessary steps to develop the integration framework.

1.1 Objectives

The IFC Infra Integration Framework is set to achieve:

- Analysis of the currently available drafts of the IFC infrastructure extension initiatives with respect to joint / overlapping areas project, including
  - the IFC-Road project by the Korean chapter (note: the Korean IFC-Road project had already been analysed and modifications had been suggested by MSG)
  - the IFC-Rail project by the Chinese chapter
  - the IFC-Bridge project led by the French chapter
- Definition of jointly used data structures as a common basis, including
  - terrain geometry
  - earthwork geometries (cut and fill volumes)
  - subsoil modelling
  - cant / super elevation
  - clearance
  - spatial aggregation hierarchy for linear assets
- Provision of modelling guidelines for bSI Infrastructure extension projects
  - consistent extension of the different class trees for spatial structure, element and element type structure, element breakdown structure
  - common criteria for the class inheritance structure (by infrastructure discipline, like IfcBridgeElement, IfcRoadElement, IfcRailElement, or by common functionality)

- common criteria for reusing existing classes from the building domain, like IfcWall, IfcSlab
- maximum class inheritance levels
- usage of object type libraries
- usage of enumerations and property sets
- usage of coordinate reference system
- usage of alignment and linear references for positioning purposes
- preferred geometry description method for identified use cases

- Ability to map common infrastructure information between InfraGML (developed by OGC) and enhanced version of IFC
- A foundation for standardized data exchange during the entire lifecycle, including requirements, design, construction, operation, maintenance and destruction/recycling

These objectives have to be realized within the current architecture of the IFC schema and shall lead to a downward compatible extension.

1.2 Deliverables

In order to achieve the objectives the following main deliveries are developed during the project

- A clear definition of the scope for common infrastructure information in this standard and references to other standards covering other scopes relevant for infrastructure information. In order to provide context to all other descriptions, this includes the definition of a reference process description in the form of a high level process map containing and defining the most important stages, stakeholders and exchanges
- A clear definition (ontology) of common infrastructure information in the scope of this standard as the conceptual schema jointly developed by buildingSMART and OGC using UML
- The general extension to the buildingSMART IFC4 schema comprising the common infrastructure model, delivered as a recommendation to enhance the EXPRESS schema in a consistent way
- A modelling guideline for the infrastructure domain specific projects on how to consistently extend the IFC structure
- Facilitation of two review panels
  - From client and domain expert side to state the requirements and assess the solution
  - From software vendor side to assess the implementability of the solution

1.3 Project execution

The project work is carried out by the project team. At least one member of the project team is member of buildingSMART Model Support Group (MSG) to carry out the schema extension. The project leader will be determined and leads the project team.

The work is supervised by the Infrastructure Integration steering committee of the Infrastructure room, where the stakeholders are adequately represented (see Figure 1).

The steering committee will nominate a representative to be the direct contact person for the project leader. The project leader reports to the steering committee and will work closely with the steering committee representative during the execution of the project.

Proposal:

- Steering committee representative for the Infrastructure Integration project – Henk Schaap
- Project leader – André Borrmann, Technical University Munich, Germany

The steering committee (in close collaboration with the project leader) will invite client representatives, domain experts, and software vendor representatives to participate in the “Expert panel”.

The project team is supported by management support staff for building up the expert panel, workshop invitations, taking minutes and distributing minutes and materials.

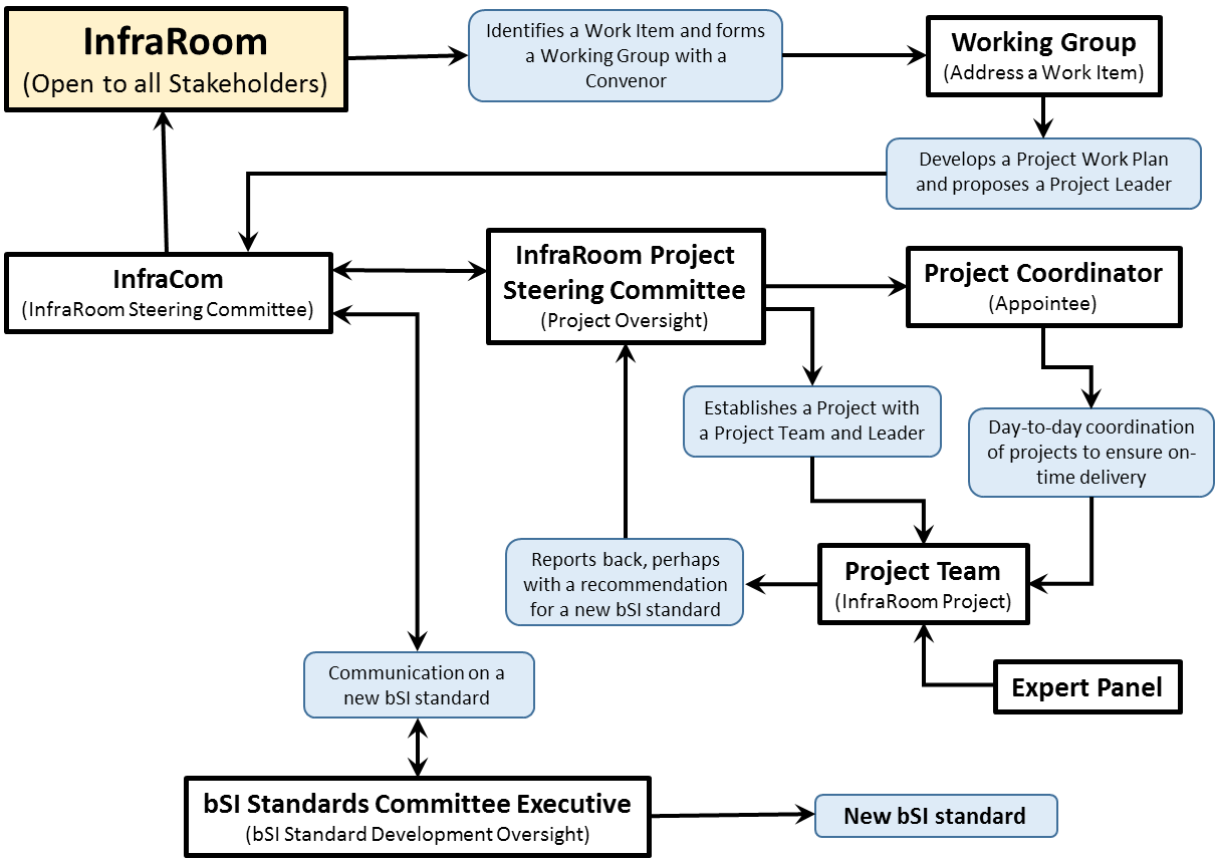

Figure 1 Organisational structure, in accordance with the Infrastructure Room Charter

2 Work Plan

The work plan of the Infra Integration project is based on existing work experience coming from IFC-Alignment development and preliminary work in buildingSMART, OGC, and other initiatives.

2.1 Existing Work

The project will built upon the significant work by the Korean IFC-Road project, the Chinese IFC-Rail project and the IFC-Bridge project led by the French chapter. All three projects have defined extensive data models for describing infrastructure assets. However, the projects have developed mostly independent from each other. In consequence, diverging or even incompatible approaches to modeling commonly used exist. The proposed project will analyze in detail the proposed data models and incorporate them to the largest extent possible. The project will also take into consideration the ongoing Infra Asset Management Requirements project, as well as other relevant activities, such as Japanese developments on Tunnels.

Beside the IFC-related initiatives, there are also other data models. LandXML is a widely adopted quasi standard for representing roads. However, it has a number of modelling errors and it is no longer actively maintained. The Finnish infrastructure clients initiated the Finnish Inframodel development[1], it documents and enhances LandXML1.2 for well-defined use cases; this development has also lead to buildingSMART Recommended Technical Report [2](adopted by InfraRoom in March 2015).

1 See http://cic.vtt.fi/inframodel/

2 See http://cic.vtt.fi/bSI_LandXML12_MVD/

OGC has created a "Land and Infrastructure" working group with the goal to develop InfraGML[3].

OKSTRA[4] is used for road information systems in Germany. OKSTRA standard is only target for the German market, since the complete data model is in German language.

OpenBrIM[5] is an XML file format for bridges, however it is only poorly supported by software packages.

In the Singapore bSI Standards Summit Fall 2015, the Infrastructure room concluded the following resolution: "

The InfraRoom resolves to establish an Overall Architecture Working Group to address the issues of integration across the evolving Infrastructure standards development. The InfraRoom appreciates the results from the discussion of issues during the session on Integration.

The InfraRoom acknowledges the work done by national IFC development programs on Roads, Railways, Bridges and Tunnels, and asks that they provide their conceptual schemas as a resource for the Overall Architecture.

The InfraRoom acknowledges the urgency of developing the Overall Architecture for Infrastructure Extensions and asks all parties involved to take this into account."

2.2 Project work package structure

The work packages (WP) of the Infra Integration project are:

WP0 Completion of Project Execution Plan

Based on the project proposal and the Memorandum of Understanding a full project execution plan has to be developed, showing work packages, deliverables, work schedule, budget plan, project team and the project organization in terms of responsibilities and reporting lines.

Tasks: T0.1 Development of Project Execution Plan
T0.2 Agreement of Project Execution Plan

Deliverable: Completed Project Execution Plan

Milestone: M0, 31.01.2016

WP 1 Requirement Analysis

Analyze the requirements of existing data exchange processes in infrastructure projects. The requirements of a neutral data model capable to present both semantic as well as geometric aspects have to be determined. Typical user scenarios and use cases have to be captured and documented. Existing data exchange standards for infrastructure projects such as the LandXML standard should also be taken into consideration. Methods of the Information Delivery Manual (IDM) are used to create process maps and exchange requirements from the user requirements. It has to be documented in detail, who are the users of the IFC infrastructure extension and for what purpose the data is needed.

The client and domain expert panel will contribute to the requirement analysis and validation. A strong coordination between the project team and the expert panel will be established.

Tasks: T1.0 Define complete high level bSI infra scope.
T1.1 Select and define scope and use cases for this project (subset of T1.0)
T1.2 Analysis of Rail exchange requirements
T1.3 Analysis of Road exchange requirements

3 See http://geospatial.blogs.com/geospatial/2013/12/a-proposal-to-replace-landxml-with-infragml.html

4 See http://www.okstra.de/

5 See http://openbrim.org/Schema2.aspx

T1.4 Analysis of Bridge exchange requirements
T1.5 Analysis of Tunnel exchange requirements
T1.6 Identification of common exchange requirements
T1.7 Validate common exchange requirements (with WP3).
T1.8 Refinement of scope and use cases

Deliverable: [1] Requirement Analysis, including fine-tuned scope definition

Milestone: [1] M1 30.04.2016

WP2 IFC Schema Extension and Extension Modelling Guidelines

The scope of the model is defined from the outcome of the WP1. A model extension for IFC is defined as a conceptional schema using the Unified Model Language (UML) as a graphical notation. The corresponding EXPRESS schema and the XSD schema are derived from the conceptional schema. The schema is documented using the definitions from the requirement analysis. .

Different stages of the IFC schema will be presented to the domain expert and software expert panels. The schema extension needs to be incrementally improved with the feedback from these panels.

Tasks:
T2.1 Analysis of proposed IFC-Road extension
T2.2 Analysis of proposed IFC-Rail extension
T2.3 Analysis of proposed IFC-Bridge extension
T2.4 Analysis of proposed IFC-Tunnel extension
T2.5 Develop draft conceptual schema
T2.6 Validate draft conceptual schema
T2.7 Develop final IFC4 extension
T2.8 Validate final IFC4 extension (with WP3)
T2.9 Develop modelling guidelines for bSI infrastructure extension projects

Deliverables:
[1] Draft IFC4 schema extension
[2] Final IFC4 schema extension
[3] Final IFC4 extension documentation

Milestones:
[1] M2 31.07.2016
[2] M3 31.10.2016
[3] M4 15.12.2016

WP3 Facilitate the expert panels

Facilitate the expert panels (both for clients / domain experts and for software experts). Hold regular meetings with the panels. Inform them via email groups and a development blog and other social media activities.

Tasks:
T3.1 Set-up of expert panels
T3.2 Facilitate reviews with the expert panel

Deliverables:
[1] Expert panel discussion at project start - 01.02.2016
[2] Expert panel discussion prior to Milestone 1 – 15.04.2016
[3] Expert panel discussion prior to Milestone 2 – 15.07.2016
[4] Expert panel discussion prior to Milestone 3 – 15.10.2016
[5] Expert panel discussion prior to Milestone 4 – 30.11.2016

WP4 Project management

Manage the technical work of the project, including the reporting to the steering committees according to Figure 1. Write quarterly reports and inform the stakeholders on progress. Cooperate with the project

representative. Organize the collaboration with OGC, in particular with the "Land and infrastructure" SWG for the joint development of the conceptual schema.

Tasks: T4.1 Project management

Deliverables: Quarterly project progress reports

3 Work breakdown (activities per work package)

WP0 Completion of the Project Execution Plan

Activities:

- Develop the project execution plan (scope, schedule, budget)
- Form the project team
- Present the Project Execution Plan to the stakeholders and the Infrastructure steering group
- Achieve agreement and initiate the kick-off of the project work

WP 1 Requirement Analysis

Activities:

- Define a reference process description in the form of a high level process map containing and defining the most important stages, stakeholders and exchanges to provide context to all other descriptions
- Informally select and document typical user scenarios and use cases of different stakeholders for
  - Road design, procurement, construction, operation, maintenance and destruction/recycling
  - Railway design, procurement, construction, operation, maintenance and destruction/recycling
  - Bridge design, procurement, construction, operation, maintenance and destruction/recycling

  Note: Limit scenarios to those relevant for this standard. There might be scenarios that's more relevant for e. g GIS or ITS standards.
- Identify exchange scenarios with highest priority on the basis of the importance for the international stakeholders
- Formally describe which data is required in data exchanges of infrastructure projects (IDM method)
- Validate refined scope against use case of the model
- Request feedback from users and software expert panel.

These steps need to be repeated and the model scope needs to be incrementally refined.

Risks:

- No consensus in expert panel
- Requirements can be misunderstood by project team
- Some important requirements could be missing in the requirements review
- Unimportant requirements that are needed only by one stakeholder could be misleadingly included in the requirement analysis

Risk Measures:

- front end focus on discussion and consensus in order to be able to escalate in time
- Make a review with stakeholders to find out if the requirement were correctly determined.
- Count the number of stakeholders that needs a certain requirement to find out the importance

WP2 IFC Schema Extension and Extension Modelling Guidelines

Activities:

- Develop a conceptual schema comprising all information within the refined scope of WP1
- Align this work with the Land & Infrastructure conceptual schema developed in parallel in OGC
- Extend the IFC4 schema based on the conceptual schema
- Complete the IFC4 extension, and guarantee its syntactical correctness
- Complete the overall documentation of the model extension
- Develop modelling guidelines to be followed in bSI infrastructure extension projects

Risks:

- A common conceptual schema between bSI and OGC cannot be achieved
- The extension within the current IFC architecture is too complex
- The resulting IFC extension does not capture all requirements defined in WP1
- The resulting IFC extension proves too difficult or too ambiguous to be implemented efficiently

Risk Measures:

- Involve OGC technical experts in the project
- Get involved in OGC "Land and Infrastructure" SWG
- Include the domain and the software expert panel in reviewing the conceptual schema
- Test the resulting IFC4 extension (and MVD) in WP3

WP3 Facilitate the expert panels

Activities:

- Set-up domain expert panel
- Set-up software expert panel
- Provide intermediate project results to the expert panels (at least before each milestone)
- Facilitate online meetings with the expert panels
- Integrate the results into the work packages

Risks:

- Inadequate representation within expert panels
- Inactiveness of some experts (due to voluntary nature of participation)

Risk Measures:

- Involve stakeholders and Infrastructure room in selection of expert panels
- Show stakeholders' commitment and realistic goals to experts to get better responses

WP4 Project Management

Activities:

- Progress reports, invoicing, representation in bSI, coordination with OGC

WP5 Communication and Dissemination

Activities:

- Communication within the project team and within bSI via Infranet
- Communication to the general public via project website
- Dissemination of the project results

4 Project Team

The technical project team will comprise technical and IFC modeling experts from buildingSMART International Model Support Group (MSG), Open Geospatial Consortium (OGC) and a number of research institutes from around the word.

The following persons are named already:

- André Borrmann, Project Lead
- Thomas Liebich, bSI Model Support Group
- Tim Chipman, bSI Model Support Group
- Jim Plume, University of New South Wales (UNSW)
- Julian Amann, Technical University Munich (TUM)
- Dominic Singer, Technical University Munich (TUM)
- Juha Hyvärinen, VTT Technical Research Centre of Finland (VTT)
- Nobuyoshi Yabuki, Osaka University (OU)
- Francois Grobler, bSI IFC Roads and Railways project
- Hyunjoo Kim, University of Seoul (UOS)
- Yushen Liu, China Railway BIM Alliance (CRBIM)
- Hyunseok Moon, Korean Institute of Civil Engineering and Building Technology (KICT)
- Christophe Castaing, bSI IFC-Bridge project
- Paul Scarponcini, OGC (based on the MoU agreement between bSI and OGC)
- Laura Mol, Gobar Adviseurs

The nomination of the domain and software expert panel shall be done in collaboration with the stakeholders and the Infrastructure room.

5 Cost breakdown

WP0	3.200,00 €
WP1	48.900,00 €
WP2	47.400,00 €
WP3	22.600,00 €
WP4	14.400,00 €
WP5	1.200,00 €
Travel	13.000,00 €
Total	150.700,00 €
bSI Overhead	22.605,00 €
Project Sum	173.305,00 €

6 Schedule

The project will commence on February 1st, 2016 and will be completed on December 15th, 2016. The pre-project phase for WP0 “full project execution plan” is from 01.11.2015 till 31.01.2016.

The main milestones are aligned with the buildingSMART International meetings, in March and October 2016.

Detailed schedule:

ID	Work Package	Start	End
1	WP0: Completion of the project plan	01.11.2015	15.12.2015
2	WP1: Requirement Analysis	01.02.2016	30.04.2016
3	Milestone 1	30.04.2016	30.04.2016
4	WP2: IFC Extensions & Guidelines	01.05.2016	15.12.2016
5	Milestone 2	31.07.2016	31.07.2016
6	Milestone 3	31.10.2016	31.10.2016
7	Milestone 4	15.12.2016	15.12.2016
8	WP3: Facilitate the expert panel	01.02.2016	15.12.2016
9	WP4: Project management	15.12.2015	15.12.2016

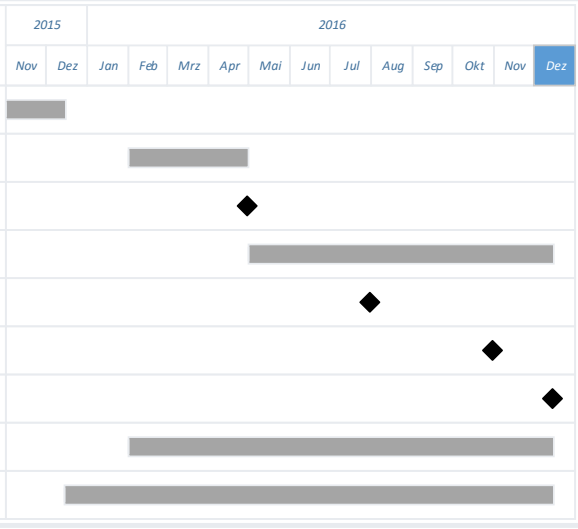

Figure 2: Project Gantt chart