buildingSMART International (2022)
385-Handover Handover using openBIM

LKqeqXwd

bSI Information Delivery Specification (IDS) for integrated openBIM and openGIS Platform

Entrant details

Role or Job Title on the Project	Senior BIM Consultant
Employer	Lands Department Hong Kong
Employer Role	Public Sector Owner/Client
Are you or your employer a member of buildingSMART?	Yes - Chapter Member

Entry details

Entry Details

By checking this box I understand and acknowledge that this awards program is to assess information about openBIM, and that openBIM is not only about the use of solutions. openBIM is about setting up an environment where every party in a team can work in the optimal way ("how they prefer") without putting limitations on others. It is about freedom to take control over your data and workflows, while keeping that freedom for others as	✓

well. Full use of open standards is not mandatory for this mission.

Website | https://hongkong.nederlandin3d.nl/

Location

Strategic Building Innovation (SBI)
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Submitting Party and Stakeholder Logos (compiled into one .ppt/pptx file for upload)

PPTX	Submitting party and stak... (5.7 MiB download)

Entry Description

This groundbreaking project by an international team of experts **extends the frontiers** of buildingSMART International (bSI) **Information Delivery Specification (IDS)** development and introduces broader use of **openBIM® at an urban scale**, integrating it with openGIS. It provides a **reproducible process** that can be adapted, scaled, and reproduced in other applications. Moreover, it **informs advancement of bSI standards** through the project teammates' direct participation in bSI's IDS Standards development efforts. The project represents international good practice thinking of experts from Asia, the European Union, the United States. IDS is a machine-readable dataset that defines requirements of information provisions and exchange processes; bSI began development of this standard in 2020.

Please see the video for a quick summary: **Scope of the entry (video).mp4**.

The use of Building Information Models stored in a central data repository shows great potential for improving the efficiency and effectiveness of City Management. Government agencies using this approach have seen the number of models grow into hundreds of thousands. The city of Dresden has a data repository with 136,000 models, Rotterdam has 205,000, Hong Kong foresees collecting 300,000. The number will grow as road and bridge models are added to repositories. **The challenge** for these government agencies is assuring and **controlling the quality of the models** so that the models meet specifications for creating a city model. Pooling openBIM and openGIS expertise from the US, Asia, and European Union, we **developed IDSs and IDS Checker** according to bSI's new IDS standard. The IDSs support the **integration of openBIM and openGIS** and streaming of the integrated data; the **IDS Checker is validated** through use on 47 building IFC models and 102 infrastructure IFC models.

Studying the **application of IDS to control IFC model quality was an imperative** for the forward-thinking Lands Department (LandsD) agency as they developed a long-term roadmap to store 300,000+ IFC models in a BIM data repository. They realized that IDS could help **automate IFC model compliance** with information requires before inducting them into the Open Standards Government BIM Data Repository (GBDR).

To facilitate the proof-of-concept study, LandsD developed a written IDS set based on use cases, converted them into machine-readable files (idsXML), and **developed an IDS Checker** that reads the files and checks the IFC models uploaded to the GBDR.

The IDS Checker was **tested with 149 IFC models** and the results were quantified. In application, the IDS Checker will be used to validate IFC models handed over to LandsD before they are stored in the GBDR.

Project Highlights:

• **Defined Information Delivery Specifications** (IDSs) to support the use cases of the Open Standards Government BIM Data Repository (GBDR), including a key use case: integration of openBIM and openGIS for creating a city model.

• **Identified IFC entities, attributes, properties**, and property values to be checked based on the IDS sets.
• **Developed the IDS Checker** based on the latest version of IDS, version 0.5, on buildingSMART International's github website (https://github.com/buildingSMART/IDS).
• **Validated IDS Checker** with IFC models stored in the Open Standards GBDR. The validation involved running 149 IFC models (47 building IFC models and 102 infrastructure IFC models) through IDS Checker and generating metrics, showing the quality of IFC models.
• **Validated IFC models** stored in the Open Standards GBDR for a 4D-based decision support system at an urban scale, among other use cases.

Technical Highlights:

• **Used Information Delivery Manual (IDM) workflow** to develop the written part of Information Delivery Specification (IDS).
• **Developed a set of machine-readable IDSs** following bSI's IDS standard version 0.5 (https://github.com/buildingSMART/IDS).
• **Contributed to the development of bSI's IDS standard** through frequent communication with bSI's IDS standardization team
• **Developed IDS sets compatible with IFC 4**.
• Developed a prototype of the Open Standards Government BIM Data Repository **(GBDR) integrated with the IDS Checker**
• Developed the Open Standards Government BIM Data Repository **(GBDR) compatible with CityGML**
•**Tested IFC-to-CityGML conversion.**
• **Used open standard glTF** with 3D Tiles to make IFC models light for data streaming.
• Tested and used **algorithms for mesh simplification** and **indoor object exclusion** to keep the models shareable on the web at an urban scale.

Contribution to bSI Community:
The project team **contributed to the development of bSI's IDS standard** by sharing examples and code sets, providing feedback, suggesting improvements, and responding to requests and **collaborating with bSI's IDS group**. At bSI's invitation, the project team **presented project experience and openBIM+openGIS knowledge during the bSI events:** Strategic Advisory Council Meeting 2021, bSI Virtual Summit Autumn 2021, and bSI Virtual Summit Spring 2022.

Strategic Alignment:
Lands Department (LandsD) drafted a **five-year roadmap** for the development and implementation of the Open Standards Government BIM Data Repository (GBDR). The Data Repository will store and serve 300,000+ IFC models in the future. The main tasks for the initial stage were to develop information requirements (i.e., Information Delivery Specifications), IFC guidelines for meeting the IDS, and an IDS checker for checking IFC models to be stored in the Open Standards GBDR. **LandsD coordinated efforts among several other government agencies that will hand BIM files to LandsD**; these included Drainage Services Department, Water Supplies Department, Civil Engineering and Development Department, Highways Department, Architectural Services Department, and Electrical and Mechanical Services Department. The IDS, IFC Guideline, and IDS Checker were developed in close coordination with these agencies, supporting the integration of the department models with openGIS at an urban scale.

What stage of completion is the entry content representing?	Built asset lifecycle: Handover stage; Platform development: Pilot study and prototyping

Stakeholder Statements

Rick Klooster (CTO of Future Insight, the Netherlands):

For a government to really make use of BIM designs in broad scale it's crucial that the quality is on a high and consistent level. The IDS project is therefore crucial to easily check if the BIM designs are on the appropriate quality level.

Hans Hendriks (Founder of deBIMspecialist, the Netherlands):

My first experiences with IDS have been very positive. It ensures that the specifications are drawn up explicitly, after which the IDS checks can be used very efficiently. A BIM modeler already knows in advance how and what to model! I see a lot of potential in using IDS as it will make the processes repeatable and scalable with better model quality!

Jiri Hietanen (Founder of Simplebim, Finland):

Merits of IDS: Relevant, reliable and correctly structured models are essential for the broad use of BIM by people who are not BIM experts. With IDS we can define what data are needed (relevant), how it must be exchanged using IFC (correctly structured) and it finally enables vendor-neutral validation of the exchanged models (reliable).

Nelson Yam (Senior Land Surveyor/BIM, Lands Department, Hong Kong):

Maintaining **consistent, good quality data** in 100 - 200 projects managed each year by 6 distinct Works Departments in Hong Kong's Development Bureau has been one of the key issues challenging the success of our **Government BIM Data Repository**. **Accurate, reliable data** are an essential foundation for Hong Kong's broader aspirations to **support data-driven decisions for future Smart City** applications.

To help organize data from projects in these 6 departments, the Lands Department (LandsD) adopted an Information Delivery Manual (IDM) and engaged Strategic Building Innovation (SBI) to collaborate in development of an **automated model checker based on bSI's Information Delivery Specification (IDS)**, a solution that will benefit each of the Works Departments as well as the Lands Department by streamlining model validation processes, increasing the reliability and efficiency of openBIM® information exchange, and providing **reusable software components** to meet future needs.

Ten model checking requirements were prioritized for this initial effort, addressing the most important use cases; this work was completed successfully in May 2022 and **documented in quantified reports** showing benefits to all stakeholders and **underscoring the importance of consistent quality standards** for project owners. These metrics will provide a baseline of current performance used to measure and demonstrate data quality improvements realized in the future.

Tony Rinella (Co-Founder and Senior Director, Strategic Building Innovation, USA)

As consultants, educators, researchers, and long-time advocates for industry advancement, SBI was delighted by this opportunity to ❊ fill **a critical gap in process and implementation knowledge linking openBIM® with open GIS** for very large, highly detailed model sets, ❊ contribute input to extend the bSI IDS standard itself, and ❊ ultimately raise the level of international good practice.

The IDS Model Checker **automates quality assurance and control processes that have proven impossible to accomplish manually** at the scale required to maintain large BIM portfolios. Compliance verifications that might take a few persons-days per model to perform manually were completed in **an average of 12 seconds per model** using IDS Model Checker on **149 models in the proof-of-concept set**. This approach will **easily scale to accommodate the 300,000+ model**s anticipated by the client.

Accomplishing this **using open Standards that forever protect data access rights for owners and governmental stewards** regardless of market challenges allows the industry to overcome many of the uncertainties and risks formerly associated with open Standards digital strategies for management of the built environment. This project **informs creation of more robust IDS Standards** and opens a pathway to profound and rapid digital transition supported by **reliable and repeatable** open Standards good practices.

Upload a 2 minute video to show the scope of the entry.

MP4	Scope of the entry (video... (121.8 MiB download)

openBIM Claim

Detailed description of openBIM used on the project or initiative

openBIM Achievements:
Our project teams have been involved in and supporting the development of buildingSMART International's (bSI's) Information Delivery Specification (IDS) standard. The bSI's IDS standard is a new standard under development since 2020. Our project teams have been actively testing IDS standard during bSI's IDS implementation stage and contributed to the standardization and stabilization. We have developed IDS Checker that can operationalize idsXML files generated from human-readable IDSs. We used IDS Checker for checking the IFC models received from government agencies and, although the qualities of the IFC models were not satisfactory at the beginning, the checker showed its capability of quantitatively assessing the quality of IFC models against IDSs and providing feedback to the BIM authors.

Motivation:
From 2021, Lands Department (LandsD) has been developing a roadmap for the Open Standards Government BIM Data Repository (GBDR). The vision of the roadmap was to integrate openBIM and openGIS data and create a data repository that is scalable, serviceable, and shareable. After a pilot study with around 260 native models collected from seven government contracts, LandsD quickly realized this cannot been done without a "neutral" format, information requirements, and harmonization. With a mix of proprietary formats, the users of the data repository will likely go through difficulties due to inconsistency and lack of required entities, properties, or property values. For the data to be scalable, serviceable, and shareable for the city, the data repository had to be developed based on open standards.

bSI's new standard – IDS:
bSI's new IDS standard was the key to creating a scalable, serviceable, and shareable data repository. The development of bSI's IDS standard is in its initial stage and going through continuous improvements. IDS defines information requirements, can be written in an idsXML format, and exchanged between software designed to be compatible with the bSI's IDS standard. The IDS can be used to check IFC models - in this sense, IDS can be used to build a model checker which we have done in our project and referred to it as IDS Checker. The difference between commercial model checkers, such as Solibri, and IDS Checker of our submission is that our IDS Checker is following bSI's standard for expressing information specifications.

Some organizations also have been using model view definition (MVD) for model checking. The original intention of MVD is to define a subset of IFC data structure given a certain use case and deliver/convert the subset information for the use case. Somewhat different from this original intention, organizations, such as Statsbygg, also have been using MVD for model checking. However, in comparison to MVD, IDS is more flexible and fit for model checking as IDS allows a user to be free from a use case (i.e., model view) and to constrain values with a regex pattern, require values to use enumeration, and require values to fall under a certain range (min and max values).

"We were able to innovate using openBIM."

Information Delivery Specification (IDS) is a new and innovative standard under development by buildingSMART International (bSI). It is still going through continuous improvements, so the standard will remain in flux for some years to come. From the beginning of the IDS development in 2020, we have contributed to the development by working with the standardization and validation group, providing feedback, and being active on the bSI's github website (https://github.com/buildingSMART/IDS). We also look forward to providing idsXML files to other community members for expediting the IDS adoption in the industry.

Besides IDS, our project teams have used other openBIM standards, such as IDM, IFC 4, BCF - and further embraced openGIS. To present the BIM data at an urban scale with contextual maps, we have utilized openGIS with the following open standards/solutions: CityGML, Cesium, 3D Tiles, and glTF.

To validate the innovative uses of the IDS and the openBIM+openGIS integration, we have also tested the Open Standards Government BIM Data Repository (GBDR) platform with models of varying level of developments/details (LODs). We have worked with 1000+ CityGML models at LOD 1 (according to CityGML LOD definition) and 149 IFC models at LOD 100-300 (according to BIMForum's LOD definition). APIs allowing the development of IFC-based web applications were also used to develop a 4D-based decision support system at an urban scale.

Our roadmap for the development of the Open Standards GBDR also includes plans for incorporating the buildingSMART Data Dictionary (bSDD) to IDS and further utilizing APIs for developing IFC-based web applications.

openBIM methods used

- ✓ IFC 4
- ✓ BCF
- ✓ IDM
- ✓ IDS

Have you used bSDD to add additional extensions on top of IFC?

No

Were there other regional or open standards used other than those listed above?

3D Tiles, Cesium, CityGML, glTF, ISO 19650 (with local annex), OmniClass.

Level of Collaboration

✓ Multi-domain in two or more organizations

Information Requirements

PDF	Information requirements.... (3.2 MiB download)

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openBIM Evidence

Software Ecosystem Map

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Process Maps

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openBIM Data Metrics Summary

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Additional openBIM Supporting Evidence

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Lessons Learned

One of the advantages of using buildingSMART International's (bSI's) new Information Delivery Specification (IDS) standard is that IDS will be transferable between BIM tools when software vendors adopt bSI's IDS standard and develop functions or plugins for reading machine-readable IDS files (e.g., idsXML files). bSI's IDS standard is an international and open standard for defining and exchanging information specifications - a scalable and shareable solution to exchanging information requirements. However, we have also learned some downsides to IDS: (1) the checks are usually limited on the schema (data structure) level or, more specifically, checking the information related to IFC entity type, classification, property, attribute, material, and range of values, (2) the checks are not applicable to geometric information, such as dimensions, and (3) the checks requiring complex logical assessment, such as if statements, are difficult to implement. To address these limitations, our project teams have categorized information specifications that can be expressed with bSI's IDS standard and the specifications that cannot, and have used our IDS Checker following bSI's IDS standard for the former and used commercial model checkers, such as Simplebim, for the latter. We recommend other project teams in our bSI community to take a similar approach: using idsXML files and IDS checkers following bSI's IDS standard and supplementing this with commercial model checking tools that allow more complex checks, such as geometry and route checks. We also encourage solution providers (e.g., software vendors) to adopt IDS and develop plugins or functions for reading idsXML files so information requirements (i.e., IDS) can be made interoperable and shared between software applications and stakeholders.

"We were able to identify where we need openBIM to develop further."

Today, information requirements are usually shared in form of documents - such as exchange information requirement (EIR), BIM execution plan (BEP), information delivery plan (IDP) - describing what information needs to be delivered, in which format, and when. We foresee that, in the future, the sharing of the information delivery specification can be done in the form of machine-readable format between different tools, eventually helping to reduce miscommunication and to deliver the correct information, and keeping everyone on the same page. For instance, LOD-I requirements in EIR can be issued in a machine-readable format (i.e., Information Delivery Specification (IDS) file), and an IDS file containing the requirements can be issued for a design stage - another IDS file can be issued for a construction stage - and shared among the project stakeholders. Transferring IDS files between BIM tools is still difficult today as the development of buildingSMART international's (bSI's) IDS standard is still in its initial stage, and software vendors have yet to adopt IDS into their tools. But when BIM authoring tools, in the future, are developed with a function (e.g., plugin) for reading the machine-readable specification, BIM authors should be able to import the specification into the BIM authoring tools and check their models against the specifications before submitting the client or owner. Another room for improvement is making the bSI's IDS standard fully interoperable with the buildingSMART Data Dictionary (bSDD), which needs to be done by bSI, the standards setting body.

Upload .ifc file(s) or other technical files to support validation of the research results.	https://hongkong.nederlandin3d.nl/

Share any instructions for accessing the .ifc or other technical files for review.

See "Attachment 04 - Instructions for website and idsXML files.pdf".

Username: jury
Password: buasoawi

Use Cases

BIM Uses were defined on the project	✓
BIM Uses formed an integral part to how the project was delivered	✓

I agree to be contacted for more information about the project BIM uses outside of this awards program. | ✓

Documentation on use case(s) as a single file upload

PDF	Use cases.pdf (1.7 MiB download)

Log in to awards.buildingsmart.org to see complete entry attachments.

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Technical Documentation

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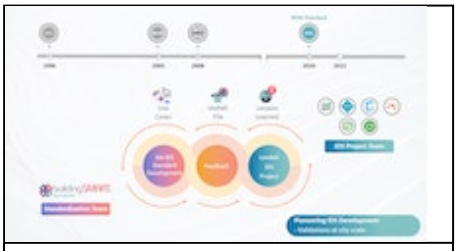

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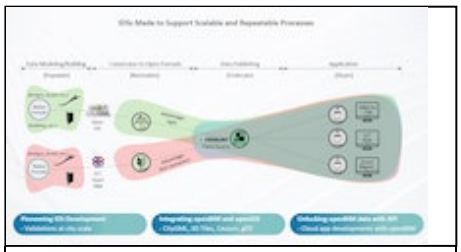

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