The buildingSMART Awards Yearbook

Winners 2020

Extraordinary winning projects from 2020 from the buildingSMART International Awards Program

buildingSMART International

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About buildingSMART

buildingSMART is the worldwide industry body driving the digital transformation of the built asset industry, committed to delivering improvement by the creation and adoption of open, international standards and solutions for infrastructure and buildings. buildingSMART is the community for visionaries working to transform the design, construction, operation and maintenance of built assets and is an open, neutral and international not-for-profit organization.

The buildingSMART Awards program was established in order to recognize exemplary projects that have used buildingSMART standards and solutions to effectively overcome interoperability challenges. The first awards were presented in Toronto in October 2014, and the program continues to grow year on year.

The 2020 Awards saw projects compete in 7 categories, with an additional 3 Awards being presented at the discretion of the buildingSMARTmanagement team, resulting in 10 project winners.

2020 Highlights

Categories

This program was divided into four broad categories; Project Delivery, Operations, Research and Technology. Each category has sub-categories and these provided the basis for the awards program.

Jurors

This awards program saw a record 111 jurors across 23 chapters. The role of the juror includes grading project subissions against a strict criteria designed to ensure the highest quality of submission. This year there was also a new addition of a triage team to help reduce the amount of work on all jurors.

Submissions

There was a record 111 submissions across all the categories. The breakdown for those that past triage are listed below:

- Asset Management: 4
- Construction: 11
- Design: 15
- Handover: 2
- Integrated Project Delivery: 4
- Professional Research: 8
- Technology: 22
- Student Research: 8

Special Mentions

Due to the high quality of submissions, there were a number of projects deemed of a high standard enough to warrant a special mention. These projects scored exceedingly highly but fell slightly short of the required number to become a finalist. These projects therefore qualified as a "Special Mention" and were duly awarded this during the ceremony.

Categories

- Asset Management
- Client Leadership
- Construction
- Design
- Handover
- Innovation
- Professional Research
- Student Research
- Technology
- Technology Leadership

Finalists

ACCA software – ITALY.	Pages 24-25
Auckland International Airport Ltd - NEW ZEALAND.	Pages 6-7
BEXEL Consulting - SLOVENIA.	Pages 16-17
BIM & Scan – Ireland.	
Byggstyrning – SWEDEN.	Pages 10-11
Cardno Victoria Pty Ltd. – Australia	
CCCC Highway Consultants CO.,Ltd. – CHINA.	Pages 12-13
China Railway First Survey and Design Institute Group Co., Ltd – CHINA.	
COWI – NORWAY.	
École des Ponts ParisTech – FRANCE.	Pages 20-21
Ineco – SPAIN.	
Lendlease – AUSTRALIA.	Pages 22-23
Losinger Marazzi SA – SWITZERLAND.	
Norwegian Public Roads Administration – NORWAY.	Pages 8-9
Technical University of Munich - GERMANY.	
The University of Manchester – UNITED KINGDOM.	Pages 18-19
University of Sao Paulo - BRAZIL.	
Vestfold Hospital – NORWAY.	Pages 14-15
VIA IMC GmbH – GERMANY.	
Warbud SA – POLAND.	

buildingSMART International

WINNER

Auckland Airport maps its future with openBIM

Auckland Airport, New Zealand

About the Airport

Auckland Airport is an international airport that enables to safe carriage of passengers and users to and from New Zealand. The airport itself covers a land area of approx. 1700 hectares, onto which both its international and domestic terminals operate covering approx. 170,000m2 of space. Every year, 21 million passenger's pass through these terminals. The airport itself has full operational control of both the CAPEX and OPEX work. To ensure it could keep pace with growing demands and the need to ensure future capacity planning, the airport began to work on a project to deliver a smarter methodology for supporting these goals.

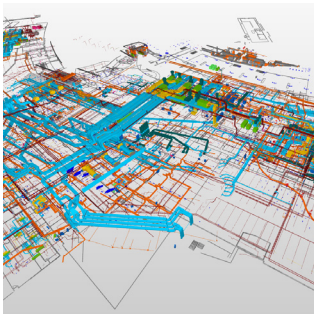
Core Objectives

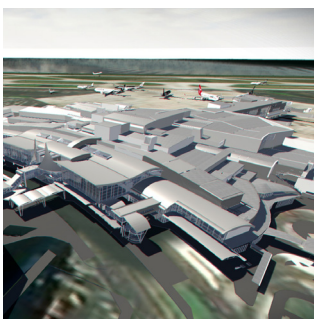
To enhance the use of IFC across multiple projects for enhancing the digital for the airport. The airport wanted to mandate the use of openBIM methodology to connect a variety of tools from their stakeholders.

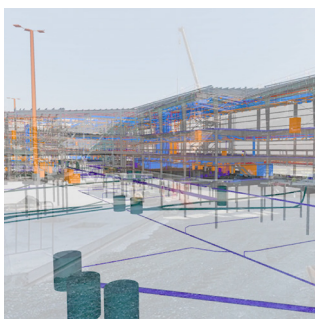
About the Projects

Prior to the Covid-19 pandemic, the airport was undertaking its biggest capital works program and had committed to spending NZD $2 billion for a variety of projects. At the time the global pandemic started, there were 15 ongoing projects spread across the whole airport. All these projects were actively delivering models in IFC format. In the years prior, there had been numerous projects that were also delivering models in IFC format that fed into their federated terminal asset information model. The concept of digital delivery had been widely adopted by the airport since 2015 which was accelerated by the asset information model in place. There were a variety of different projects running concurrently, including:

Terminal Building Asset Information Models (AIM) – this project including continuous







development for more than 100 IFC models spanning a variety of design models, as-built construction models and Scan-to-BIM models, covering all disciplines.

IFC Model Sharing – this process was fully supported in accordance with their IDM (information delivery manual) requirements and were fully geocoordinated. The client did not restrict the use of authoring tool and utilized Oracle's Aconex platform as their common data environment. These models were used for a variety of use cases such as baggage handling, capacity planning, smoke simulation and new building design. Tools such as Sketchup, Revit, and Archicad were used extensively. Numerous projects were also utilizing BCF for issue resolution.

Capital Works Master Schedule (CWMS) – was a project that had a long-term view for their 2044 master plan. IFC was used for their 4D enabled plans, including better simulation and planning with Synchro, scale and geolocation with Archicad and overlaying project polygons with existing utilities data.

BIM to GIS – was a project that focused on delivering floor plans for better FME management. There was also a Proof of Concept alongside an external consultancy to convert existing 2D survey data into an IFC model (Using 12D) with a new property set that contained all the available utility data.

Highlights

- Over 100 disparate models successfully geo-loacted and exported to IFC
- 250,000+ elements modelled within the existing international terminal
- Client developed Asset Information Delivery Manual (AIDM), mandating OpenBIM delivery requirements for Native and IFC models for all new projects
- Developed a comprehensive 4D Capital Works Masterplan model utilizing IFC at its core

buildingSMART tools used

IFC 2x3, IFC4, BCF

Software used

- Autodesk (Revit, Navisworks, Civil3D, AutoCAD, Recap pro, BIM360 Field and Glue), ArchiCAD, Solibri, SynchroPRO, Oracle Aconex, Oracle Primavera P6, Tekla, FME, ESRI ArcGIS Pro, Renderlights,12D, Leica Cyclone Register 360, BIMCollab, Prosteel, AutoCAD, Microsoft PowerBi, PyroSim

Other Standards

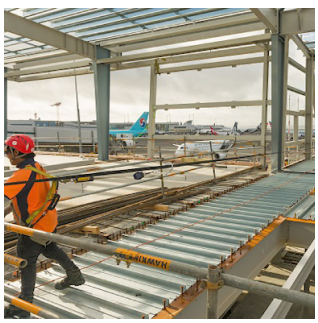
- Omniclass, E57, XYZ, DWG, Collada, DWFx

Result

Jurors in the category of Asset Management were impressed with Auckland Airports innovative approach to openBIM. As the owner-operator, the jury felt the airport provided clear guidance to all those delivering work during this transformative time. It was clear that this projct adopted the best of both buildingSMART standards and solutions to deliver an effective outcome.

> "openBIM enabled us to do more with less by being free to work between multiple tools as needed, without having to work within the constraints of one software. It puts the output at the centre, which in the reality of a client organization is what matters most."

Karl Fitzpatrick, Auckland Airport



buildingSMART International

WINNER

V440: A Machine-Readable Norwegian Classification Manual for Bridge Inspections

Norwegian Public Roads Administration, Norway

About the Project

The initiative to launch a machine-readable classification manual for bridge inspections originated from one of the larger infrastructure projects owned by the Norwegian Public Roads Administration (NPRA), the Bjørnafjorden fjord crossing, which aims to build a long floating bridge with an elevated section. As the Bjørnafjorden project needed a common classification system to align the incoming data streams, NPRA applied the classification defined in the existing bridge registration manual V440.

The V440 project lasted a year, reaching completion in August 2020, and involved four software vendors who actively participated through prototyping and the implementation of the published V440 ontologies in their software solutions.

Today, the resultant Norwegian bridge registration manual—V440—is issued by the Norwegian Public Roads Administration (NPRA) as a PDF document.

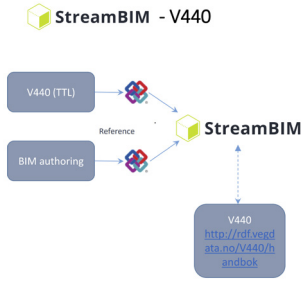
Core Objectives

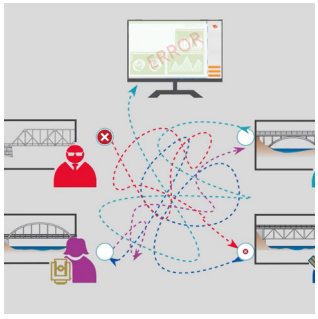
The project objective was to make the classification structure described in V440 available as an open, machine-readable format, to allow for automated and consistent classification of Norwegian bridges and structures in different software solutions.

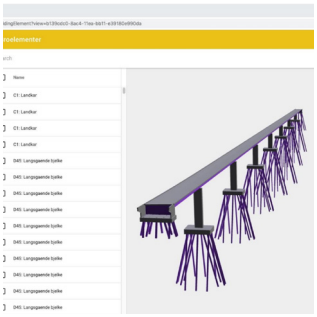
Project Description

Phase One

As the first step in Phase One, the domain experts in NPRA moved the information from the PDF-formatted V440 manual to a spreadsheet in a structure that easily could be imported into TopBraid Composer to define the ontology. The V440 classification ontology was developed using Linked Data and Semantic Web (LD/SW) technology, which employs open formats and are considered as openBIM in this project.







Phase Two
In phase two, NPRA and the project team conducted quality assurance revisions of the ontologies and published them at a server site.

In addition, a SPARQL endpoint was published, allowing the software vendors to use the querying language SPARQL to access the classification structure. GraphDB was used as the triplestore to provide the SPARQL endpoint.

A GitHub site was established, containing all the relevant information needed for the participants in Phase Three of the project, including ”getting started” material and the ability to ask questions.

Phase Three
In Phase Three, software vendors were invited to implement the use of the published ontologies.

This was followed by a prototyping process called openLAB adapted by buildingSMART Norway. This “workshop” lasted for several months where the participating software vendors could develop their solutions and exchange information and experiences.

The resulting classified BIM models were exported from the prototype editions of the software to the validation software as IFC 2x3 and/or IFC4 files.

Highlights

- Showed the benefit of moving “digital paper”-based (PDF format) classification systems to an open machine-readable format.
- Showed how easy it is for software vendors to integrate well-documented ontologies into their software to produce valid IFC models.
- Showed the benefit of using the LD/SW technology to link different ontologies together with linking rule sets.
- Developed a lean and simple ontology modelling process using Excel spreadsheets for domain experts and Top Braid Composer for the LD/SW experts.
- Made very good demo showcases for the use of LD/SW technology in four different software solutions.
- Taught interested software vendors the basic concepts of LD/SW and how to implement this technology in existing software packages.

buildingSMART tools used

IFC 2x3, IFC4, ifcOWL

Software used

Areo, Quadri, Tekla Structures, StreamBIM, Solibri, MS Excel, Protégé, TopBraid Composer, GraphDB

Other Standards

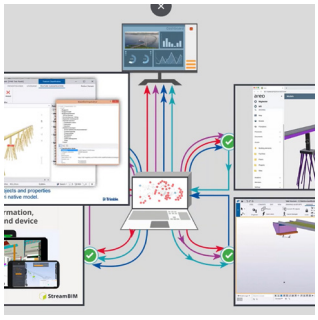
RDF, RDFS, SPARQL, OWL

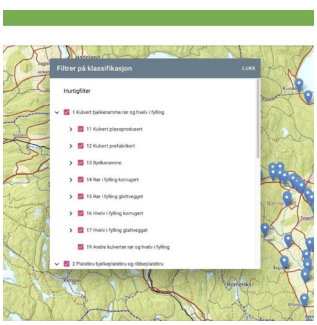
Result

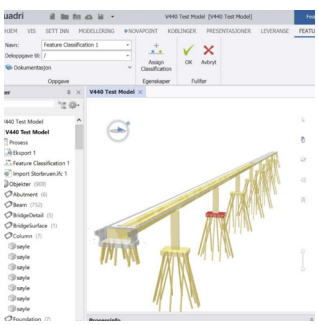
The use of openBIM and other open standards is the very essence of this project, with the main achievement being the V440 ontology. The project used only open formats when defining the ontologies and linking rule sets.

This project demonstrated how quickly software vendors can implement the use of Linked Data and Semantic Web (LD/SW) ontologies in their software when the ontologies are published in an open, standardized and well-documented format. By opening up LD/SW as the technology platform for openBIM, there are almost no limits to the possibilities that can achieved by linking and combining different ontologies.

The links to the V440 ontologies have now been published at the official NPRA site for manual V440 and the NPRA now expect the industry to use these ontologies in their daily work.

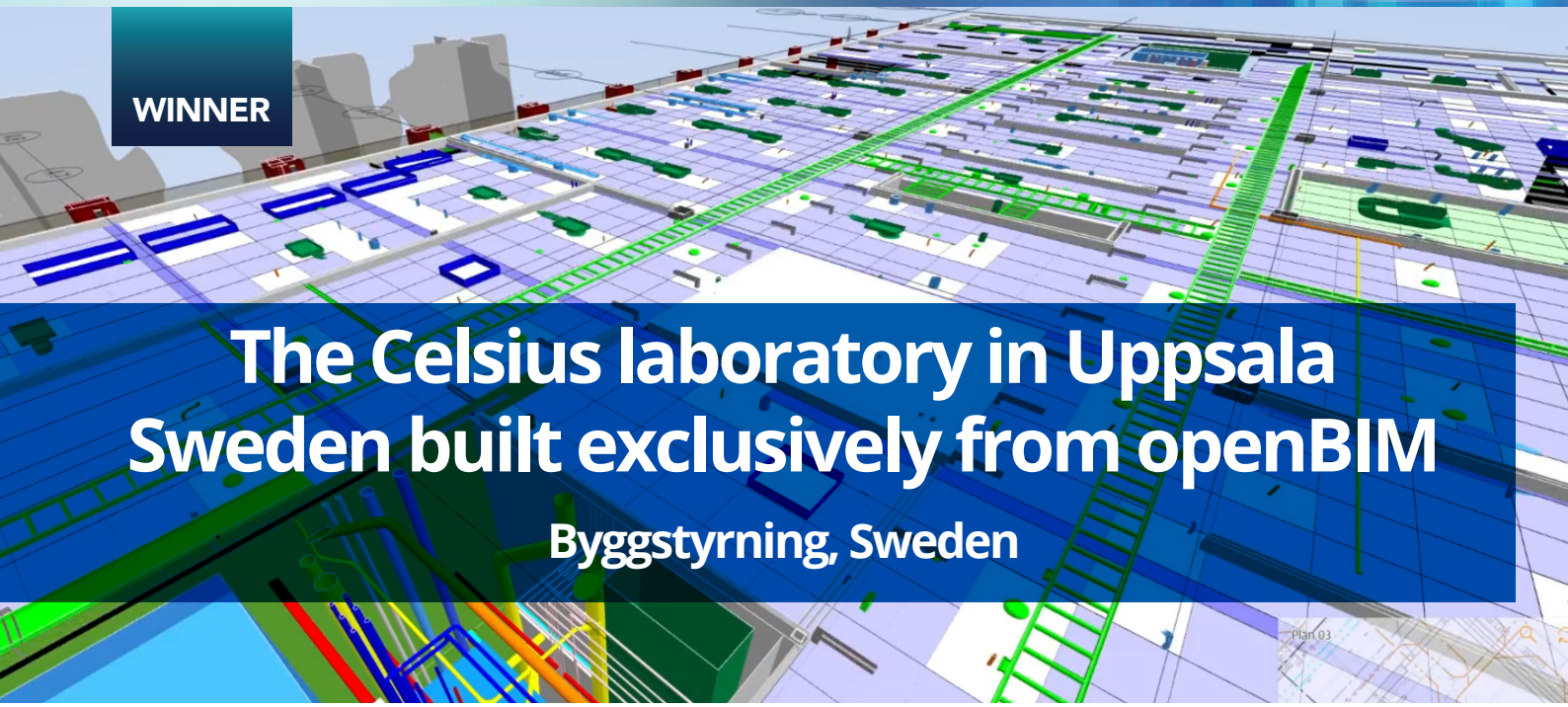






buildingSMART International

WINNER



The Celsius laboratory in Uppsala Sweden built exclusively from openBIM

Byggstyrning, Sweden

About the Project

Project Celsius is a brand new 12,000m2 headquarters for the Swedish Food Agency, whose emphasis on using proven modern technology and solutions was a key factor in their initial brief to construction management firm Byggstyrning: "To dare to ask, to dare to try new solutions and not to do as we have always done. To be brave is to dare to make difficult decisions if they lead to a better whole. Celsius should be a role model and inspire visitors."

Core Objectives

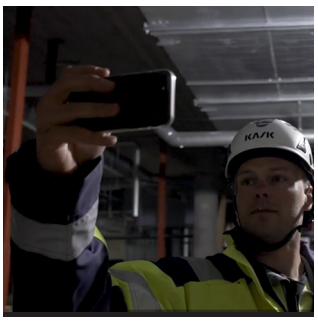
From the outset, Project Celsius was driven by two clear goals: to work exclusively in openBIM—so as to create an unbroken and robust information chain—and to achieve industry-leading sustainability targets.

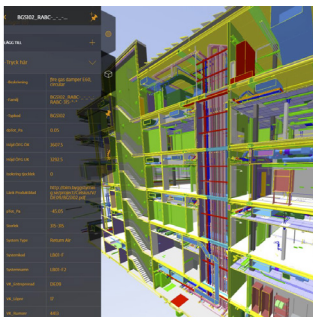
Project Description

To fulfil the vision of an unbroken information chain, an openBIM process was applied at all phases of the design and build of Celsius.

Design Phase: The design team focused on producing high-quality openBIM models with accurate and quality-checked information for participants downstream. Due to the ease of communication between stakeholders and designers through the BIM Collaboration Format (BCF), they were able to identify and solve more issues (over 1000) in the design than in previous projects.

Construction Phase: Project Celsius took the bold move to use the IFC model as the legal construction documents, knowing that they could rely on the format as an ISO standard. The 3D IFC models were to be viewed as a replacement for traditional construction drawings, this meant that throughout the whole construction phase there were no paper documents and all trades used mobile devices





The gap between office and field was bridged by empowering all workers with an openBIM platform, which was agreed upon following direct consultation with the construction workers in order to implement the most functional and understandable application available to them. As a result, hardhat workers adopted openBIM and mobile technology in the field with ease, making the shift from drawings to 3D construction possible.

The openBIM application that was implemented, StreamBIM, offered several time-saving opportunities, such as through highly efficient communication of administration items, including quality inspections, safety issues, rework orders, as-built documentation, control checklists and design mark-ups. Additionally, an automated process was developed to keep the openBIM mobile application updated with the latest IFC models, thus saving hours each week in data management.

Highlights

- IFC models as legal construction document;
- 90% built from IFC models in IFC tablet applications in the field (StreamBIM);
- 80% fewer rework orders;
- All issues and communication related to locations in model by BCF;
- Weekly automated export of IFC models from native application to aggregated IFC model in cloud (StreamBIM);
- No paper allowed on site (completely digitized jobsite);
- Workers ranked the project extremely high in communication.

buildingSMART tools used

IFC 2x3, BCF

Software used

Revit, Navisworks, Autocad, Civil3D, Tekla Structures, ArchiCAD, Solibri, Rhino, SimpleBIM, StreamBIM, BIMcollab, BIMeye, BIM360 Design, Miro, Holobuilder, InsiteVR, Unity, Twinmotion.

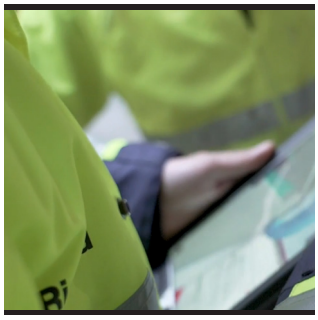
Other Standards

BIP, Building Information Properties (Swedish national open industry standard on naming IFC Property sets, attributes and values)

Result

The benefits of the use of openBIM in the project are clear in some of the statistics: transport costs were reduced by 80% as a result of ordering materials from openBIM models, there were 80% less rework orders compared to projects not using openBIM models, the final costs are estimated to be as much as 10% below the initial budget, and the project has been ahead of schedule throughout its lifecycle.

The Construction award for Project Celsius is a recognition of the effort in challenging the status quo in the industry. The project is proof that the industry is now ready to move past the legacy of paper-based information exchange and move into a collaborative, data-driven construction process using openBIM as a solid foundation.



buildingSMART International

WINNER

openBIM standards utilized in the design and construction of Panama Canal 4th Bridge

CCCC Highway Consultants Co Ltd, China

About the Project

Panama's Ministry of Public Works confirmed the CCCC-CHEC consortium won the bid for the project of the fourth bridge over the Panama Canal in 2018. The bridge is to be constructed just 0.5 kilometers north of the Bridge of the Americas and will have a design life of 100 years. The new bridge will connect the two ends of the Interoceanic Canal, boost transport links to Panama West and improve connectivity to inner Panama, benefiting at least 2 million local people.

Core Objectives

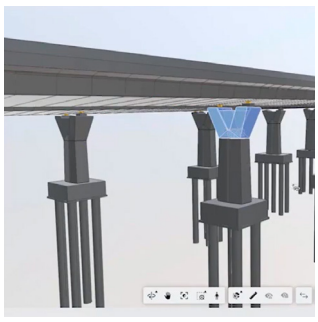
To utilize openBIM standards in the bridge design in order to increase interoperability and management efficiency.

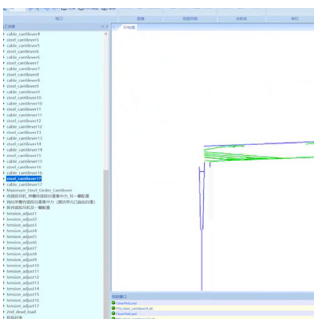
Project Description

The project comes with multiple and varied challenges, including but not limited to: satisfying numerous stakeholders, managing large scale cross-disciplines within the design team, overcoming difficult terrain and safety challenges, and undertaking specific studies and analysis due to the geographical location.

The client mandated in the Terms of Reference that the strategic objectives of the project were to create a seamless ecosystem of collaboration within project team, as well as to maximize BIM value by extending the usage from design to construction and asset management.

As well as full BIM usage throughout, also mandated in the project brief were BCF, COBie and IFC as the delivery formats. The openBIM standards, combined with ISO19650, were adopted in the project along the whole design phase, solving design challenges, improving cross-discipline collaborations and project interoperability, reducing coordination issues, and advancing project data qualities.





The detailed usage of openBIM is as follows:

IDM: In this infrastructure project, a tailored general cross-disciplinary IDM was created for the design phase.

IFC: IFC2x3 files hold structural information such as road structure modelling and bridge structure modelling, which are transformed to the service engineer for designing the transportation facilities and bridge accessories, as well as constituting the federated model for clash detection and coordination. An IFC schema database allows the data engineer to retrieve and operate according to the project needs. Further, using IFC has eliminated the barriers between different disciplines and software, of which there are more than 10 in use in this project.

BCF: BCF was used as the issue communication format. In both the modelling software (Revit) and coordination software (Navisworks), BCF-based issues were created and published onto the BIMTrack platform, which acts as the central server for hosting, tracking and interacting all the issues. By using BCF, all the issues can be maintained and tracked for the whole issue lifecycle until closed.

COBie: COBie standard was applied to the project from the design phase with the aim of extending the BIM use to the asset management phase, as well as making routine data validation. BIM models, together with COBie sheets, were uploaded to the FM platform YouBIM, to allow facility managers to view and check the data. By adopting COBie, potential mistakes were avoided, which saved on cost and provided a great return on investment.

LandXML: LandXML and IFC provides a readable protocol for the data exchange between stakeholders (e.g. topography data between the survey engineer and the bridge engineer) saving a large amount of time that would otherwise be spent in dealing with different format and files.

Highlights

- Client mandated native file formats and IFC, BCF, COBie;IFC
- Client required full BIM usage in design, construction and maintenance stages;
- openBIM standards, combined with ISO19650, are adopted successfully in the project;
- More than 10 different design software used in the project.

buildingSMART tools used

IFC 2x3, BCF, IDM

Software used

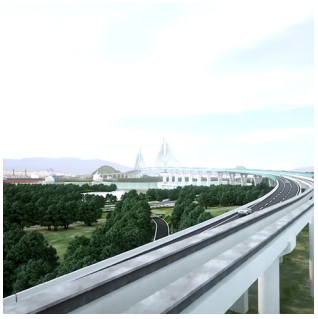
- BIM360, Navisworks, BIMTrack, BCFier, Revit, Dynamo, Civil3D, AutoCAD, Inventor, ANSYS

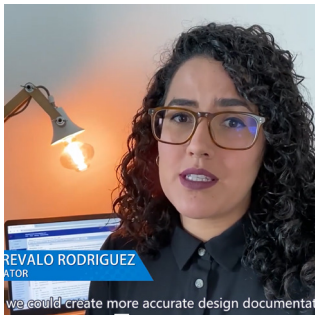
Other Standards

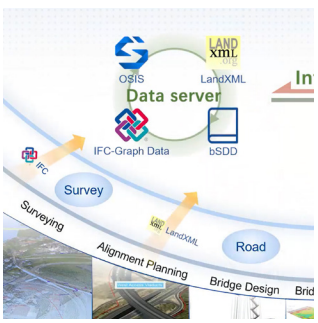
- COBie, LandXML

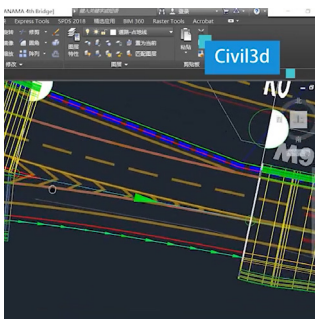
Result

By applying openBIM standards and philosophy, the project has thus far operated more efficiently and smoothly, by reducing data silos and enhancing interoperability. The project has been optimized in the design phase and moves towards a sustainable lifecycle.









buildingSMART International

WINNER

Vestfold Hospital
The Tønsberg Project
Vestfold Hospital, Norway

About the Project

The Tønsberg Project is the last stage of the Hospital Development Plan, initiated in1990, for the Vestfold County Hospital in Norway. The Tønsberg Project is divided in two parts—the Psychiatric building (delivered in May 2019) and the Somatic building (to be delivered in Q4 2021). The project was developed in two stages, as part of the old Psychiatric building fell within the footprint of the new Somatic building. The estimated value of the project is 3 Billion NOK (circa US $330 Million).

Core Objectives

To utilise existing and new digital tools and methodologies to achieve measurable results in design, construction and operation, specifically:

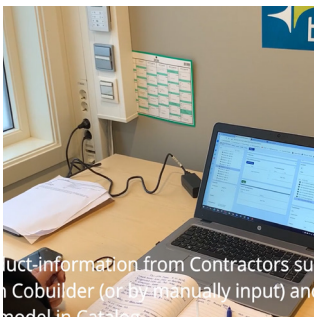
- functional and construction quality equal to or better than comparable hospitals;
- substantial reduction on project cost (10% reduction compared to a project finished in 2005 with corresponding regulatory technical standard);
- a complete handover in an openBIM FM documentation system;
- BREEAM Very Good certification.

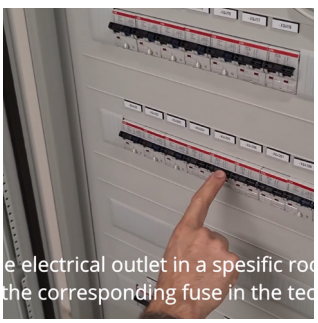
Project Description

The implementation of openBIM has been a focus of South-Eastern Norway Regional Health Authority for over 10 years, with a goal to improve efficiency through digitalisation.

Using IFC4, the Tønsberg Project developed and deployed a Facilities Management (FM) software solution based on openBIM to ensure smooth handover, clear information ownership and data longevity.

The resulting Electronic Building Journal gives hospital building operational personnel more immediate and easy access to the model and all FM information, by directly connecting them to the IFC model in both 2D and 3D.





This project established a new and efficient openBIM-based method to gather and deliver FM information, by automatically extracting information/documentation about objects and building systems from the contractors' supply chain and an external product database. BIM objects were directly connected to this extracted information. This method paves the way for an even smoother FM information handover delivery once all design group/contractors and building wholesalers start using Serialized Global Trade Item Numbers (SGTIN) as product identification—both in the model and the supply chain.

Notably, it is the first project in Norway to use the Integrated Project Delivery (IPD) model. This is a collaboration model with early involvement of the construction contractor and a shared risk-reward for all project participants, with a joint responsibility for mistakes and omissions during design and construction.

Highlights

- An Integrated Project Delivery (IPD) project:
- Client demanded openBIM (IFC format) for file exchange and the delivery of both IFC files and native files for FM information delivery:
- Established a novel method to connect information about building systems and objects from the supply chain to the FM information tool:
- FM information is easily and quickly available to hospital operations team on a openBIM platform.

buildingSMART tools used

IFC 2x3, IFC4, BCF, mvdXML, COBie, MVD, bSDD, ifcXML

Software used

EDMmodelServer (including EDMweb, EDMissueDB, EDMcatalog, EBIMconnect) by Jotne EPM Technology AS, Solibri Model Checker, BIM Collab, ArchiCAD, Revit Structures, MagiCad, Tekla Structures, Novapoint, dRofus, CoBuilder, Map Portal from Norwegian Map Authority (Statens Kartverk), GLN database by GS1 Norway Primavera P6, Tekla, FME, ESRI ArcGIS Pro, Renderlights,12D, Leica Cyclone Register 360, BIMCollab, Prosteel, AutoCAD, Microsoft PowerBi, PyroSim

Other Standards

Serialized Global Trade Item Number (SGTIN) in unique asset identification.

Result

buildingSMART International recognized the project's use of openBIM as the foundation of all its design work when it won in the Design category of the 2017 Awards program, and this has continued right through to the Handover phase, which is still underway as its second phase nears completion. The project is on schedule and on budget, including a near 10% cost reduction compared to a project that was completed in 2005. In line with the project objectives, BREEAM Very Good certification has been achieved for the Psychiatric building and the same is expected for the Somatic building.

One noted benefit of using openBIM is the reduced time to find relevant information in a maintenance situation. Traditionally, this would take from 0.5 to 3 hours, but with the hospital's new openBIM FM information tool, the time is reduced to only 5 to 15 minutes, depending on the complexity of the sought information. In many ways, the Tønsberg project is a pilot project, in which the handover process has been radically changed and may be considered as a model for the future.

buildingSMART International

WINNER

Smart openBIM Project Management on Novo Brdo Residential Complex with Bexel Manager

BEXEL Consulting, Slovenia

About the Project

The Novo Brdo neighbourhood is a new, publicly funded development by the House Fund of the Republic of Slovenia, and is comprised of 22 buildings housing 575 rental apartments. The 77,000m2 development focuses on the lifestyle needs of the young and old alike, and, as such, includes diverse public areas with shops, services, a library, playgrounds, extensive green areas and even a large, natural rainwater pond.

Core Objectives

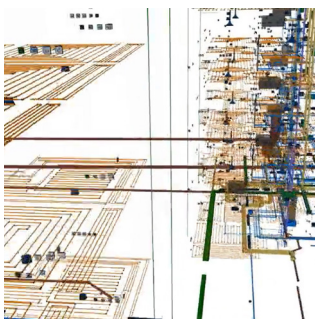
As a publicly funded project, transparency in project management processes has been defined as an important objective of the BIM implementation. Also, thorough mutual understanding and vast collaboration between project stakeholders are identified as the means for eliminating rework and lowering project risks and waste in effort, time and resources.

openBIM was identified as having a crucial role in the meeting of these project objectives and, as such, it was a mandatory requirement that all BIM results were delivered in open formats.

Project Description

Implementation of openBIM workflows and data exchange made the project goals achievable for stakeholders throughout the entire project lifecycle. Using BEXEL Manager (IFC-certified software), a large-scale federated BIM model was established as a single source of truth , with over 510,000 elements from 89 different IFC files. A Common Data Environment (CDE) was established to efficiently manage the project's communication, accessibility and updating challenges. An integrated Document Management System (DMS) allowed stakeholders to exchange documents with no format limits and to link directly to BIM model elements through fully supported openBIM standard workflows.

All project participants could access, at any time, insight into the planned quantities of work,



materials, specifications and changes that occurred over the course of the project. The central BIM model prevented any miscommunications and disputes typical for construction projects.

Timely detection of potential and actual collisions in the project, and efficient collaboration with project designers through information exchange, were enabled through the federated BIM model, CDE and adoption of openBIM standards. The elimination of shortcomings in the project resulted in significant savings in time and resources during the execution of works.

By maximizing the use of available data, technology and knowledge, it was possible to automate time-consuming tasks in planning, quality control, cost management, scheduling, value engineering, progress tracking and the certification process. This automation resulted in further savings in time and resources. For example, smart cost management introduced a variety of benefits through automation in cost database creation. This workflow, with IFC data as the basis of the process, allowed the project team to create a full cost database and bill of quantities with over 1,800 tasks in just 2 days. With traditional methods this type of task takes months to complete.

Highlights

- Large-scale federated BIM model with over 510,000 elements, from 89 different IFC files ;
- Using BEXEL Manager IFC Model Checker (IFC properties checking and validation) Add-in, more than 60,000 elements were identified with deficiencies in metadata (IFC properties missing or do not have adequate value);
- Automatically developed cost classification database with 1,872 cost items, and direct link to model elements through automatically created element queries based on model metadata (IFC properties);
- Implementing smart scheduling engine, based on defined spatial zones and construction sequence methodologies construction schedule with 4469 tasks and 6272 relations is generated, directly related with cost items and corresponding IFC model elements;
- More than 3,000 spatial conflicts were detected and resolved;
- Element-based monitoring of construction progress, planned vs actual comparison, earned value analysis, and regular advanced reporting.

buildingSMART tools used

IFC 2x3, IFC4, ifcXML, BCF, IDM, MVD, mvdXML, COBie

Software used

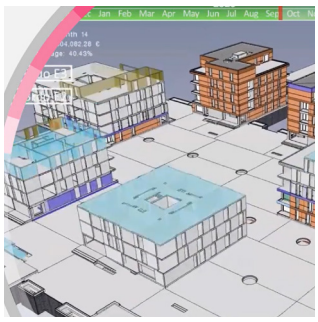
BEXEL Manager, BEXEL Manager CDE, BEXEL Manager FM, Autodesk Revit, Autodesk BIM 360, BIM Collab Cloud, Solibri model checker, Autodesk Navisworks, Autodesk 3DS MAX, Enscape

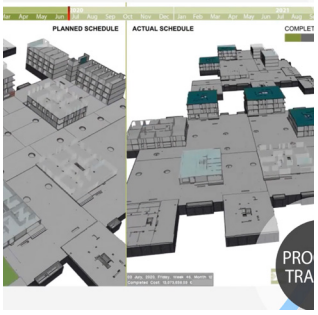
Other Standards

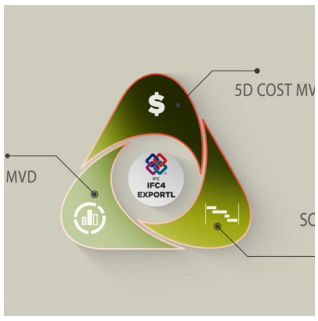
XLSX, XML

Result

Dedication to openBIM standards, as well as the export compatibility of the BEXEL Manager platform with standard traditional non-BIM file formats, allowed efficient exchange of information not bounded by technical limitations. This resulted in improved interoperability and collaboration, quality management, smart cost management and scheduling, progress tracking, reporting and facility maintenance.







buildingSMART International

WINNER

"Discovering Safety" - BIM Safety Risk Library for Built Environment

The University of Manchester, UK

About the Project

This research, by the University of Manchester, was undertaken as part of Phase 1 of the 'Discovering Safety' programme, which received funding from Lloyd's Register Foundation and data resource provided by HSE. It looked to provide a sematic alignment that could help address health and safety risks emanating from design in the preconstruction stage and lays the groundwork for the development of a safety ontology tool, that would mobilize UK Health and Safety Executive's (HSE) archive of construction health and safety risk data.

Core Objectives

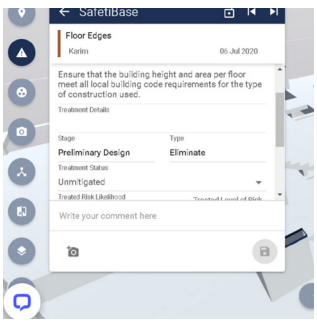
The project looked to improve access to knowledge and learning relating to how best to mitigate health and safety risks for key decision-makers on construction projects over the project lifecycle, starting with project planners and designers.

Project Description

As part of their research, several inter-related tasks were completed—an academic and industrial literature review, engagement with industry experts through steering committee workshops and focus groups with consultants, and collaboration with BIM software providers to develop the new platform.

openBIM provides solutions for improving software interoperability, thus ensuring accuracy of multi-party collaboration and improving the efficiency of the whole project. IFC schema was therefore considered in the project to achieve the required interoperability to store and exchange data related to construction safety management between different stakeholders.

A BIM prototype was developed—a new version of SafetiBase—where designers can identify potential risks and provide appropriate treatment prompts based on a web-based BIM platform (3D Repo). Another key output from the research was the



development of a safety and health exchange (SHE) ontology, where all the concepts and relationships are identified, and the ontology is mapped to relevant classes in IFC schema (ifcOWL ontology).

On the basis of the work done in Phase 1, future work could cover the following:

- Expanding the risk type covered in this phase (i.e. fall from open/edge) to include other prominent risks through establishing a community of practice of planners and designers who can extend the database and review more incidents in HSE and companies' archives.
- Evaluating the developed ontologies in real cases and aligning with other developed ontologies in the AECO domain such as ifcOwl.
- Developing a proof of concept for automatic rule-checking in 3D environment with some prominent risks
- Developing a proof of concept for 4D modelling with some prominent risks. This would explore how the knowledge base can be utilised in the 4D environment to take into account the impact of design and construction sequencing on health and safety.
- Developing an IDM and a MVD for safety management to improve the integration between BIM data and safety databases for better earlier safer decisions.

Highlights

- A conceptual model for risk treatment prompts in the design and planning stages including seven concepts, their sub-concepts based on available guidelines and their relationships.
- 165 RIDDORs and 31 press releases incidents were reviewed and annotated against the seven identified concepts
- A treatment prompt matrix based on the treatment prompt type and stage of implementation.
- Nine scenarios and 162 treatment prompts related to fall from open/edge and in-situ concrete buildings.
- Development of a safety and health exchange (SHE) ontology where all the concepts and relationships are identified, and the ontology is mapped to relevant classes in IFC schema (ifcOWL ontology).
- Development of a tool (SafetiBase) to identify, highlight and suggest a treatment for construction safety risks on a web-based BIM platform (3D Repo).

buildingSMART tools used

IFC4, ifcOWL

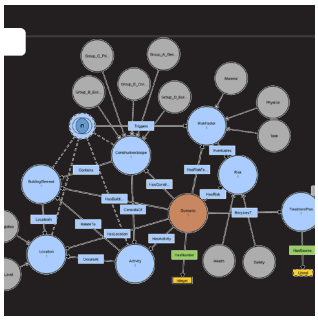
Software used

Revit, Solibri Model Checker, BIMVision, 3D Repo

Result

By developing the semantic bridge between HSE archive (as represented in the SHE ontology) and ifcOWL classes, a knowledge database is available to designers and planners where they can easily access treatments to the eventuated risks in their design.

This helped to minimize occupational hazards early in the design, improve collaboration between stakeholders, enhance multidisciplinary data (related to safety, time and cost) and provided a roadmap for achieving interoperability between BIM and Agent Based Modelling (ABM) for safety in construction.



buildingSMART International

WINNER

Smart BCF

École des Ponts Paris Tech, France

About the Project

This project was undertaken by students in the Master BIM program at École des Ponts ParisTech with a view to create a solution that increases the usage of BIM and paves the way for all stakeholders in the French construction industry to work together using digital models. To do this, two important limitations need to be overcome. The first is the expense of modelling software, which many simply cannot afford. Secondly, many contributors on a construction project may not possess the necessary modelling skills required when inputting information to the digital model.

The project team used openBIM standards, IFC and BCF, to develop the Smart BCF solution.

Core Objectives

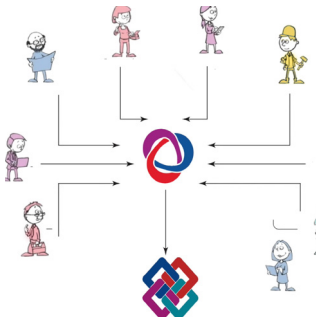
The objective of this project was to produce a solution that will facilitate accessibility to and uptake of the digital model within the French construction industry.

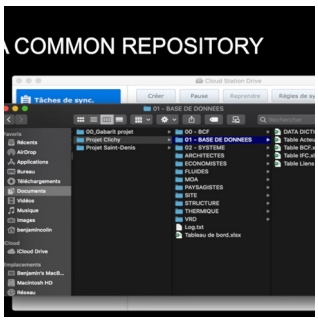
Project Description

Smart BCF is a solution based on five complementary components, using openBIM standards BCF and IFC. It's an intuitive and easily implemented solution that allows all stakeholders of a project to use the BIM model.

The five components are detailed as follows:

- A **Common Data Environment** (CDE) that centralizes exchanges and shares models, files, and data relating to a project, structured in such a way as to respect the ISO19650 standard, with separation between the project statuses (e.g. "work in progress", "archived", etc.).
- A **database** into which all information extracted from BCF comments and IFC models are regularly saved. This database provides documentation and traceability of exchanges and modifications of a project.





- A **tool for modifying and informing the IFC model**, was the central component of the solution. In the description part of the BCF, the user enters a command specifying the parameter and its value. This is linked to the CDE, meaning the user can use the tool without changing their framework, and, after a validation circuit, the model is updated. This tool was tested for many use cases (programming, design, construction., etc) and shown to be fully functional and operational.
- A **property creation assistant**, in the form of an interface, that allows the user to check if a property is already present in the data dictionary and give access to the property definition before creation. In this way, property definition errors can be avoided, thus ensuring the reliability of the data structure. The project team envision the next step would be to link the created properties to a data dictionary, such as the buildingSMART Data Dictionary (bSDD).
- This tool also makes it easier for the user to follow the exact command syntax required to successfully modify the IFC model, as the command that is typed in the description of the BCF must follow a precise writing convention, otherwise the code will not work.
- A **tool for updating the native model**, which is a methodology for using the appropriate visual programming tool for the native modelling software (e.g. Dynamo for Revit, Grasshopper for ArchiCAD, Visual Scripting for AllPlan, Marionnette for Vectorworks).

Highlights

- The project is not a rival solution to existing platforms, but rather complements them by offering the ability to produce information (not only view it), validating the modifications before executing them, and tracking the information flow.
- The project garnered interest from contractors and owners
- The solution doesn't need large investment to implement.
- The solution is easily deployable.

buildingSMART tools used

IFC 2x3, IFC4, BCF, bSDD

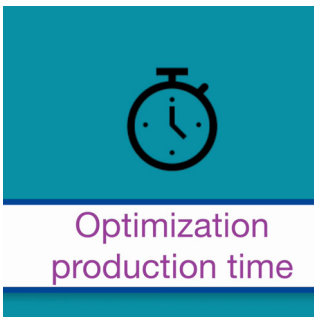
Software used

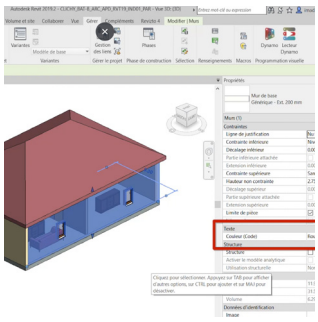
Evebim, Python

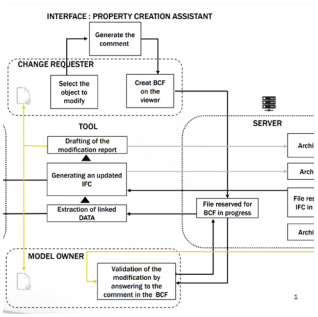
Result

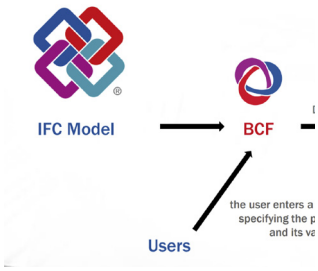
The Smart BCF solution gives workers in the French construction industry the ability to enhance 3D models with relative data, freeing them from software dependencies and costs. Through the application of openBIM and the use of IFC and BCF file formats, the solution aims to give every stakeholder the opportunity to participate in the BIM process.

The project team identified several further potential benefits of the application of Smart BCF, including better centralization of exchanges, productivity gains, better traceability of data enrichment and optimized production time.









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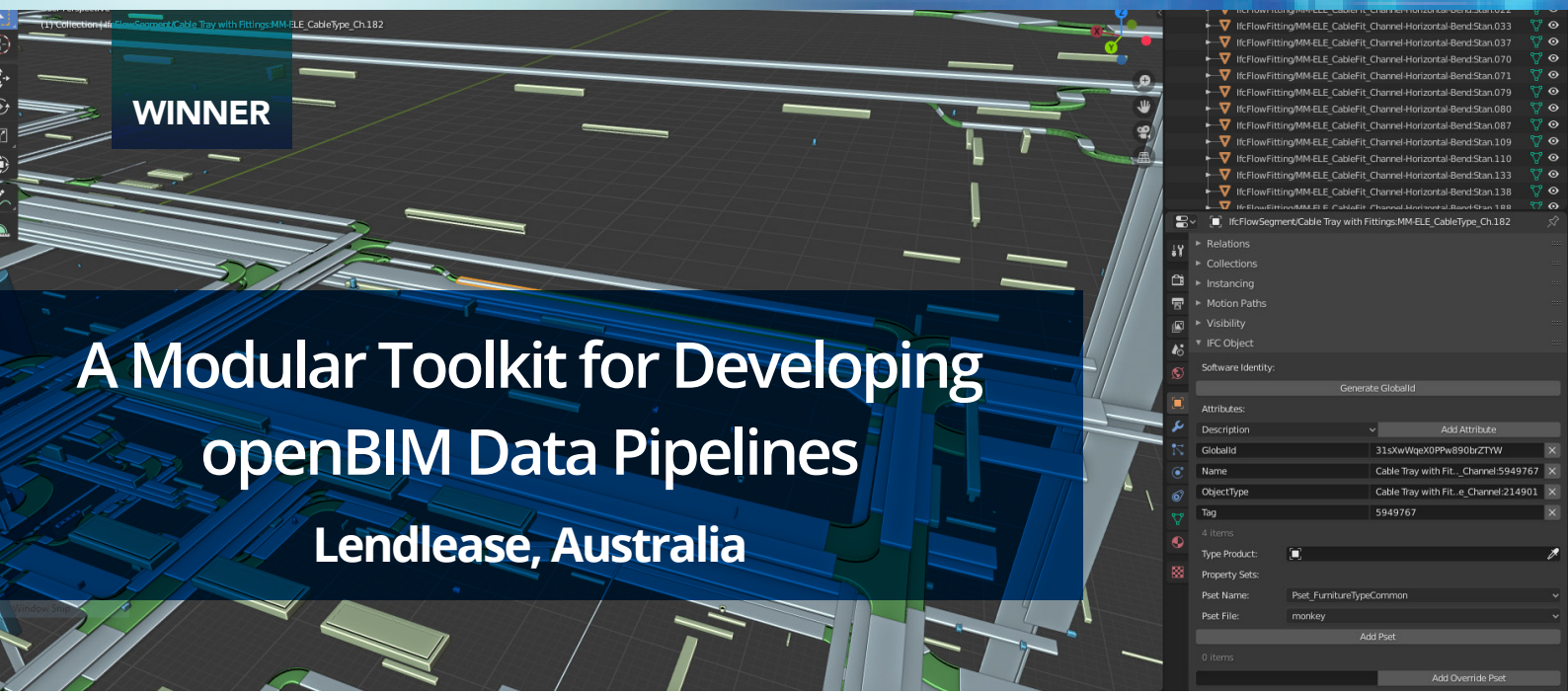


A Modular Toolkit for Developing openBIM Data Pipelines

Lendlease, Australia

About the Project

Smaller market players, cross-platform users, those who cannot afford proprietary tools, those ideologically preferring free software (e.g. non-profits, governments, academics, FOSS advocates), and the general community are having increasingly less access to their own built environment data. This project recognized that combining free software with openBIM increases its exposure to a wider market, whilst also allowing larger players to build their own digital pipelines more rapidly compared to relying on external software vendors.

Core Objectives

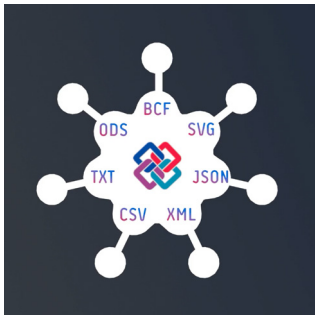
To combine the use of openBIM with free software to give greater access to built environment data and to help develop data pipelines without reliance on proprietary software.

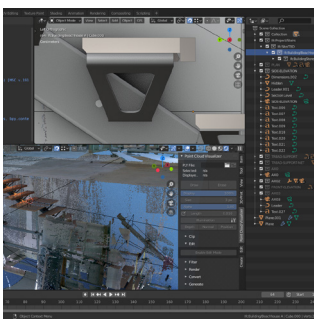
Project Description

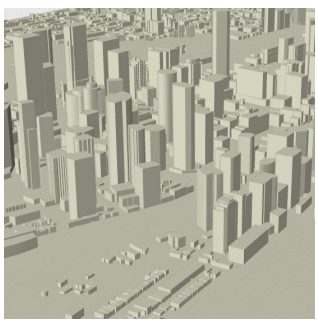
Lendlease developed a suite of seven Unix-influenced modular, decoupled, and cross-platform openBIM tools under free and open-source software licenses, to include a wide spectrum of functionality. openBIM was treated as a core native format and database, as opposed to a transfer methodology between program imports and exports; without openBIM the development of a technology pipeline such as this would not have been possible.

The suite was developed in under a year, in an open and transparent manner, targeting a variety of use cases at multiple project phases to be used by different stakeholders. Each tool uses IFC data as an input format and reads directly from the IFC as a native database. Further functionality includes BCF management, IFC collision detection, 2D IFC construction drawings, IFC data validation for exchange requirements, COBie analysis, IFC comparison, and IFC building physics simulation.

On a small prototype project, the pipeline was used to deliver a building (~250m2) from concept design through to construction.







The entire model was designed with IFC as the native file format. No other native format, proprietary or otherwise, was required to capture the data. This openBIM requirement also includes all construction documentation. 2D drawing data and annotation was stored in IFC, and further translated into the SVG open standard, with zero proprietary software. This guaranteed that all documentation was derived from openBIM data

On a larger commercial / infrastructure project, the client mandated the delivery of openBIM data, with the COBie MVD. Approximately 3.3GB of IFC data was delivered each fortnight by a diverse set of disciplines: architectural, structural, MEP, fire, and landscape. A custom model delivery procedure and data auditing pipeline was developed to process this openBIM data.

During the development of the tools, a new online architecture, engineering and construction (AEC) community was started, with a focus on integrating free software and open data, where the community heavily participated in the testing, suggestions, and collaborative development of the pipeline. This community has brought together volunteer software developers to help form an integrated pipeline revolving around openBIM standards accessible to everyone.

Highlights

- A suite of seven cross-platform, Unix-style tools were developed under free software licenses, tackling a variety of openBIM use cases across multiple project phases.
- A small project was delivered from design to construction using only IFC and SVG (for documentation) as native formats (no other CAD/BIM formats were used) with no proprietary tools, demonstrating the feasibility of openBIM as a native format.
- An automated, openBIM auditing procedure was implemented on a large government mixed-use infrastructure project
- A new, open-source architecture community was started, garnering 330 members within the first six months

buildingSMART tools used

IFC 2x3, COBie, MVD, IFC4, mvdXML, BCF

Software used

IfcOpenShell, Blender, BlenderBIM Add-on, FreeCAD, IFCDiff, IFCCOBie, BIMTester, IFCClash, IFCCSV, IFCPatch, Git, Git-LFS, Bitbucket, Pipelines, Revit.

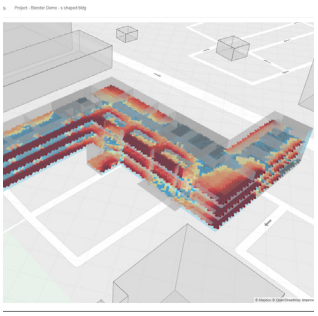
Other Standards

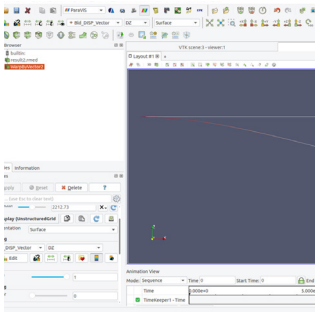
Uniclass, SVG, JSON, XML, HTML, Git, J/XUnit XML, Gherkin Syntax

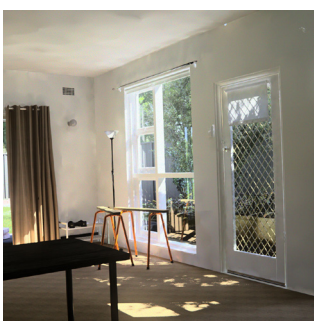
Result

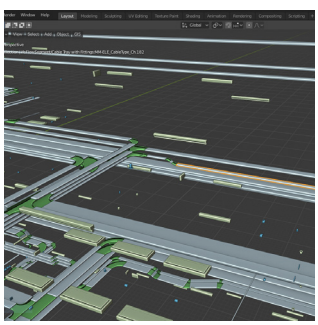
Lendlease found that their toolkit, with its wide spectrum of functionality, was better able to satisfy client requirements than existing proprietary software. The data-focused, modular toolkit is easier to digest, requires less translation, allows stakeholders to use the best tool for the job, results in high quality data, is easier to develop, and helps to rapidly deploy new standards.

Lendlease recognised that for openBIM (a fundamental component of this project) to succeed, increased accessibility for the entire industry and empowerment through available tools is necessary. For this reason, Lendlease release their toolkit and source code for free, for use within the industry.









buildingSMART International

WINNER

usIFC.server: Revolution in the Use of IFC Files from Static to Dynamic

ACCA Software, Italy

About the Project

An IFC model is thought of as a static snapshot at the time of construct or, rather, as a specific exchange of information for a particular purpose. It is known that IFC models are monolithic, difficult to manage and update. But an IFC model can be much more than that—it can, and should, be an evolving object that has the same life span as the building / infrastructure that it represents. IFC models, in fact, are the openBIM digitalization of the building / infrastructure itself and should therefore undergo the same changes and updates as the "real" counterpart.

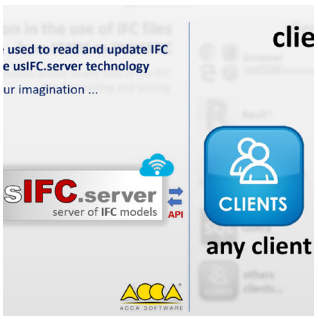
usIFC.server, developed by ACCA software, enables IFC files to be simultaneously available to multiple users who collaborate and share their model in the openBIM format with the ability to read and modify it dynamically, even when using different software or devices. openBIM and, in particular, the IFC file format are the foundation of this project in its entirety.

Core Objectives

To revolutionize the current concept of IFC files by transforming their use in the BIM process from static to dynamic.

Project Description

usIFC.server is a cloud server where the open IFC data structures can be stored. This allows IFC files to be made simultaneously available to multiple users, who can collaborate with each other in real time and share the model completely in openBIM format. With the ability to read and modify the model dynamically with different software or devices, the client can read and write (hence update) every single piece of information relating to the IFC model.



In order to achieve this, and to flatten the IFC STEP complexity, the usIFC.server exposes high-level Application Programming Interfaces (APIs) for common updating operations, so the client does not need to have a deep knowledge of the complex IFC data structures, but can nonetheless accomplish the necessary updates quickly and with ease. However, usIFC.server also has more elaborate APIs that can go into the very finest details of the IFC complexities, should that level of detail be necessary.

In the event data is required from only part of the model (or part of different models, as in the case of visualization), the server will do partial model exchange, in order to optimize the traffic generated. Updates or edits to such entities will be automatically updated in the model, making the federation of models seamless for the end user.

This project is revolutionary as IFC models, normally thought of as a "static" snapshot can now really be understood as "dynamic" models that evolve over time. From a maintenance perspective, models can be updated years after handover to reflect objects that are moved/added/removed or updated with the specifications of properties and objects as they inevitably change over time.

Highlights

- Revolutionized the concept of an IFC file: from a static to a dynamic and evolving object;
- Possibility of high-level server interaction from any client and any source;
- Edit and update of the IFC models during all the life cycle of the building / infrastructure projects;
- Querying of the information of the IFC models, even federated models;
- No need to know the cumbersome of the STEP IFC specification, whether editing or querying information.

buildingSMART tools used

IFC 2x3, IFC4, ifcXML, MVD

Software used

usIFC.server, usBIM.platform, usBIM.editor, usBIM.browser, Revit, usBIM.facility, Solibri, usBIM.viewer+, usBIM.reality

Other Standards

JSON

Result

The results achieved are unique in the world, never having been seen before, even with the use of proprietary formats. usIFC.server is proof that buildingSMART's vision is feasible and the technology stack available today is already sufficient for the task at hand.

The buildingSMART Awards are an incredible opportunity to showcase solutions and technologies that are solving current challenges and are also a sneak peek into how cutting-edge companies support the use of openBIM and how they are setting the milestones for an interoperable future.