buildingSMART International (2022)

398-TECHNOLOGY Technology Solution using openBIM

The BIM & Scan openBIM Cloud Platform: AutoCorr and AutoGen - Validation and Reconstruction Tools

GQVboERQ

Entrant details

Role or Job Title on the Project | CTO, Chief Scientist, and Co-founder

Employer

| BIM & Scan

Employer Role | Technology or Software Development Company

Are you or your employer a member of buildingSMART? | Yes - Chapter Member

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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://bimandscan.com

Location

| 4E Fingal Bay Business Park, Balbriggan, Co. Dublin, Ireland.

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

PPTX	file.pptx (29.5 MiB download)
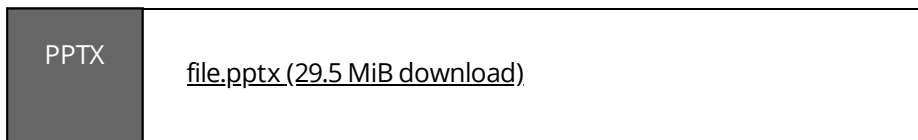
Entry Description

AutoGen and AutoCorr are built on ISO 16739 data model/schema. AutoCorr consumes ISO 10303-21 IFC SPFs, while AutoGen generates them. For workow and software vendor purposes, we chose the CV 2.0 MVD. While this MVD works well, it is envisaged we use the IFC4 DTV going forward because in both workow cases when using AutoGen and AutoCorr, the model is meant to at some point be edited. Do to lack of workow support by Graphisoft, Autodesk, etc we have chose to not serialise DTV MVD les at this time. When we get conrmation form vendor headquarters of full DTV support, then we shall serialise DTV MVD les or graphs, e.g. RDF, to be utilised in practice.

Having IFC as the backbone of our tools, opens many door to opportunity that would have otherwise been shut if we chose a proprietary route to development. These software have been used on many real world projects showing drastic improvements in speed, eciency, quality, and value. The previous submitted PPT shows a few of these projects.

One very unique feature that has yet to be developed by anyone else, is our automatic BCF reports and camera views for all entity type objects for full account ability. Where as planned objects deviate from the built assets, these deviations are serialised automatically in a new patent pending semantic point cloud enriched by correspondence colour representation of the IFC type itself. This has never been done before AutoCorr was invented and this feature plus the auto BCF for dimensional compliance control, we hope are worthy of an awards submission to bSi. On top of that, we bring to the world automatic IFC models from point clouds to be used on real projects. BIM & Scan AutoCorr is an open standards based tool developed for automatic model or construction validation utilising IFC CV 2.0 SPF's, E57 formatted Point cloud data, and automatically created BCF issues for all IFC object entity types to ensure 100% objectivity and accountability. BIM & Scan AutoCorr automatically highlights any variations between the point cloud and coordination model le using a user specied tolerance. The software utilizes open standards IFC, BCF, and E57 to communicate and compare design BIMs to corresponding point clouds within a given tolerance. It automatically creates a semantic point cloud and BCF camera views with comments, which enables quick informed decisions. The AECO, can now quickly make quality assurance decisions to either modify the as-built BIM or correct the construction on site.

As for AutoGen, it creates IFC coordination models directly from the point cloud, formatted using ISO 10303 Part 21, i.e. STEP Physical File Format (SPFF). More specically, it creates IFC2X3TC1 Coordination Model View Denition (MVD) les using the IFC Schema Version 2X3TC1 and the Coordination View 2.0 MVD (CV 2.0 MVD). However, the AutoGen is not limited to IFC model creation in SPFF, nor this particular schema and MVD versions. For example, IFC4 (e.g. IFC4.3 RC1, etc.), IFC5 (e.g. IFC5.0.1 or IFC5.1.0, etc.), and future ISO 16739 data models and schema versions are optional to IFC2X3TC1,

AutoGen covers the case where the MVD concept may be eliminated or replaced with alternative sub-set schema denitions and alternative exchange mechanisms because the algorithm is not bound by the MVD concept. Any format can be used as long as it conforms to the ISO 16739 IFC data model standard specication as per stated in the standard itself. Some examples are ISO 10303 Parts 26 and 28, and outside of the ISO 10303 STEP family formats such as ifcXML, ifcJSON, Turtle, RDF and ifcOWL. Said alternative IFC formats are inclusive of web based exchange of IFC model data warranting AutoGen to be not limited to le based exchanges on personal computers, of which at this moment in time, due to vendor adoption of said standards, ISO 10303 Part 21 is the predominant format chosen for the exchange of IFC data. AutoGen is not limited to the IFC2X3 CV 2.0 MVD, it is utilized at this time due to wide support of the IFC2X3 schema. In fact, AutoGen can read and write using any IFC Schema, e.g. the creation of an IFC4 Design Transfer View MVD model, which is envisaged to be the next most

supported MVD by vendors for the editing of parametric models in IFC format and is suited most for the next version of AutoGen.

What stage of completion is the entry content representing?	Substantial Completion

Stakeholder Statements

Testimonial 01
Location: Amsterdam, Netherlands Name: Mathijs Natrop
Companies and roles: Board Member at BuildingSMART Benelux, Owner of Solidu, BIM Coordinator at BAM Netherlands
"The use of BIM and Scan technology helps creating an Identical Digital Twin. Model-data from different designers and from different stages in the lifecycle of a building, is validated against the IFC coordination models with the help of open standard E57 scan-data. It helps designers and stakeholders, in a virtual world where the digital twin is a representation of the actual building with actual assets to be managed. Open standards IFC, E57, and BCF are key to this development and needed for collaboration with stakeholders. An automatic output of BIM & Scan AutoCorr is the open standard BCF, which makes it possible to collect issues from different tools and gather them to transfer to a specific designer. The use of BCF in this way is a must in collaboration with others."

Testimonial 02
Location: Nijmegen Area, Netherlands
Name: Stijn van Schaijk
Company and role: BIM Process Manager at VolkerWessels
"As a contractor we are scanning our projects more often, laser scanning technology is easily available nowadays. Where in the past point clouds where for specialist, they become common for project teams. We've used BIM & Scan AutoCorr on a few projects to check point clouds versus BIM. With help of AutoCorr, the differences between both files where visible within seconds, instead of hours searching for the deviations in the construction versus the IFC design models. AutoCorr delivers us coloured point clouds with deviations that are coloured red, and we can combine the automatic open standard output files from AutoCorr into our IFC files in our common IFC viewers. Due to this simple concept users can stay in the software they are familiar with. This makes adoption of this new technology pretty easy for the whole project team instead of specialists."
Testimonial 03
Location: Champaign, Illinois, USA Name: Dr. Bill East
Company and role: Owner at Prairie Sky Consulting, Director of COBie Academy at University of Florida, Adjunct Professor at Dublin Institute of Technology
"BIM & Scan AutoCorr was created to address problems when mapping open standard point cloud data with IFC formatted BIM objects. The developers of this product have used their expertise in the most demanding industrial facility settings to

provide an efficient tool based on solid research. While I am not an expert in this field, it does appear that the ability to modulate error rates while mapping objects and mapping to curved surfaces are significant innovations in this field."

Testimonial 04
Location: Deventer, Overijssel Province, Netherlands Name: Esther de Bruijn
Company and role: Co-Owner of Leap3D
"Leap3D uses AutoCorr to compare point clouds and IFC models. We use it to compare our point clouds with models that have been created in the past using old drawings. Our client likes to know what the differences are between the model once created and the current reality. We specifically like using this software because it does not only show the difference between the model and the pointcloud but it also shows the difference between the pointcloud and the model. If there are points that haven't been modelled, it will 'light up'. That is very useful. The software also enables a tolerance setting we can use finding the differences which makes it easy to use for different purposes (from very accurate to just a quick overview).
We also like the software because the support of Bim&Scan is very helpful. When we have questions, their help is fast and accurate."

Testimonial 05
Location: Edinburgh, UK

Name: Dr. Frederic Bosche (Inventor of Scan-vs-BIM)

Senior Lecturer in Infrastructure Programme Management - University of Edinburgh | School of Engineering | Institute for Infrastructure and Environment

Leader of the CyberBuild Lab, Associate Editor of Automation in Construction (Elsevier SCI IF=4.03), President of the International Association for Automation and Robotics in Construction (IAARC)

"Combining point clouds with Building Information Models (BIM) has great significance to enable construction digitalisation. To date, many works and solutions have focused on Scan-to-BIM, but a growing and critical area of interest is Scan-vs- BIM, to support construction progress and quality control, generation of as-built BIM, as well as asset monitoring. BIM & Scan AutoCorr is, to my knowledge, a unique Scan-vs-BIM solution by the fact that (1) it harnesses cloud technology; and (2) does it using open standards only (E57 for point clouds, and IFC and BCF for BIM information). The use of BCF to record (and communicate) deviations and subsequently how a BIM model should be adjusted to reflect as-built/as-is conditions is particularly interesting. BIM & Scan AutoCorr is a great platform upon which numerous applications could be conceived in a vendor-agnostic way, to promote
industry-wide collaboration."

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

MP4	[bSI_BIM_and_Scan_AutoGen_ ... (184.7 MiB download)](#)
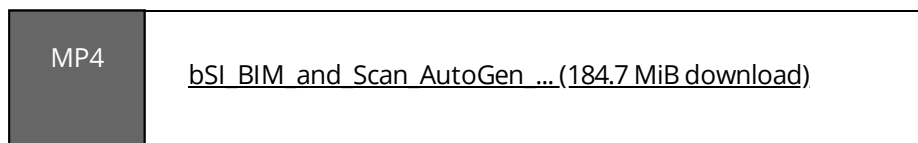
Technology Solution Description

We have developed a software called AutoGen that can automatically create IFC CV 2.0 MVD files from open standard E57 point clouds, and a second cloud based software called AutoCorr that automatically checks the automatically generated IFC models.These patent pending software algorithms have many use cases. AutoGen creates LOD 200 Architectural and Structural Models to speed up the Scan-to-BIM process, While AutoCorr is a Scan-vs-BIM solution that not only check AutoGen models, but is used for manual Scan-to-BIM checking, As-Built handover BIM checking, construction monitoring, etc. AutoCorr creates automatic BCF messages of all issues found and automatic camera viewpoint too.

What underlying technology are you using for your solution?

Novel use of BCF. Automatic IFC coordination models from point clouds. Automatic object recognition using IFC and point clouds.

Hum, MVD not on list below?

openBIM methods used	
	✓ IFC 2x3
	✓ BCF
	✓ IDM

Were there other open data standards used other than those listed above?

E57 ASTM

Similar or Comparable Solutions on the market today

None that do the same, espcially in reation to use of IFC and other open standards.

What added value does your solution give?

By using AutoGen, 1/3 of the project duration was saved, and to add more savings and value, AutoCorr was used for Automatic QA/QC. For example, poured concrete columns were automatically generated for a 6 storey building. Each column

was unique. AutoCorr check all columns aromatically for accuracy, then outputted a BCF for all columns with camera views, showing each and all column were 100% correct within the user specified tolerance.

Results In Practice

Building our tools on IFC allows many things. Firstly, when using our solutions, you do not need to buy some new design app or viewer, you simply use the one you already have and use to do your daily job! Secondly, without the afforded BCF for messages like in AutoCorr, humans could not actually solve the scale of the problem by manually creating issues for all objects. One semiconductor and airport facility projects in particular, there are simply too many objects and assets on the sites for humans to investigate all issues. openBIM now enables such solutions where prior, folks frankly pretended to be solve issues. On another note, AutoGen automatically create IFC coordination models and folks can now immediately use the results as bases of design, e.g. during retrot, or simply planning. Then these models can be amended in the native tool if needed because they are automatically linked to the design app API via the IFC data model. Very elegant workow when used correctly.

Example Use

PPTX	bSI_Award Finalist_2020_... (8.9 MiB download)
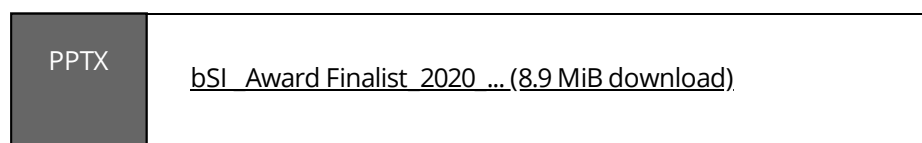
What is the accessibility of your solution?

We now have a new cloud system called BIM&Scan OpenOp (Attachment 10), and AutoCorr is now implented in that platform with new viewer built on BIMBASE: bimworks. We are the first to support point clouds in BIMbase BIMworks. This implemntation is finlaising as we speak and will be done before the awards ceremony in the event this submission makes it to the finals stage.

We also have a plugin now for Revit. My collegue next to me is packing up the install package next to me now at this moment, so we can allow users access via app store. Will deploy on Autodesk Forge as well after the aforementioned install package is finished (should be tomorrow actully).

What are next steps and future developments of your solution?

Sincethe OpenOp platfor dev is coming to an end, meaning 100% complete soon, we will expand more robustly into telecoms market, and into windfarms.

Now tha tthe solution is running in ACI in Azure, versus the previous Kubernetes deployment, the operational cost has decreased tremendously, so we expect to have many users. Currently weare actully up to approx the 500 user range and strong use on 3 major continents.

What is potentially possible in the future?

Endless possibilities when you use OpenBIM! :)

Make the case for why your solution should win.

Well, we made it to the finals in 2020. We now have a more elegant solution in the cloud, RBAC, pay per use on ACI in Azure, new employees and many new clients all bought in now;

bSI leaders use these tools on real projects for years now;

We have new one of a kind viewer built on BIMbase BIMworks (Everybody loves Ruben! :) and, we have made BIMworks support not only point clouds for the first time, but AutoCorr point clouds in a whole new game changing application.

I dont see why we should not win at this point....2 years later after finals in 2020, and still no tech the same on the market, nor other solution addressing the same problems we are addressing, much less are there any supporting OpenBIM and bSI.
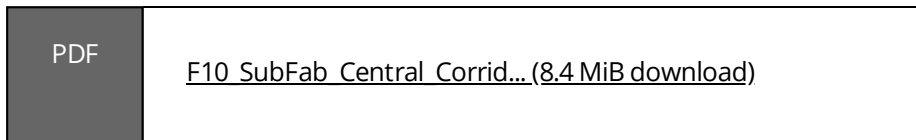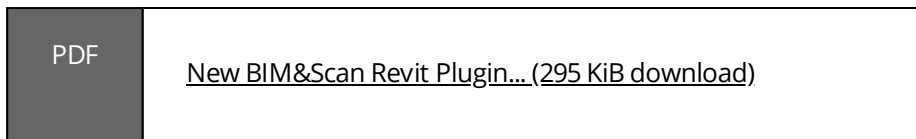
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openBIM Evidence

Software Ecosystem Map

PDF	[file.pdf (220 KiB download)](#)

Process Maps

PDF	[file-2.pdf (322 KiB download)](#)

openBIM Data Metrics Summary

PDF	[F10_SubFab_Central_Corrid... (8.4 MiB download)](#)

Additional openBIM Supporting Evidence

PDF	[New BIM&Scan Revit Plugin... (295 KiB download)](#)

Lessons Learned

Dont build a cloud platform that is expensive and needs to run all the time for the whole globe! Be smarter. Rebuild, optimise, and redeploy. We have...

Upload .ifc file(s) or other technical files to support validation of the research results.

↗ https://service.usbim.com/link/62b3345417de4ed142f8a767

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

IFC:
https://service.usbim.com/link/62b334ce17de4ea85af8a8ff

E57 (Semantic Point Cloud):
https://service.usbim.com/link/62b334e317de4ec111f8a930

E57 (Relative Heat Map):
https://service.usbim.com/link/62b3350c17de4eda43f8a95d

E57 (Absolute Heat Map):
https://service.usbim.com/link/62b3351f17de4e9229f8a966

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.	✓

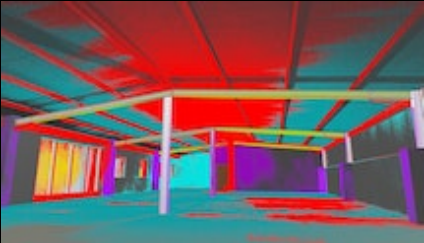Documentation on use case(s) as a single file upload

PDF	file-5.pdf (12.6 MiB download)

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

Type of attachment
Presentation
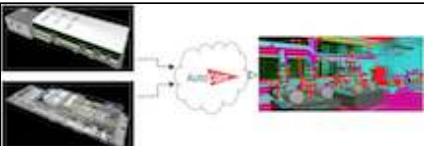
BSL_Demo_Slide... 26.7 MiB

Type of attachment
Image

AutoCorr_01.png   22.1 MiB

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AutoCorr_02.png   17.1 MiB

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AutoCorr_03.jpg   3.7 MiB

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AutoGen_Workfl... 2.7 MiB

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AutoGen_Workfl... 5.0 MiB
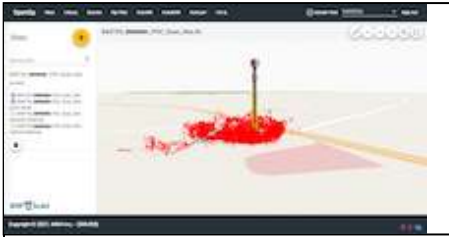

Type of attachment
Image

AutoCorr_Workfl... 6.8 MiB

Type of attachment	Type of attachment
Testimonial	Testimonial
Testamonials .pdf 42 KiB	Testimonial_01 ... 2.8 MiB

Type of attachment
Image
Screenshot 2022... 463 KiB