AECO Ecosystem Interoperability

Industry partners

GHD, DBM Vircon

UniSA Creative | UniSA STEM | Research team

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R Doe, K Kaur, M Selway, M Stumptner (2024)

Ecosystem Interoperability for the AECO Sector

The Journal of Information Technology in Construction (ITcon) https://doi.org/10.36680/j.itcon.2024.017

‘There is no single source of truth, but many specialised, partial sources of truth that need to be coordinated.’

buildingSMART International

A ‘single source of truth’.
All data and information in one central location.

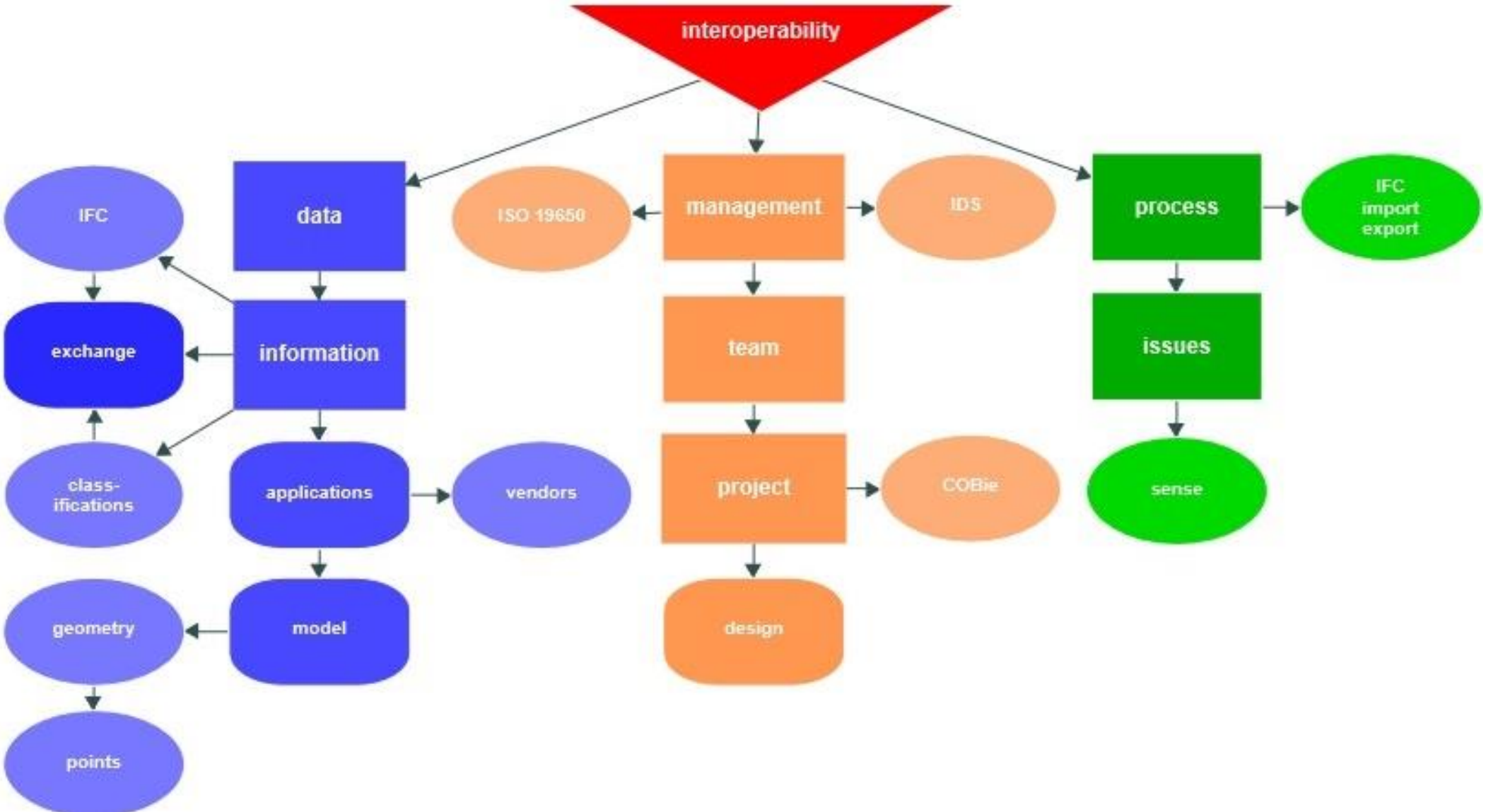
‘… my computer understands completely what your computer program is saying.’

Patrick MacLeamy, Episode 4, Build Smart

What does ‘interoperability’ mean anyway?

RQ1 (Primary): What issues continue to affect interoperability in an AECO organisation?

RQ2 (Secondary**):** Is sustainable development affected by interoperability issues?



Concept map: hierarchy of themes and sub-themes - interpreted and drafted manually by the authors.

information

‘…**who’s interested in producing what information… people are much more interested in populating their own, or producing information for their own purposes**.’ p.17

Reasserting the need for a common language - IFC

Rec 1. As there is no PCERT or similar certification available specifically for IFC, though online tutorials are available (e.g. Geometry Gym, Australia), our recommendation is that Professional Certification IFC (PCERT IFC) be developed by bSI as a framework for delivery by third parties to ensure that user input is correctly understood by those managing and implementing IFC for import and export, to and from proprietary models and CDEs.

RQ1

data

‘...data loss is more down to how the translator or mapping is built... But, with geometry issues, the default is to get back to the vendor and get them to find a solution, and some vendors are less willing to go the extra mile in resolving interoperability issues.’ p.15

Vendor lock-in – how do we resolve issues around this?

Rec. 2. National and regional jurisdictions should be widely encouraged to improve interoperability best practice by mandating implementation of openBIM, vendor neutrality, and the common language IFC. For example, in 2017 the Australasian BIM Advisory Body (ABAB) which includes buildingSMART Australasia promoted a consistent approach to the use of BIM across national jurisdictions.

RQ1

issues | multiple CDEs

‘…**we have multiple CDEs on a project, and connecting information from one CDE to another is somewhat problematic**.’ p.19

Common Data Environment (CDE), ISO 19650 (orgn. and digitisation of info. about BIM)

Rec. 3. We recommend that Germany's Publicly Available Specification (PAS), DIN SPEC 91391 series (Section 2.2.1) is promptly developed into a global ISO standard or incorporated into ISO 19650 series to provide clarity for the sector and software vendors. DIN SPEC 91391-1 covers CDE solutions applicable for BIM Levels 1-2 and looks towards new technologies to achieve BIM Level 3.

RQ1

management

‘…there’s a lot of push back, a lot of behavioural change management to go through, to actually make it happen. It’s a bit of a dead end in terms of its format, like the way you export it out into a COBie export doesn’t go anywhere.’ p.17

Handover – a test of coordination and the consolidation of information.

Rec. 4. COBie should be amended so that format outputs are consistently defined and clearly understood by users, clients and operators. Data and information consolidation tools used by clients and operators at handover should be examined and, where appropriate, referenced in COBie e.g. IBM Maximo, Ellipse, IBM TRIRIGA and SAP.

RQ1

team

‘...bringing data from a design team to construction to operations team normally involves quite strong interoperability challenges.’ p.18

Handover – a test of coordination and consolidation of information.

Rec. 5. A 'golden thread of data and information' should be embedded in the ISO 19650 series to ensure accountability for the accuracy and reliability of data and information across the entire building lifecycle, including at handover stage. Similar to the Building Act (2022), UK, accountability should include the nomination of 'duty holders' and 'appointed persons' to embed responsibility into the process.

RQ1

key issue | a ‘connected CDE’

‘…**So, the question is how they get connected… Are there third party add-ins that need to be on everyone's machine for all of this to work. Or is it some cloud-based, web-based method that needs very little input or version control of an application**?’ p.19

Ecosystem interoperability for AECO – Linked building data (LBD) or middleware?

Rec. 6. We propose implementing a proof-of-concept Network-Centric - Middleware, Shared Messaging Service. The Middleware Shared Messaging Service proof-of-concept aims to demonstrate reliable, automated cloud-based ecosystem interoperability with appropriate accessibility across lifecycle stages.

RQ1

interoperability & sustainability

‘...**efficient sustainable design processes requires inputs and outputs that can move between technical applications**.’ p.13

‘Why do our buildings cost the earth?’

Rec. 7. The impact of poor interoperability on sustainable development in the AECO sector needs to be better understood through more extensive and thorough research. Provided with accurate information, social and environmental stakeholders would be better informed and able to promote meaningful actions to mitigate the impacts on society and the environment of poor interoperability in the AECO sector.

RQ2

R Doe, K Kaur, M Selway, M Stumptner (2024)
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postscript…

rec. 2 | **national and regional jurisdictions**

Ongoing engagement: QLD Department of Housing, Local Government, Planning and Public Works;
SA Department for Infrastructure and Transport, BIM Industry Working Group.

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rec. 6 | **a ‘CDE of CDEs’**

Proof of Concept completed Jan-Mar 2024.

Paper to follow.

AECO Ecosystem Interoperability

Proof of Concept | a CDE of CDEs

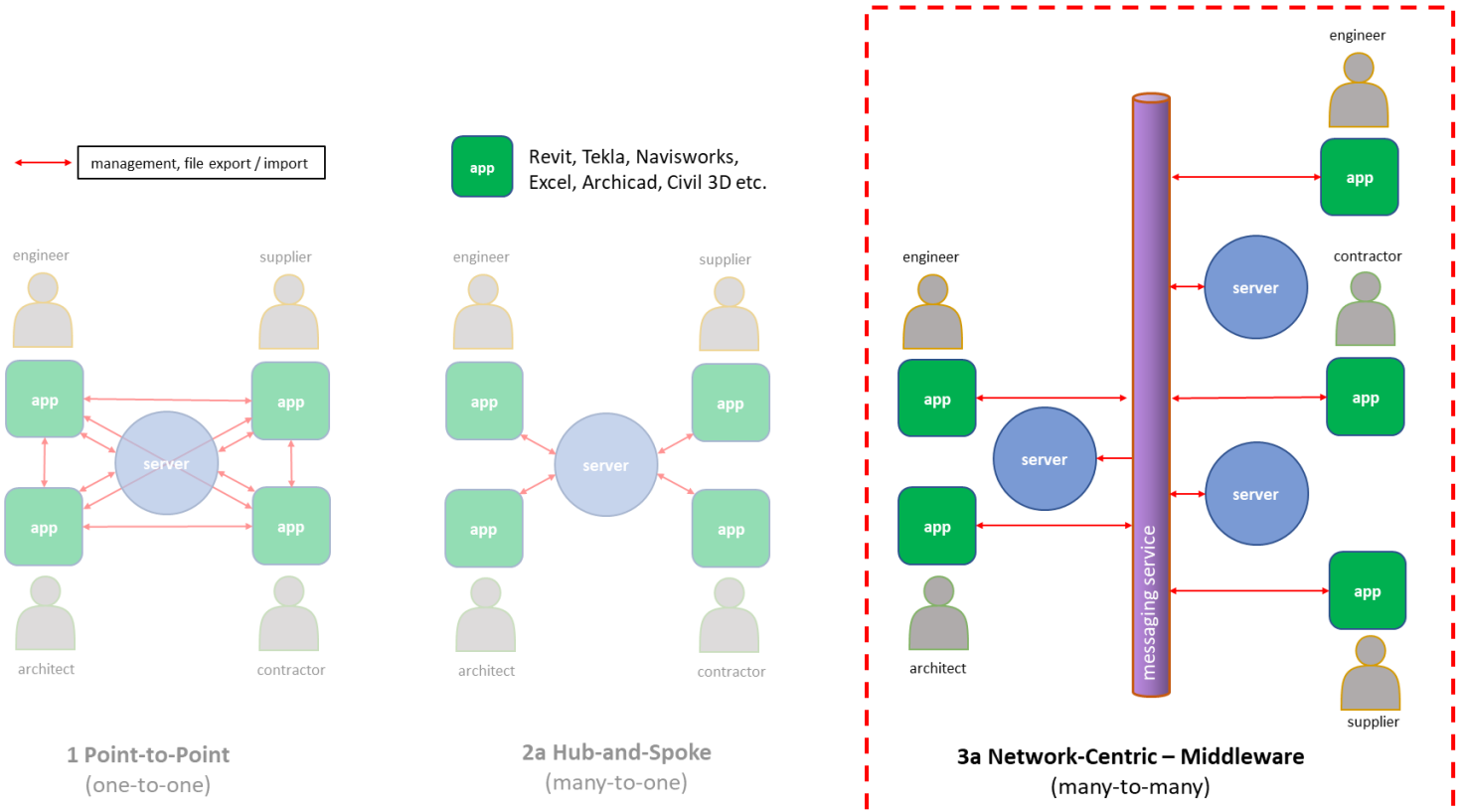
Completed: Jan-Mar 2024

Researchers:

- Dr Matt Selway, UniSA STEM
- Andrew McRae, UniSA STEM
- Dr Robert Doe, UniSA Creative
- Professor Markus Stumptner

Seed funded by:

UniSA STEM | UniSA Creative



Standards-based | Network-centric | for AECO

Components

Authoring tool: BlenderBIM x 3

CDE: BIMServer

Geometry engine: IfcOpenShell

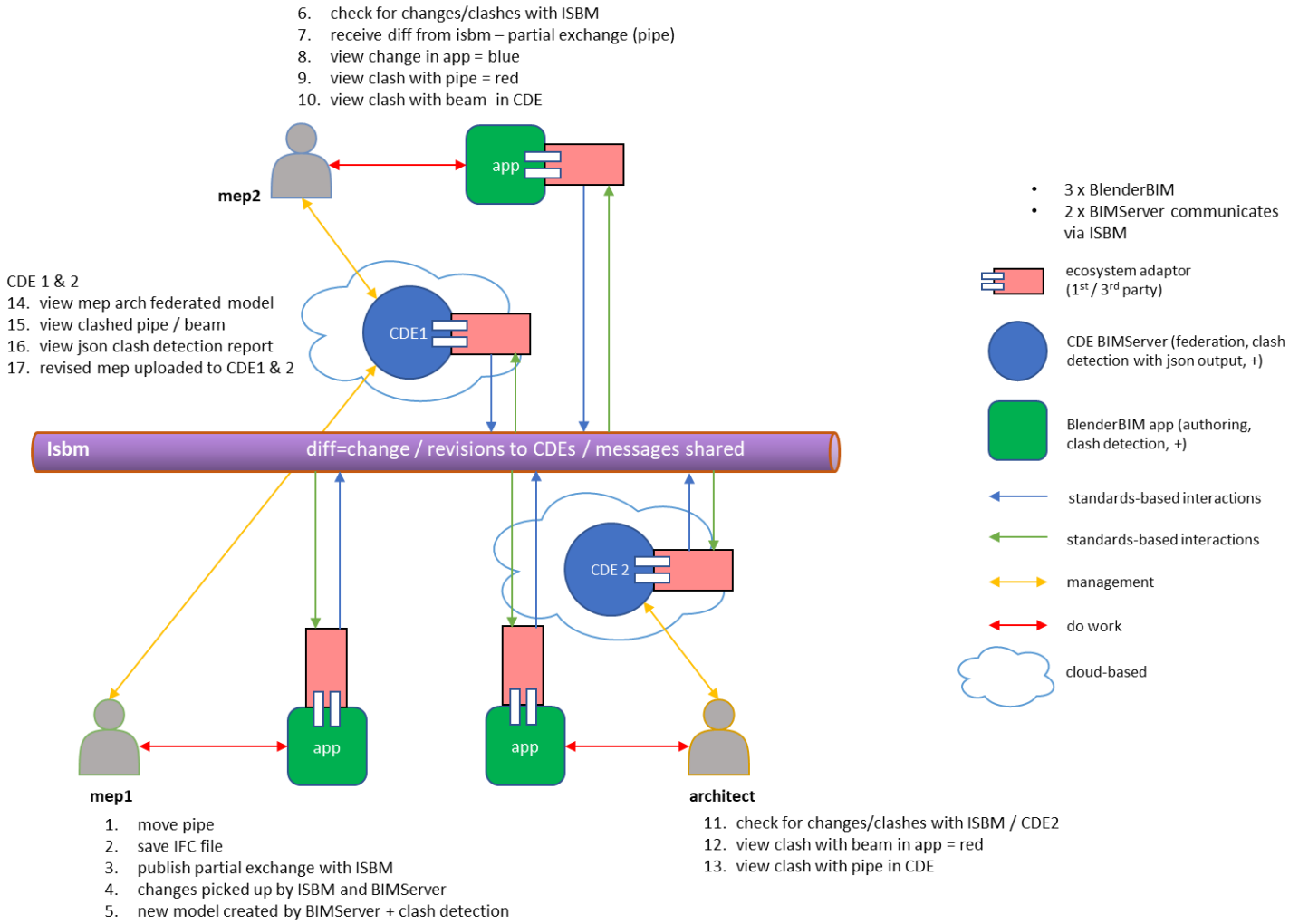
- Includes clash detection services

Infrastructure: SimpleISBM

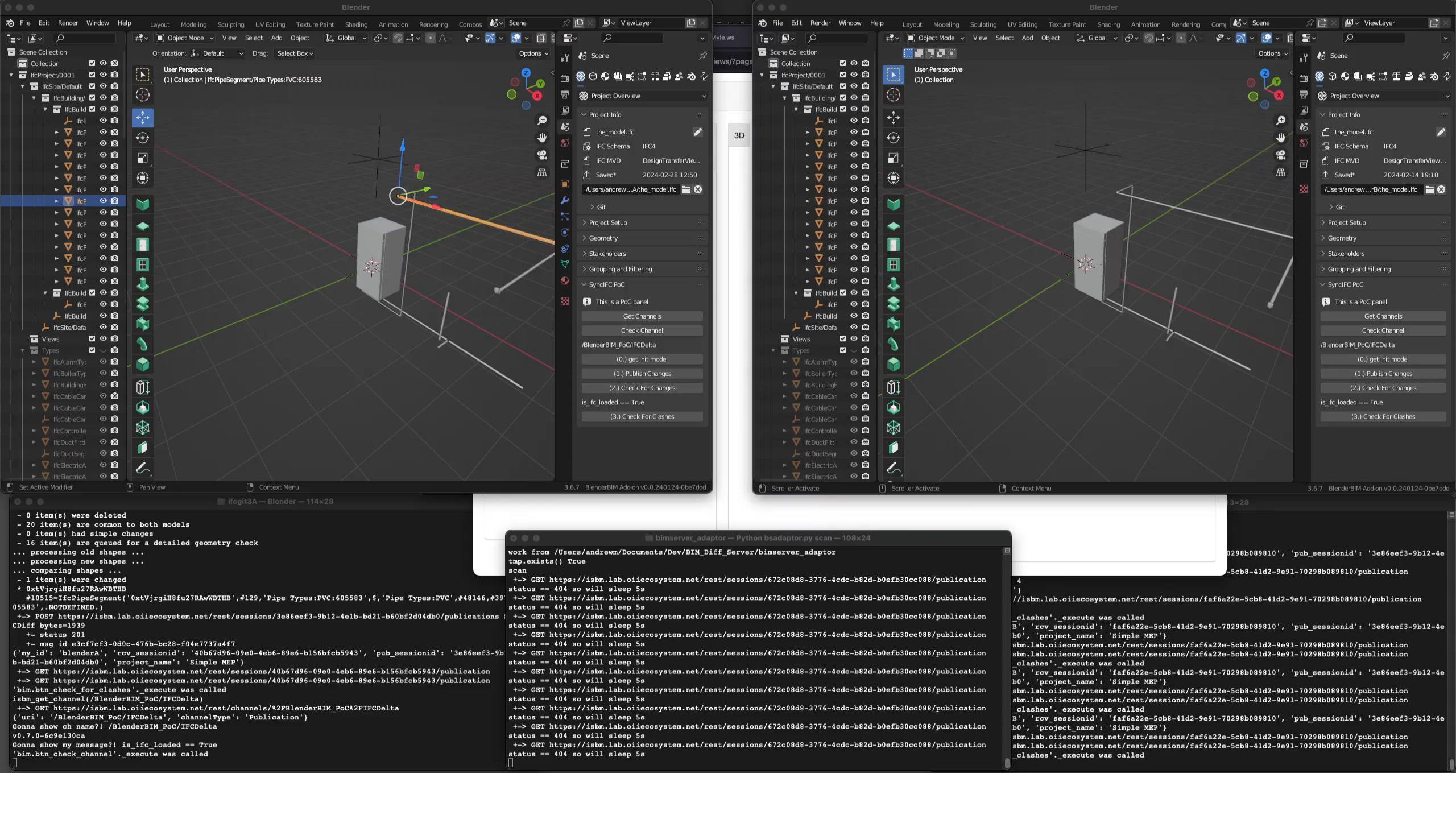
- Message bus developed by UniSA STEM and partners
- Leveraged open source, free applications to simplify implementation of **adapters**

Standards referenced:

- ISO 16739-1:2024 (IFC)
- ISO 19650 series (BIM organisation)
  - Metadata, e.g., Work States: WIP – Shared
- ISO 18101 (Automation & integration)
  - Oil & gas interoperability
- ISA-95 Part 6 (ISBM parent standard)
  - Messaging Service Model (MSM)



Use case | design discipline changes published and checked


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compos
Scene
ViewLayer
Object Mode View Select Add Object
Global
Orientation: Default
Drag: Select Box
Options
User Perspective
(1) Collection | IfcPipeSegment/Pipe Types:PVC:605583
Scene Collection
Collection
IfcProject/0001
IfcSite/Default
IfcBuilding/
IfcBuild
Views
Types
Project Overview
Project Info
the_model.ifc
IFC Schema IFC4
IFC MVD DesignTransferVie...
Saved* 2024-02-28 12:50
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Git
Project Setup
Geometry
Stakeholders
Grouping and Filtering
SyncIFC PoC
This is a PoC panel
Get Channels
Check Channel
/BlenderBIM_PoC/IFCDelta
(0.) get init model
(1.) Publish Changes
(2.) Check For Changes
is_ifc_loaded == True
(3.) Check For Clashes
Set Active Modifier
Pan View
Context Menu
3.6.7 BlenderBIM Add-on v0.0.240124-0be7ddd
Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering
Scene
ViewLayer
Object Mode View Select Add Object
Global
Options
User Perspective
(1) Collection
Scene Collection
Collection
IfcProject/0001
IfcSite/Default
IfcBuilding/
IfcBuild
Views
Types
Project Overview
Project Info
the_model.ifc
IFC Schema IFC4
IFC MVD DesignTransferView...
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(2.) Check For Changes
is_ifc_loaded == True
(3.) Check For Clashes
Scroller Activate
Scroller Activate
Context Menu
3.6.7 BlenderBIM Add-on v0.0.240124-0be7ddd
ifcgit3A — Blender — 114×28
- 0 item(s) were deleted
- 20 item(s) are common to both models
- 0 item(s) had simple changes
- 16 item(s) are queued for a detailed geometry check
... processing old shapes ...
... processing new shapes ...
... comparing shapes ...
- 1 item(s) were changed
* 0xtVjrgiH8fu27RAwWBTHB
#10515=IfcPipeSegment('0xtVjrgiH8fu27RAwWBTHB',#129,'Pipe Types:PVC:605583',$,'Pipe Types:PVC',#48146,#39
05583',.NOTDEFINED.)
+-> POST https://isbm.lab.oiiecosystem.net/rest/sessions/3e86eef3-9b12-4e1b-bd21-b60bf2d04db0/publications
CDiff bytes=1939
+- status 201
+- msg id e3cf7cf3-0d0c-476b-bc28-f04e7737a4f7
{'my_id': 'blenderA', 'rcv_sessionid': '40b67d96-09e0-4eb6-89e6-b156bfcb5943', 'pub_sessionid': '3e86eef3-9b
b-bd21-b60bf2d04db0', 'project_name': 'Simple MEP'}
+-> GET https://isbm.lab.oiiecosystem.net/rest/sessions/40b67d96-09e0-4eb6-89e6-b156bfcb5943/publication
+-> GET https://isbm.lab.oiiecosystem.net/rest/sessions/40b67d96-09e0-4eb6-89e6-b156bfcb5943/publication
'bim.btn_check_for_clashes'._execute was called
isbm_get_channel(/BlenderBIM_PoC/IFCDelta)
+-> GET https://isbm.lab.oiiecosystem.net/rest/channels/%2FBlenderBIM_PoC%2FIFCDelta
{'uri': '/BlenderBIM_PoC/IFCDelta', 'channelType': 'Publication'}
Gonna show ch name?! /BlenderBIM_PoC/IFCDelta
v0.7.0-6c9e130ca
Gonna show my message?! is_ifc_loaded == True
'bim.btn_check_channel'._execute was called
bimserver_adaptor — Python bsadaptor.py scan — 108×24
work from /Users/andrewm/Documents/Dev/BIM_Diff_Server/bimserver_adaptor
tmp.exists() True
scan
+-> GET https://isbm.lab.oiiecosystem.net/rest/sessions/672c08d8-3776-4cdc-b82d-b0efb30cc088/publication
status == 404 so will sleep 5s
+-> GET https://isbm.lab.oiiecosystem.net/rest/sessions/672c08d8-3776-4cdc-b82d-b0efb30cc088/publication
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-5cb8-41d2-9e91-70298b089810/publication
4
']
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B', 'rcv_sessionid': 'faf6a22e-5cb8-41d2-9e91-70298b089810', 'pub_sessionid': '3e86eef3-9b12-4e
b0', 'project_name': 'Simple MEP'}
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_clashes'._execute was called

Significance

Proof of Concept | a CDE of CDEs

1. **Open standards-based**
   - any proprietary system can exchange data and information
   - tests integration of existing standards and identifies gaps for new/updated standards
2. **Data management facilitated**
   - determines when, and at what level of detail, information is to be shared
3. **Supports fine-grained, event-driven, interactions**
   - improves timeliness of information
4. **Supports variety of workflows**
   - distributed, centralised, or mediated
5. **An ecosystem from design through operations**
6. **Improved collaboration**
   - participants and workflow stages integrated
   - asynchronous messaging services

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AECO Ecosystem Interoperability

Any questions?

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