New Zealand

Interoperability and its Challenges

ICIS Conference, Auckland, New Zealand

14 March 2016

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NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

The University of Auckland

Presented by

Robert Amor

CIB W78 Co-coordinator (IT in Construction)
Editor-in-Chief, Journal of IT in Construction
buildingSMART Technical Advisory Group member
BIM Acceleration Committee (NZ) member
Professor, Department of Computer Science

Today's Journey

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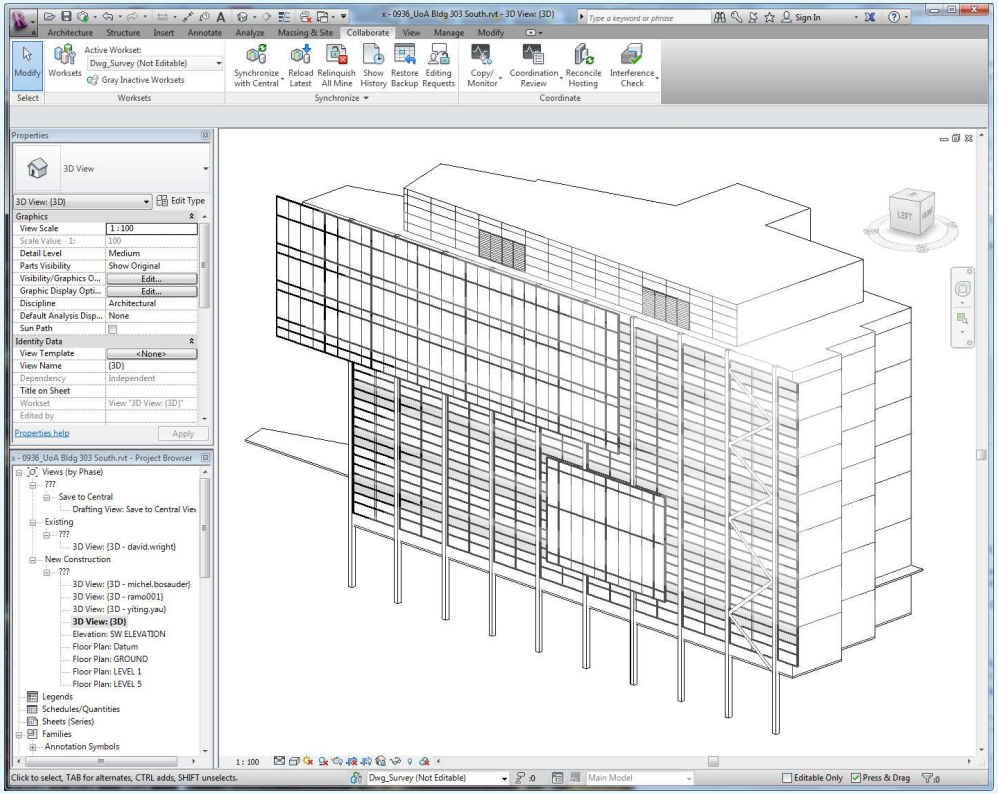
- Defining Interoperability
- Defining BIM
- Future Steps for Interoperability



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DEFINING INTEROPERABILITY

What is Interoperability?

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- IEEE Glossary: the ability of two or more systems or components to exchange information and to use the information that has been exchanged

- Wikipedia: Interoperability is the capability of a product or system -- whose interfaces are fully disclosed -- to interact and function with other products or systems, without any access or implementation restrictions.
  - Not interoperable if there is:
    - *non-disclosure of one or several interfaces*
    - *implementation or access restriction built in the product/system/service*

What Does Interoperability Look Like?

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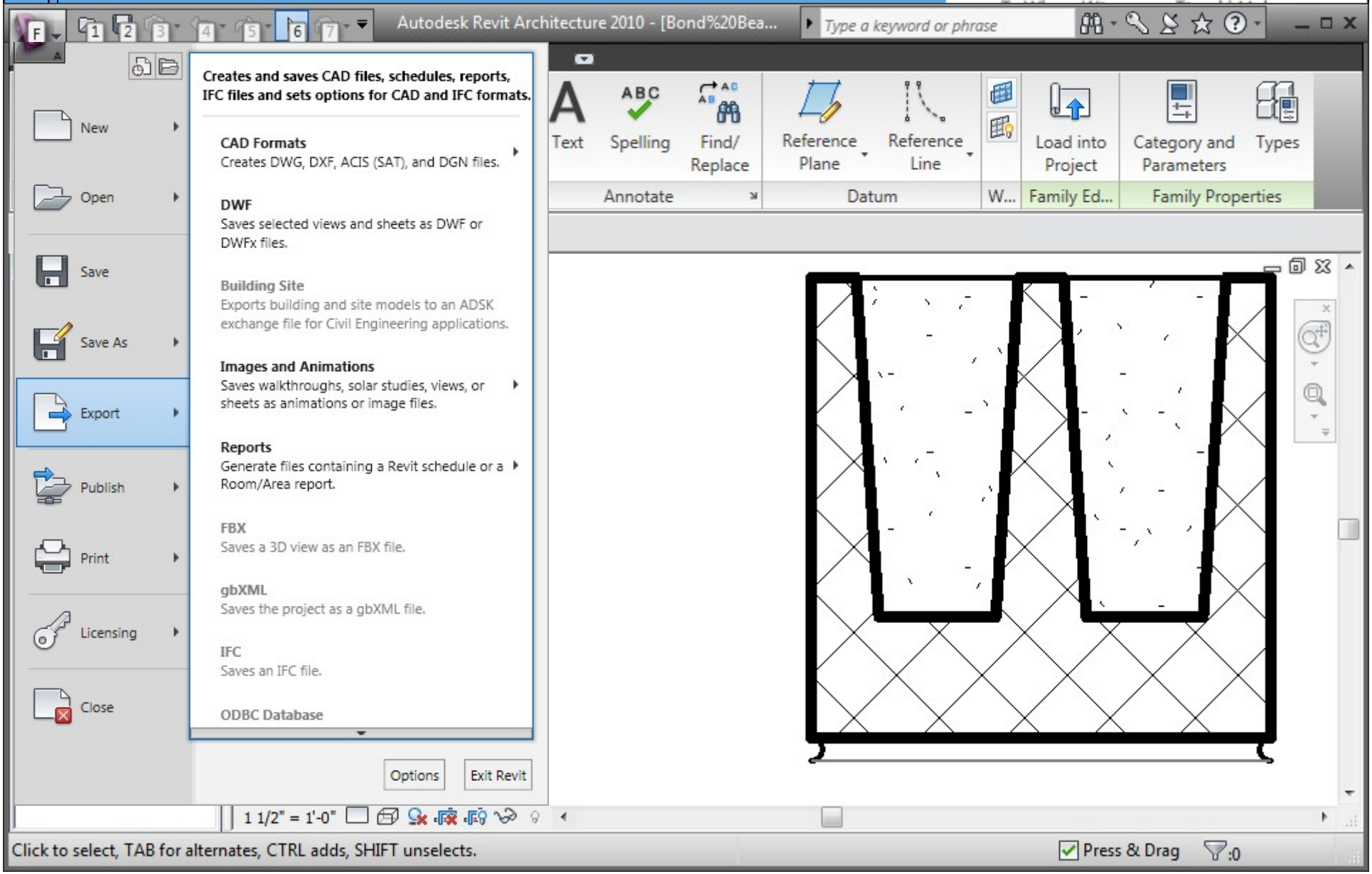

What Should Interoperability Look Like?

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What Should Interoperability Look Like?

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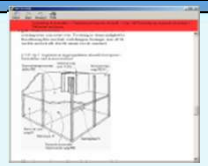
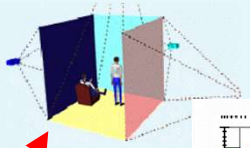
Laws and regulations
-Building regulations
-Building specifications

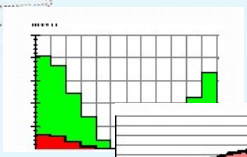


CAD software
-Drawings, calculations
-Architect, engineer,…



VRML
-Visualisation, 3D models

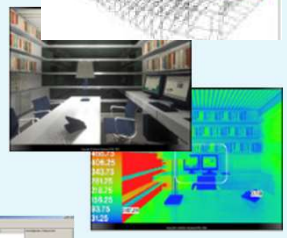
Knowledge databases
-Best practise knowledge
-Own practice



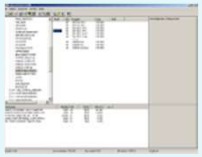
Simulations
-Comfort
-Ventilation, heating
-Life cycle cost
-Light, sound
-Insulation
-Fire, usage
-Environment
-Life time predictions

Briefing
-Functional req.
-Estimates
-Conditions
-Requirements

Demolition, refurbishment
-Rebuild
-Demolition
-Restoration

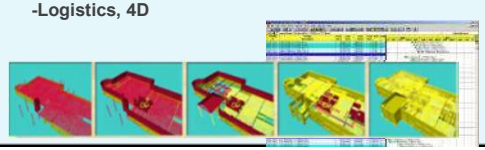


Facility management
-Letting, sale, operations
-Maintenance
-Guarantees



Specifications
-Specification sheets
-Classification standards
-Estimates, accounting

Construction management
-Scheduling
-Logistics, 4D



Procurement
-Product databases
-Price databases

BIM is the Core Underpinning Technology for Interoperability

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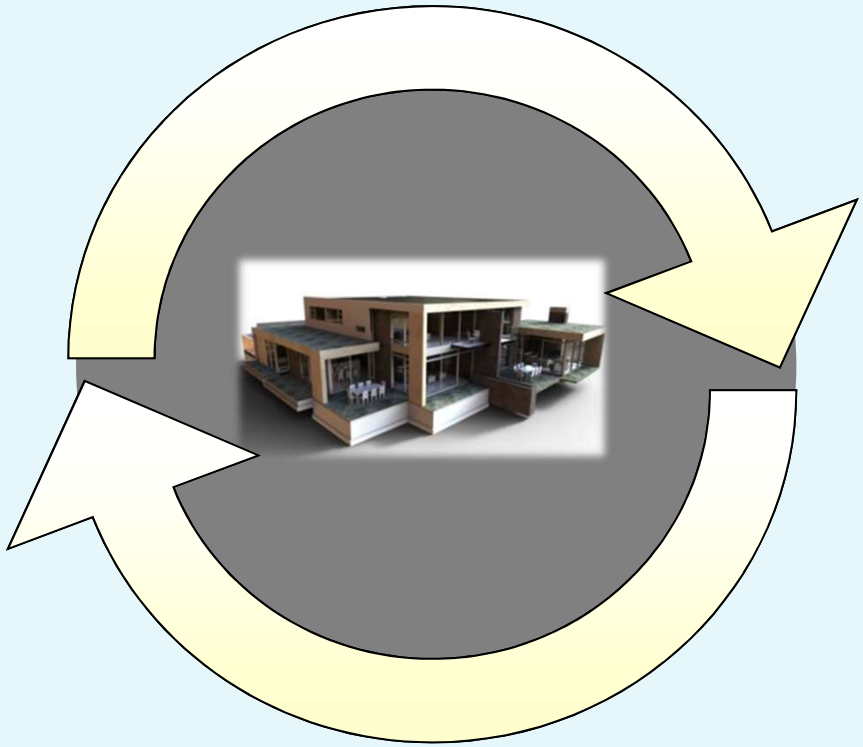

Towards Interoperability

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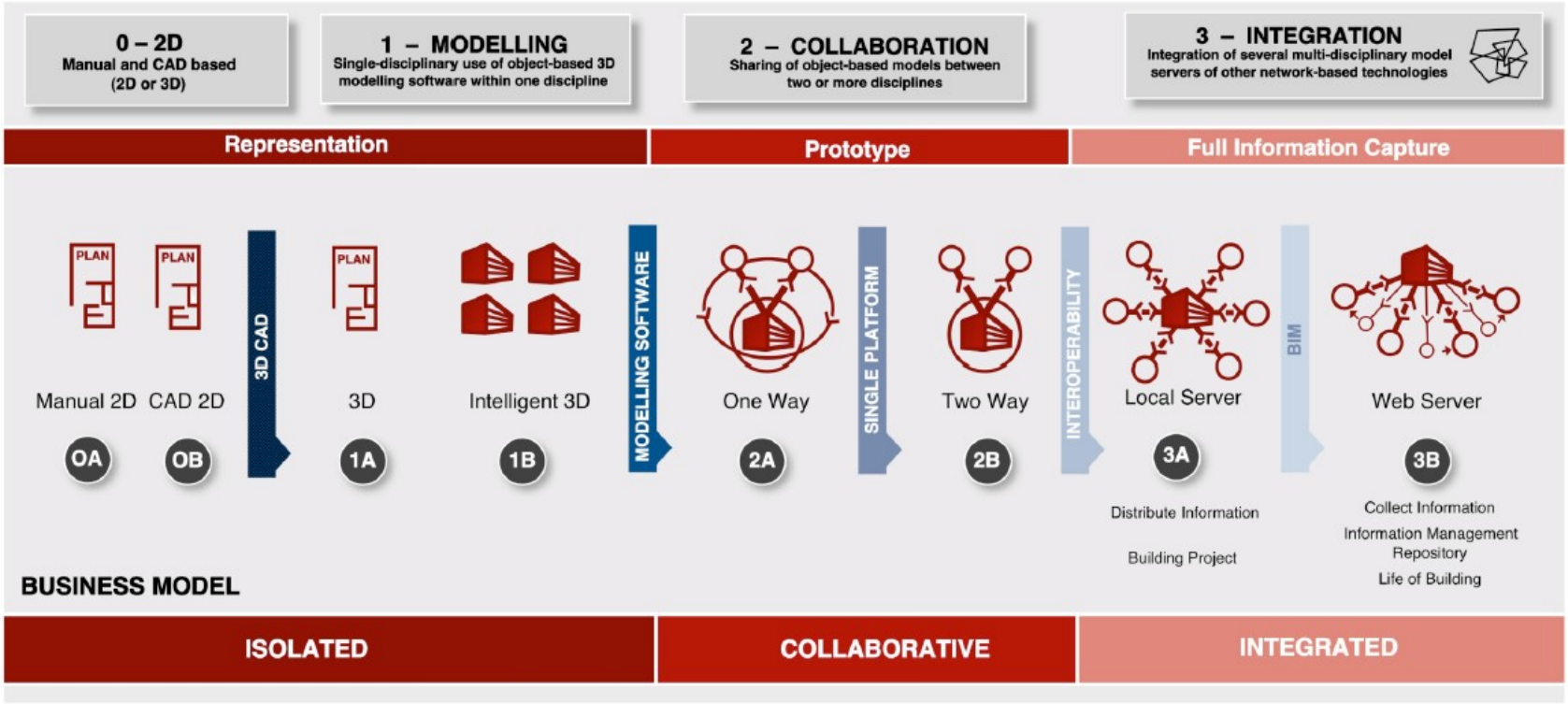
TOWARDS INTEGRATION



Source: Adapted from CRC for Construction Innovation 2009, p. 13.

Interoperability Benefit Analysis

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NIST GCR 04-867

NIST U.S. Department of Commerce
Technology Administration
National Institute of Standards and Technology

Advanced Technology Program
Information Technology and Electronics Office
Gaithersburg, Maryland 20899

Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry

Michael P. Gallaher, Alan C. O'Connor, John L. Dettbarn, Jr., and Linda T. Gilday

Importance of Interoperability

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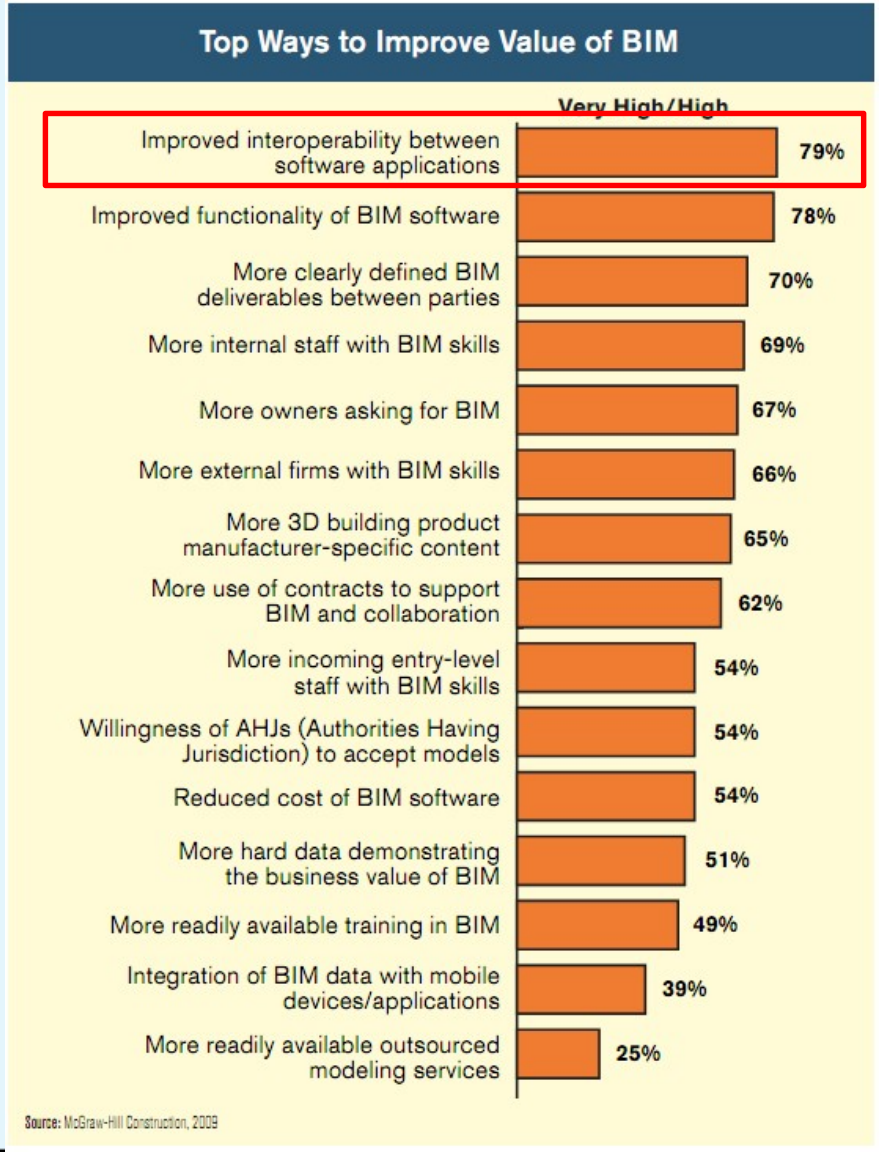
Top Rated Areas for Improvement

1) Improved interoperability between software applications. Non-interoperability limits the potential of BIM, especially in an environment where data is exchanged between various build team members. As BIM has developed and new tools have been introduced, interoperability has become an increasingly important issue. Although efforts to create standards are underway, issues remain. **Eight in ten BIM users say there is a significant need to improve interoperability.** This need is expressed by a majority of all users at all experience levels.



Interoperability Requires Process and People Change as Well

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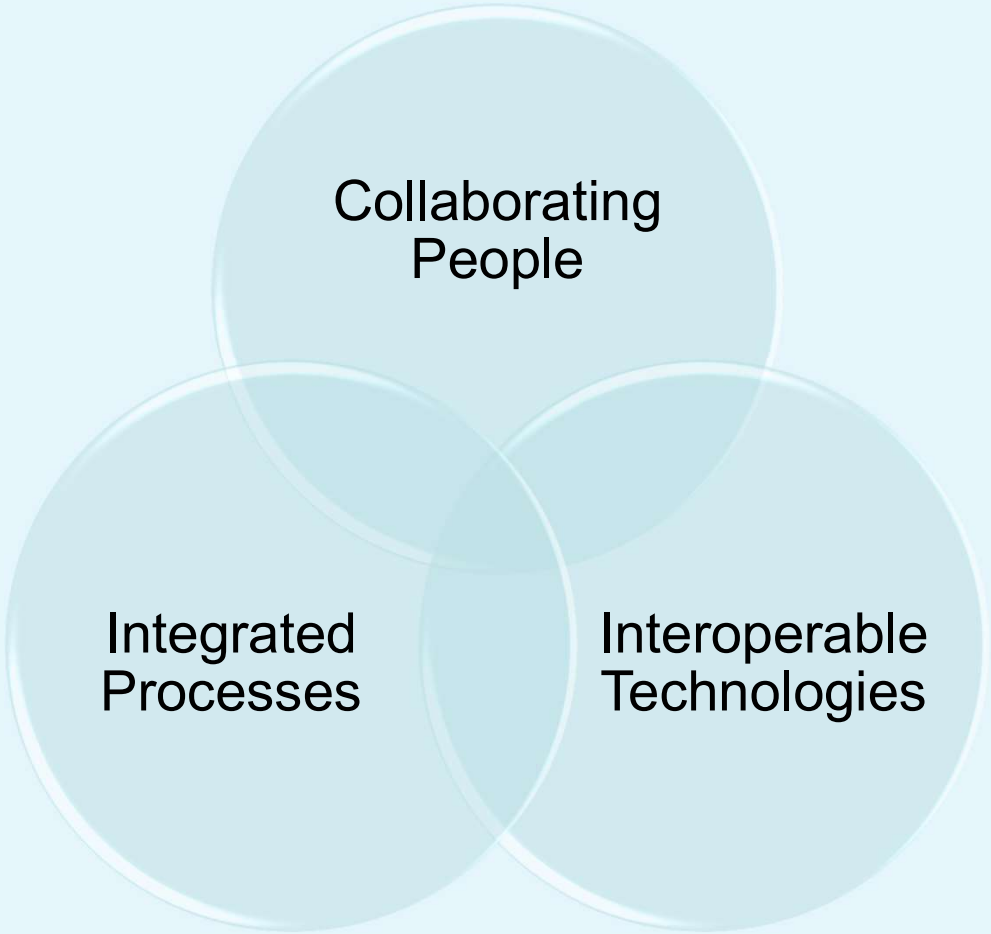

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DEFINING BIM

What is BIM?

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- Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.

  (National BIM Standard - United States)

What is BIM?

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- "an intelligent simulation of architecture"
- Digital
- Spatial (3D)
- Measurable (quantifiable, dimension-able, query-able)
- Comprehensive (including design intent, performance, constructability, financial aspects, etc)
- Accessible (to the entire team)
- Durable (all phases of the life-cycle)

(M.A. Mortenson Company)

BIM Capabilities

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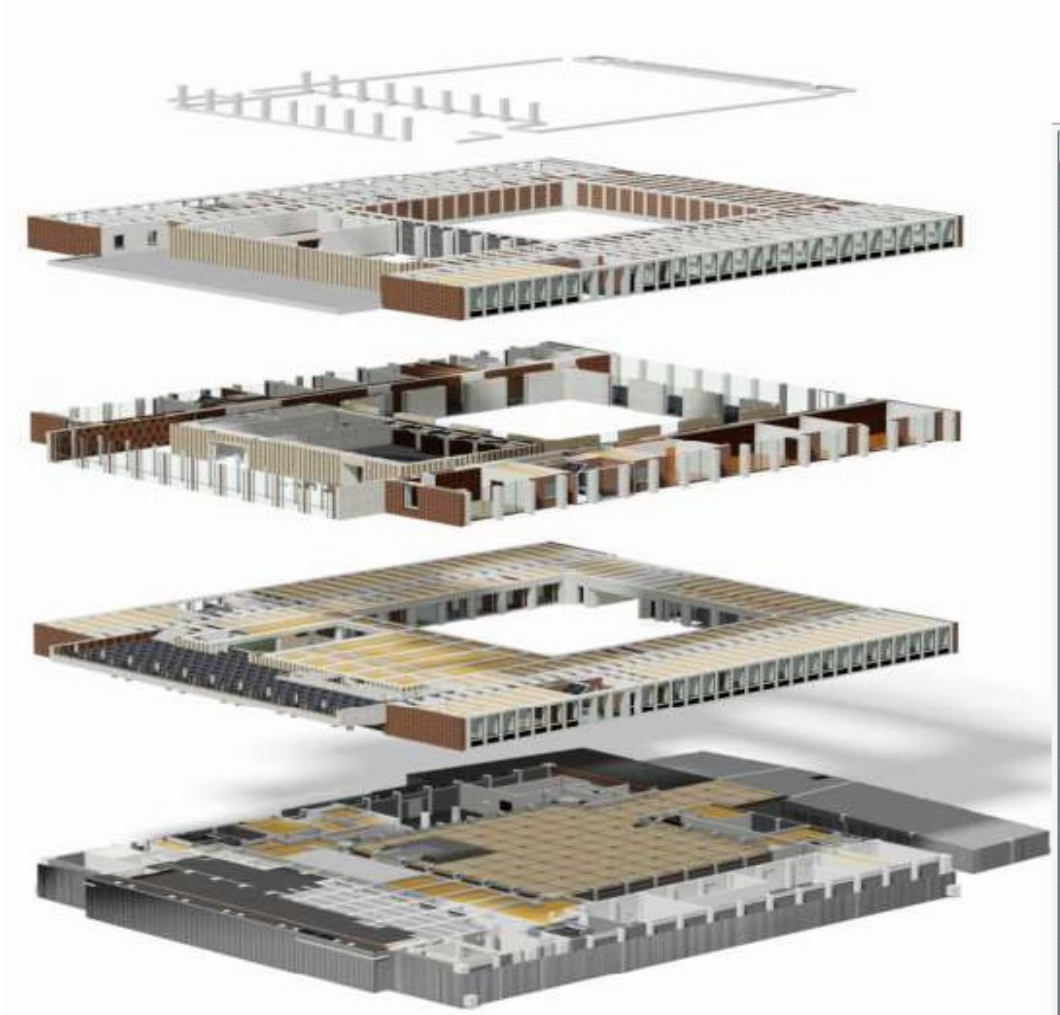

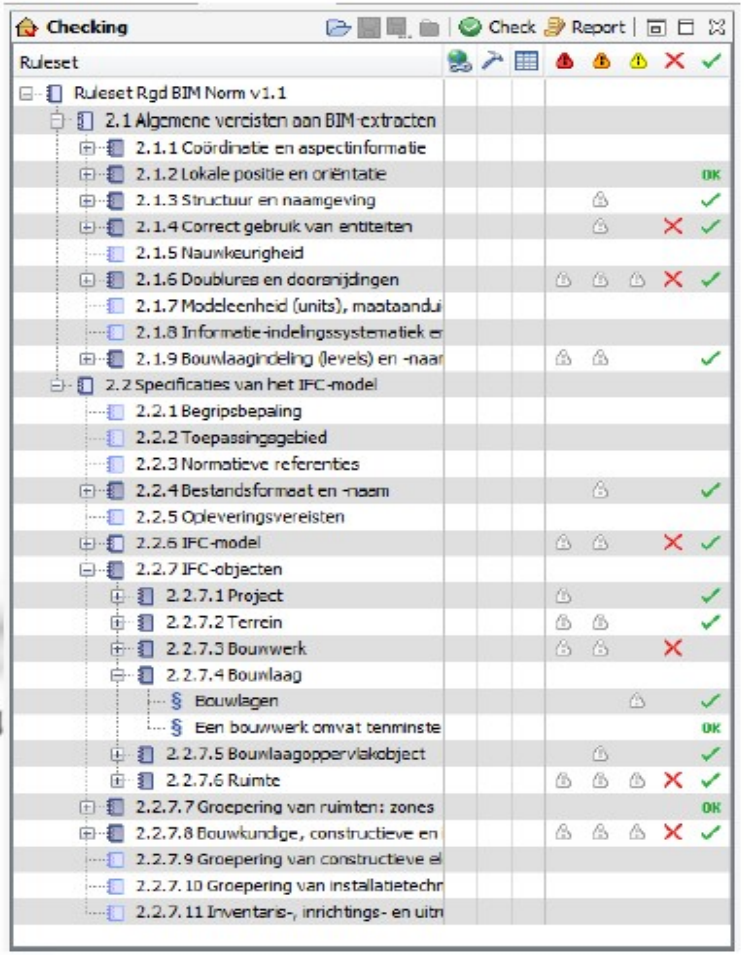

Hendriks 2015

Closed BIM Ecosystems

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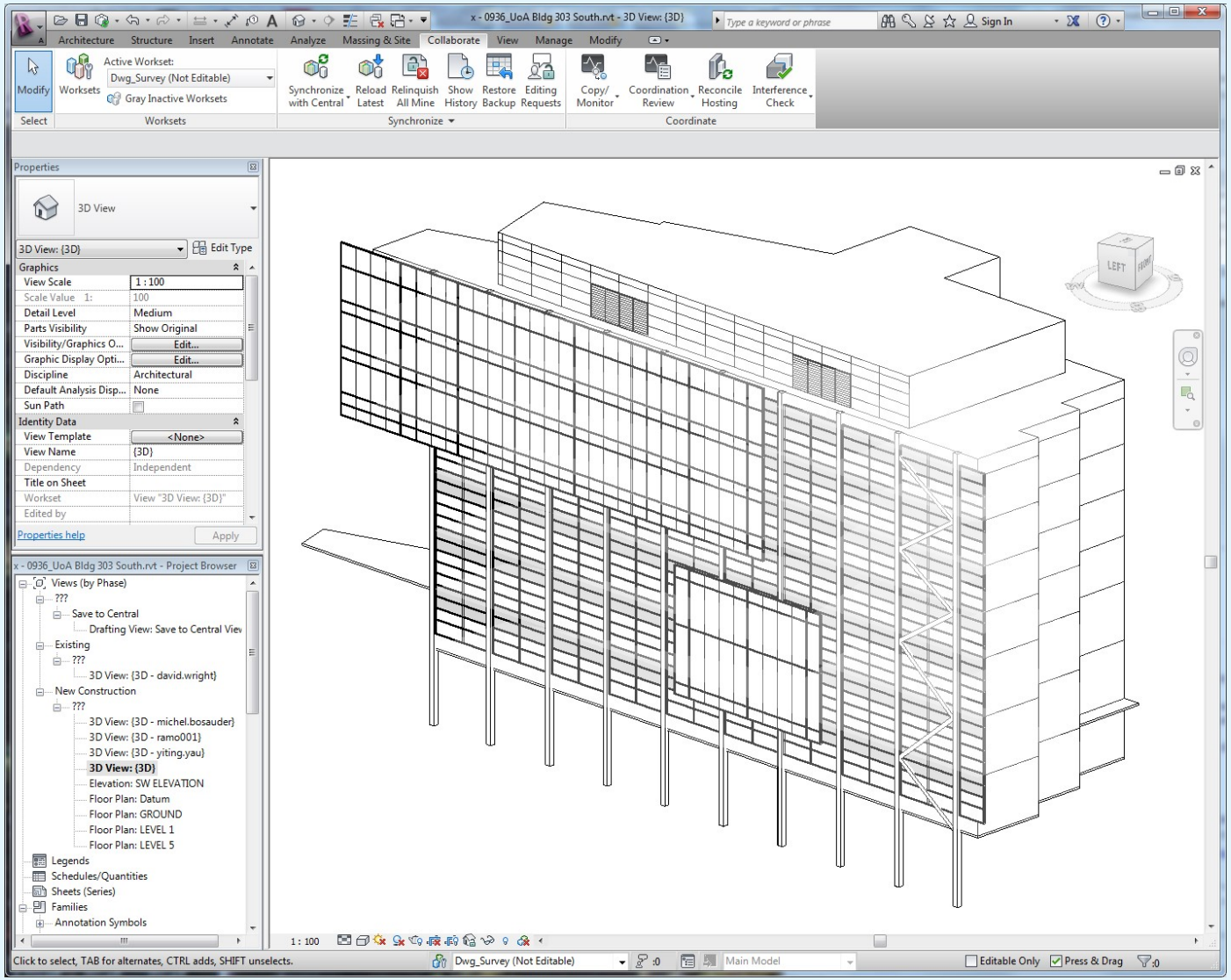

IFC (BIM) is an ISO standard

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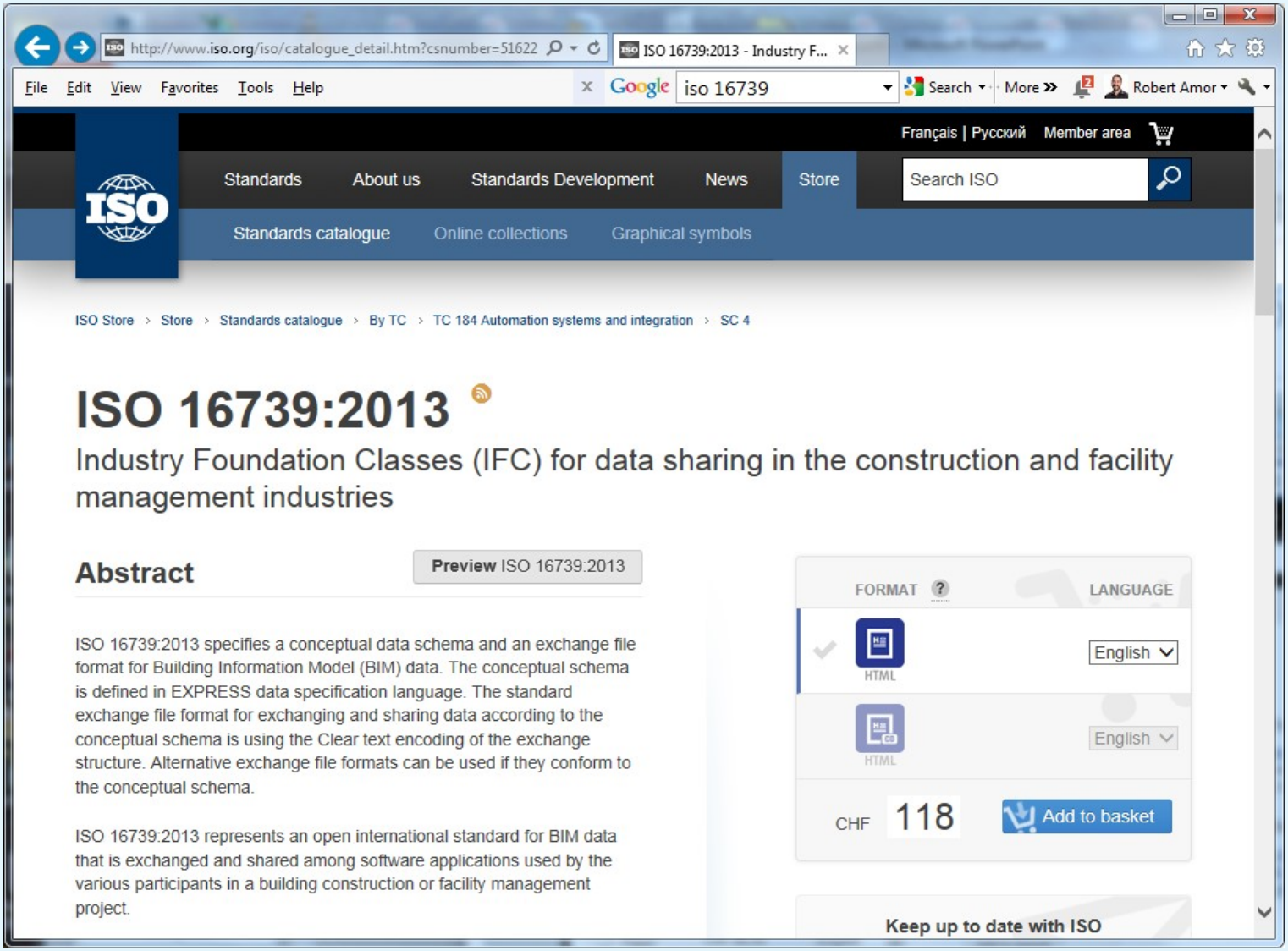

IFC Data Model - 766 Entities (http://www.buildingsmart.org/)

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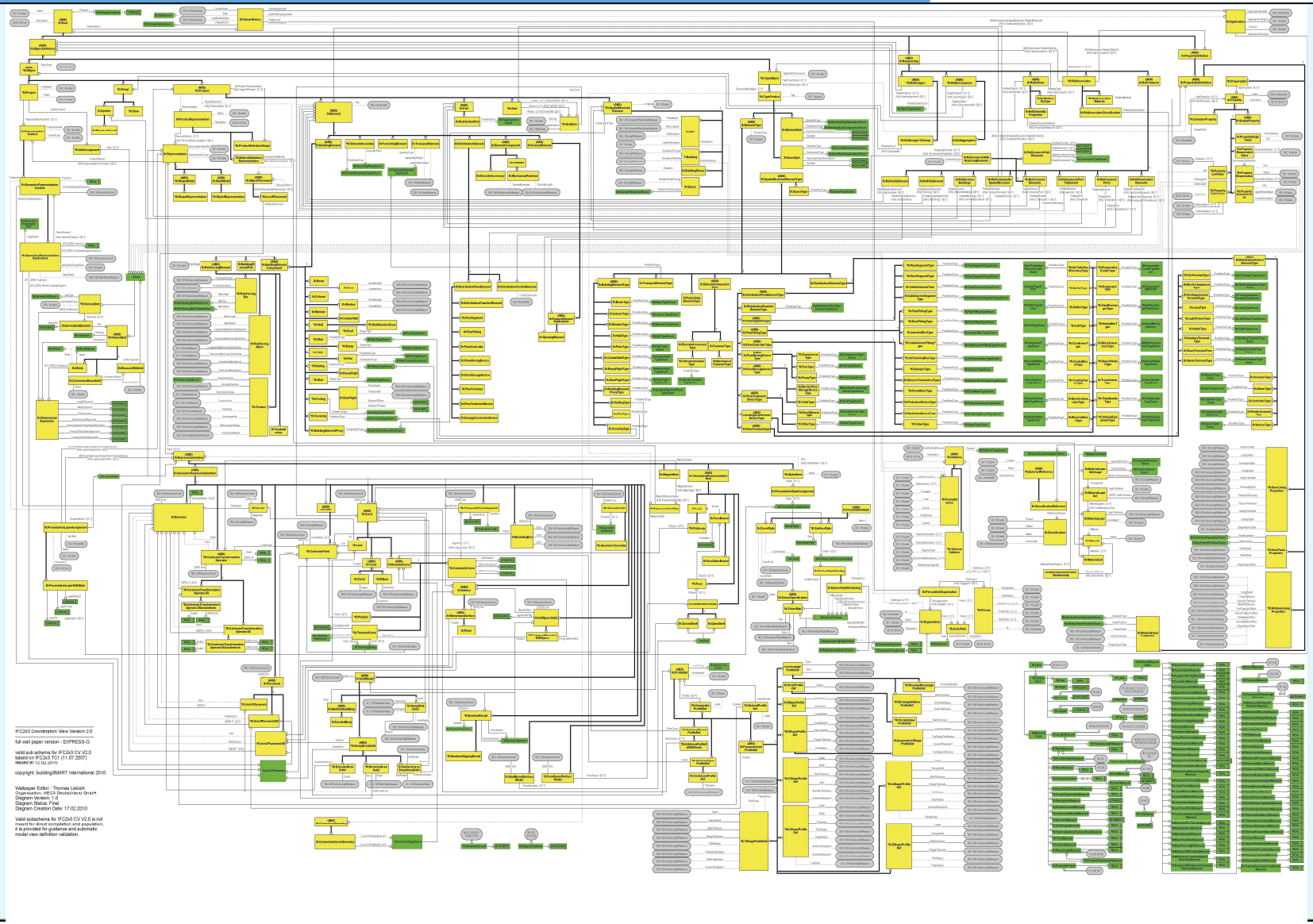

Software Tool Progress

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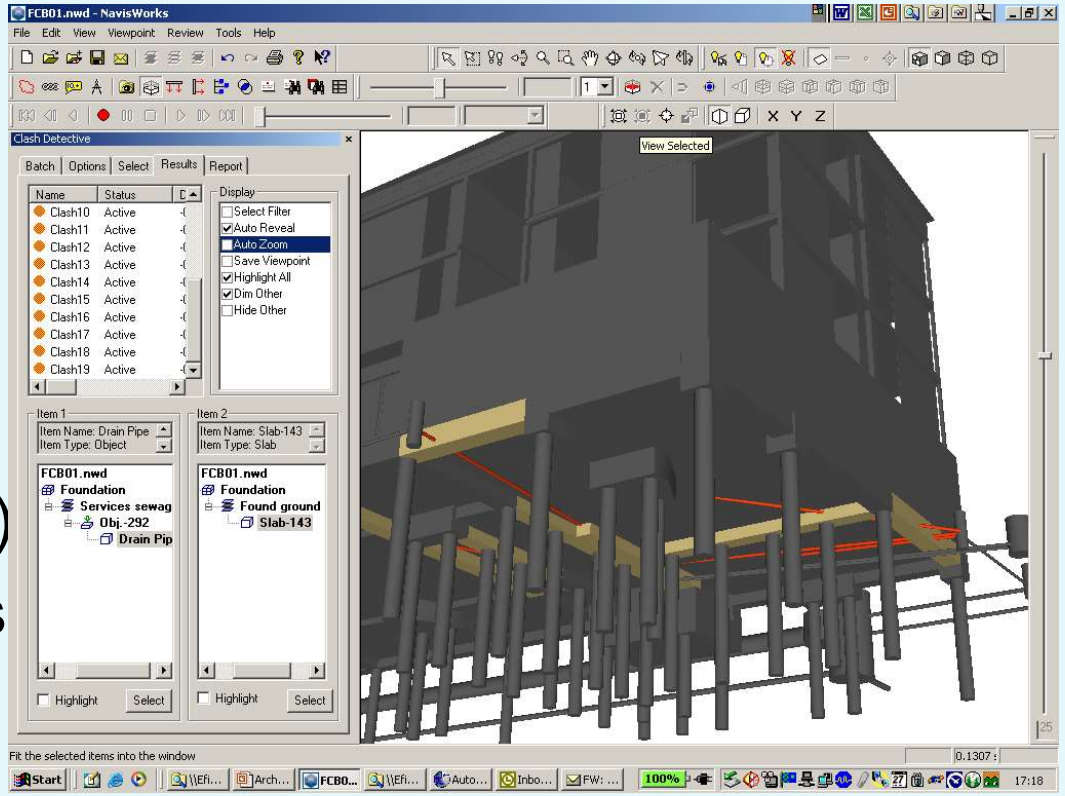
- 4,500 software tools for A/E/C-FM
  - Approx 1% are IFC enabled and certified
- BIM for
  - Collision detection
  - 4D
  - 5D
  - FM – (e.g., COBie)
  - Name your succes
    story…



NavisWorks 2009

Silo BIM

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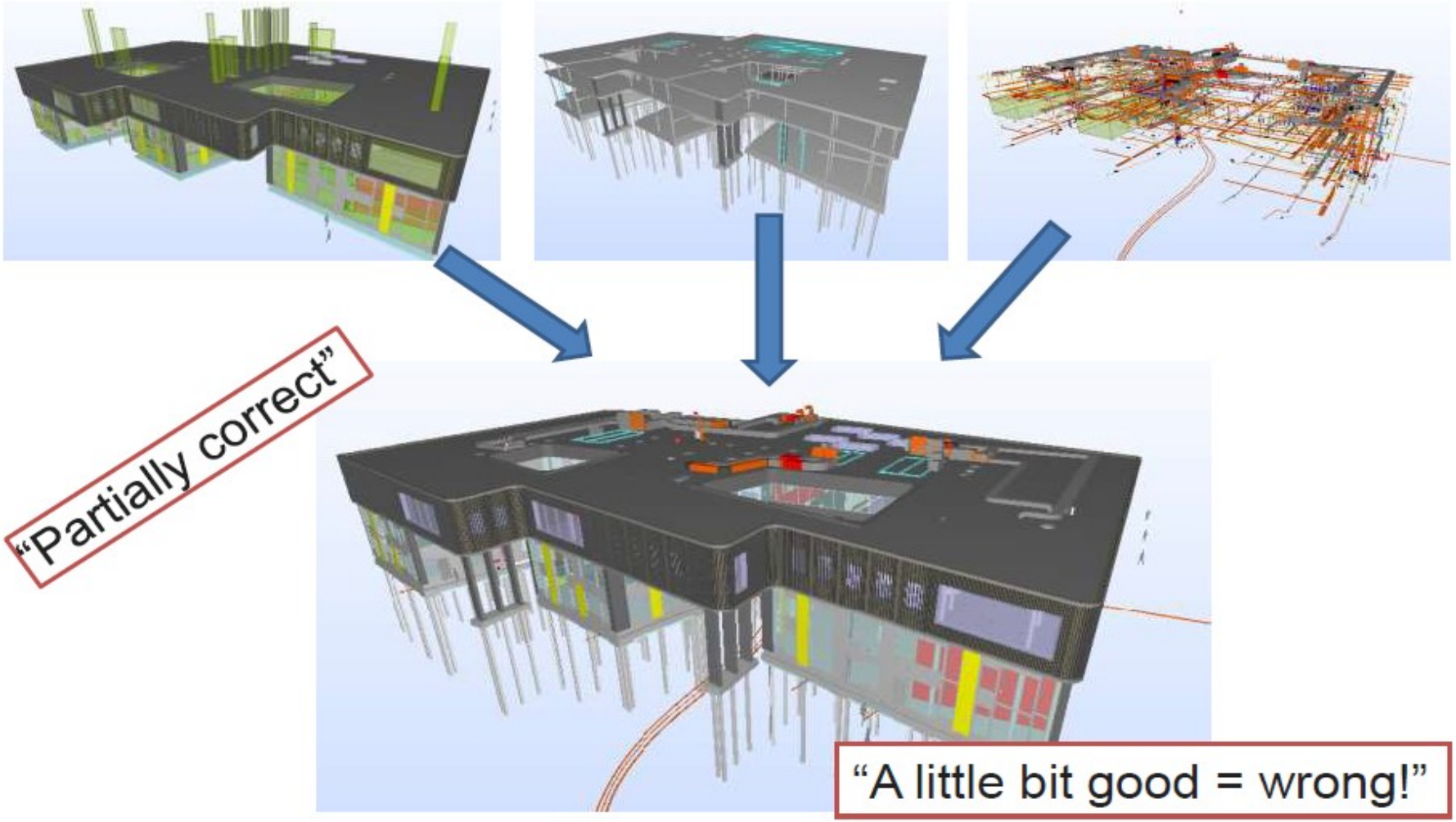

IFC
Views and Exchange Requirements

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- MVD
  - Model View Definitions (MVDs) define the subset of the IFC-data model that is necessary to support the specific data exchange requirements of the AEC industry during the life-cycle of a construction project
- IDM
  - The IDM (Information Delivery Manual) defines in the language and perspective of the professional participant what information must be contained in the “contracted exchange”. IDM also identifies the applicable business rules governing the subject exchange. For example, it may require the user applies specific classification system, such as Omniclass or constraints on the acceptable range of a parameter.

What is Not BIM?

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- Only 3D data
- No behavior
- Models comprising multiple 2D CAD reference files
- Models where changes in one view (e.g., dimensions) are not seen in other views

Other BIM Standards?

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- CityGML (http://www.citygml.org/)
  - City Geography Markup Language (CityGML) is a common information model and XML-based encoding for the representation, storage, and exchange of virtual 3D city and landscape models. CityGML provides a standard model and mechanism for describing 3D objects with respect to their geometry, topology, semantics and appearance.
- COBie (http://www.nibs.org/?page=bsa_cobie)
  - Construction-Operations Building Information Exchange (COBie) is a performance-based specification for facility asset information delivery, including equipment and spaces. (IFC compliant)
- gbXML (http://www.gbxml.org/)
  - Green Building XML (gbXML) open schema helps facilitate the transfer of building properties stored in 3D building information models (BIM) to engineering analysis tools.

Governments Mandating/Supporting BIM

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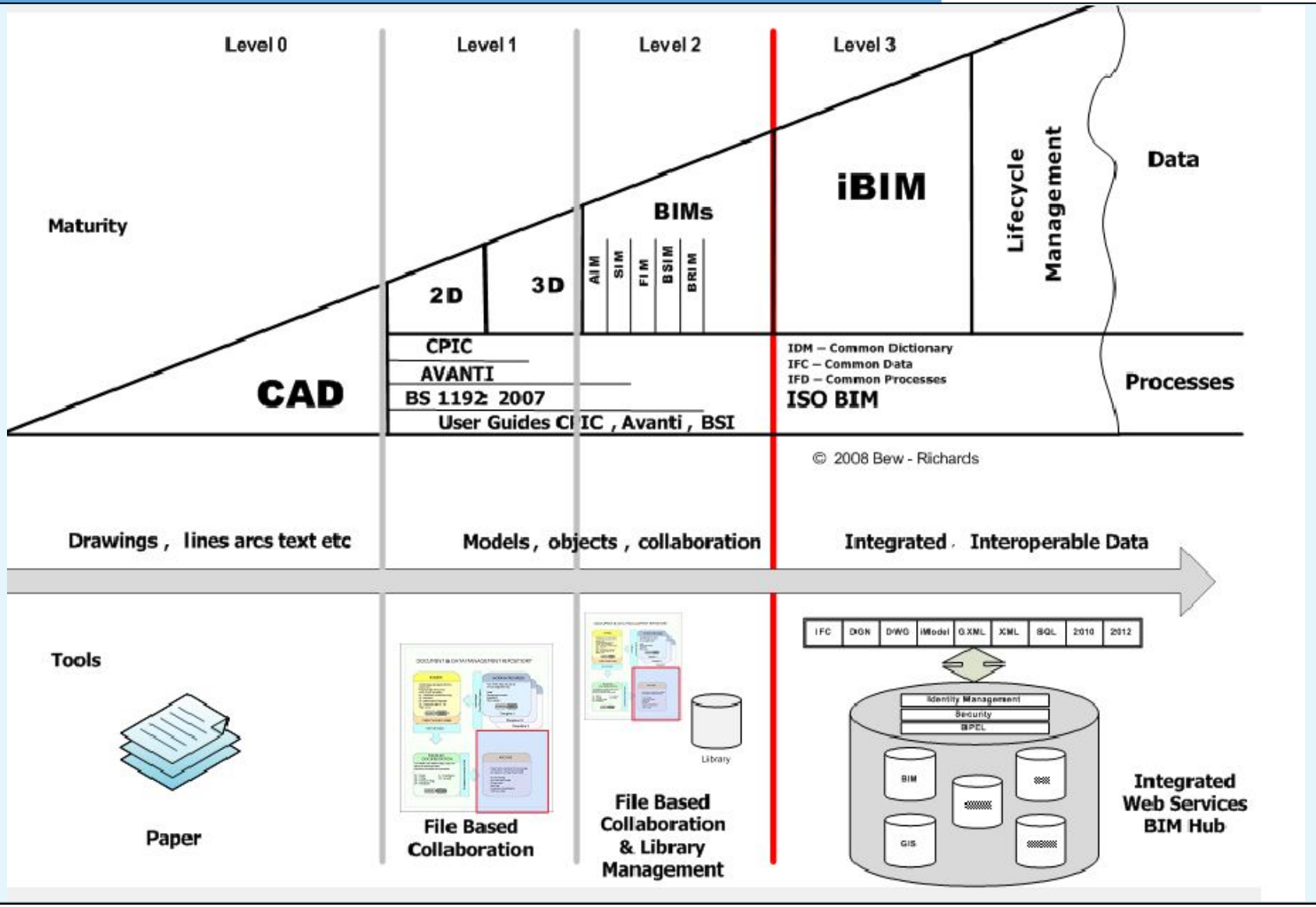

BIM Handbooks Internationally

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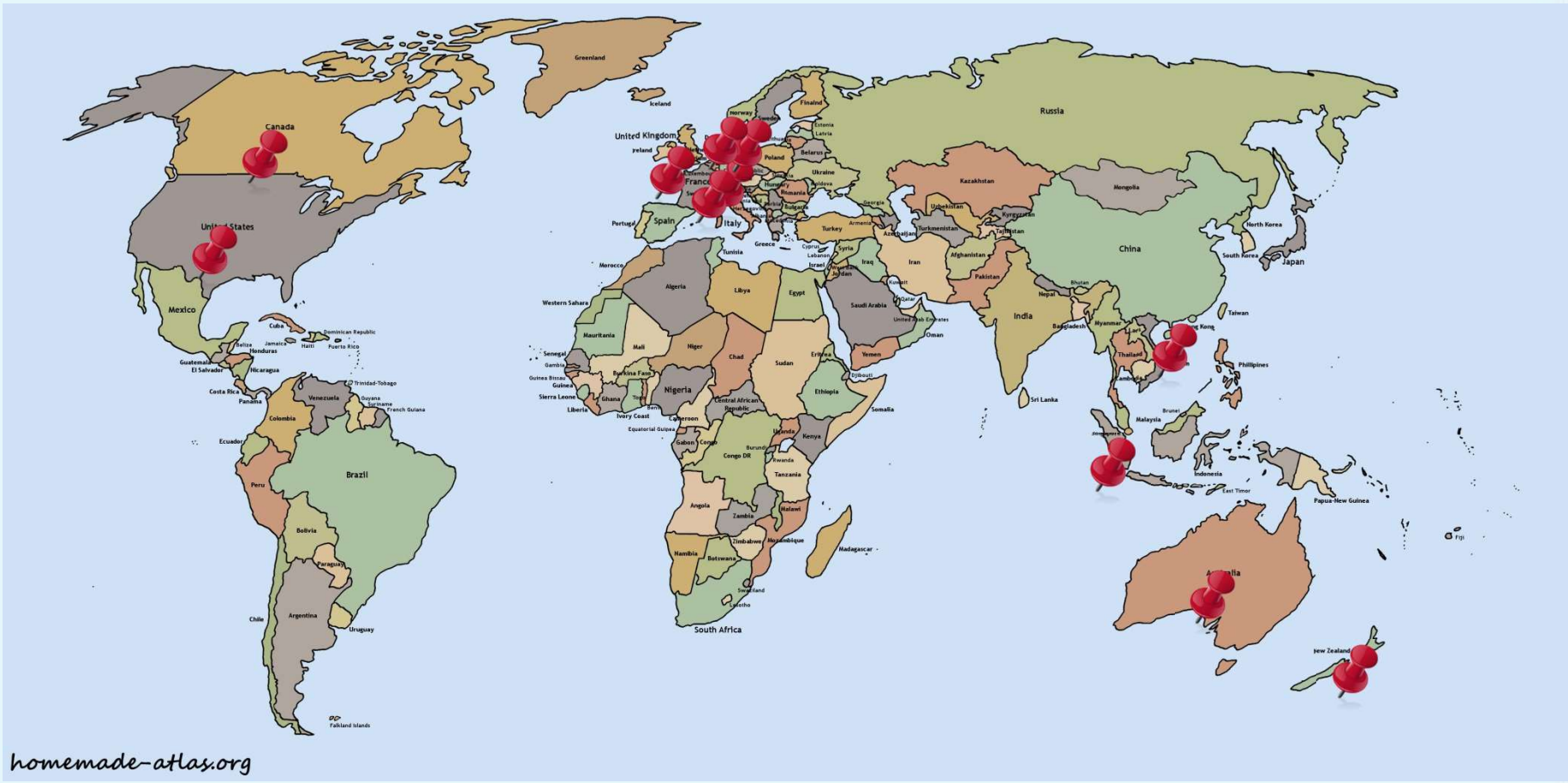

"Political World Map" by Ionut Cojocaru - Own work.
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http://commons.wikimedia.org/wiki/File:Political_World_Map.jpg#mediaviewer/File:Political_World_Map.jpg

Gartner Hype Cycle 2015

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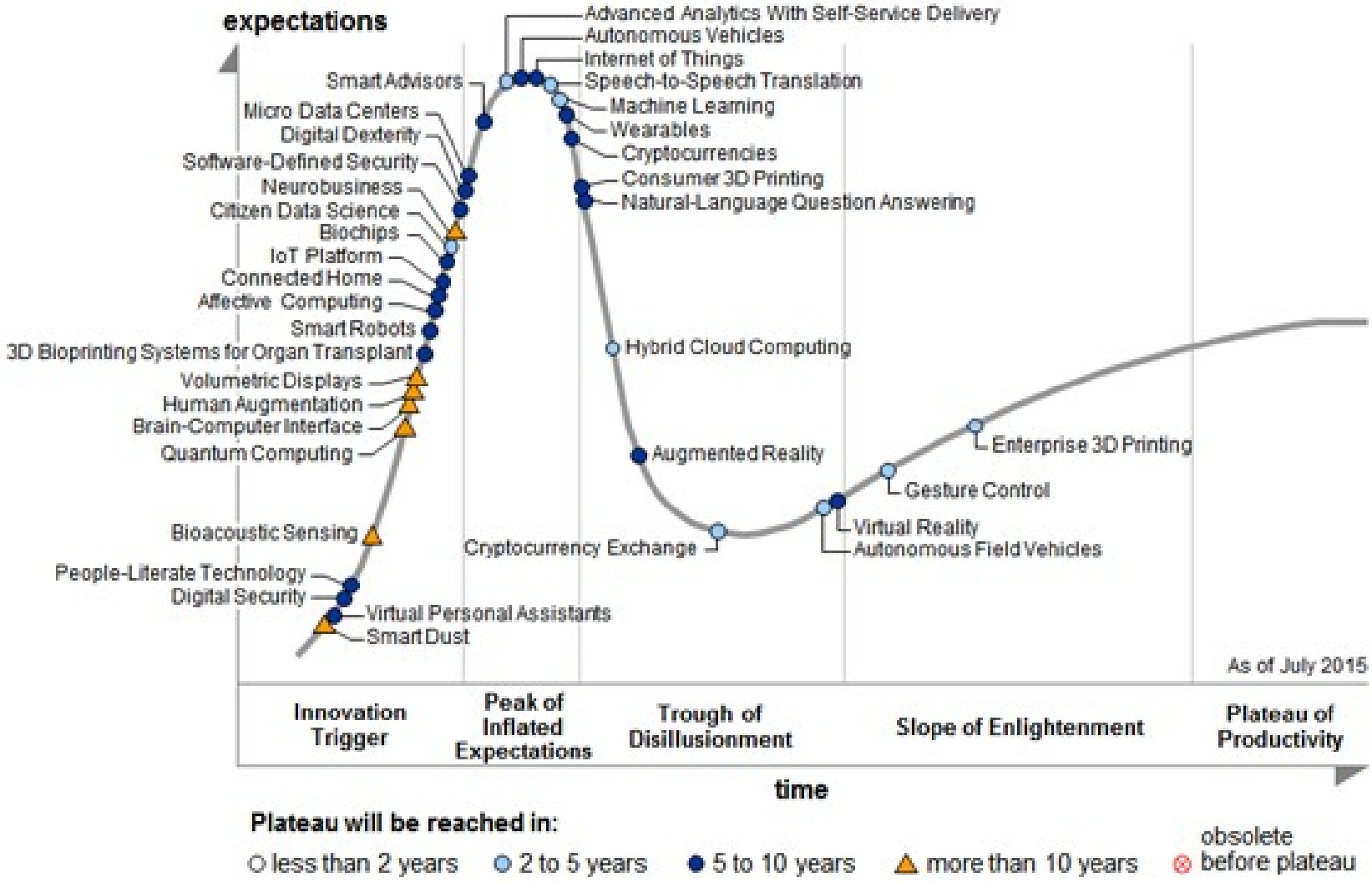

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FUTURE STEPS FOR INTEROPERABILITY

Coverage of Domains

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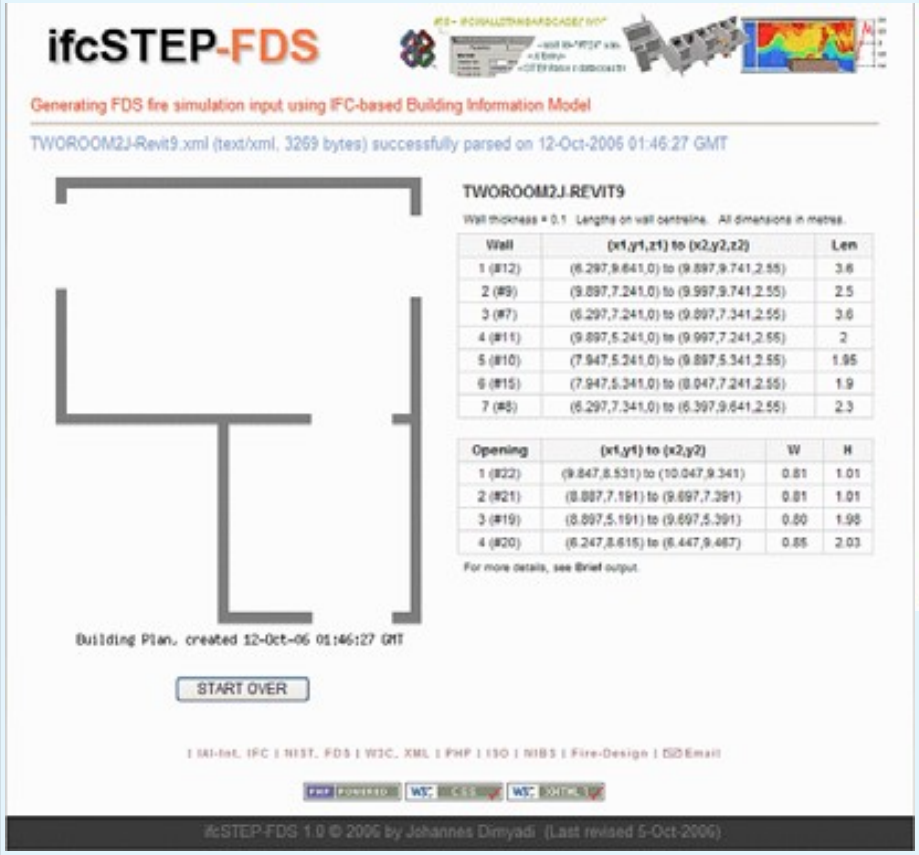

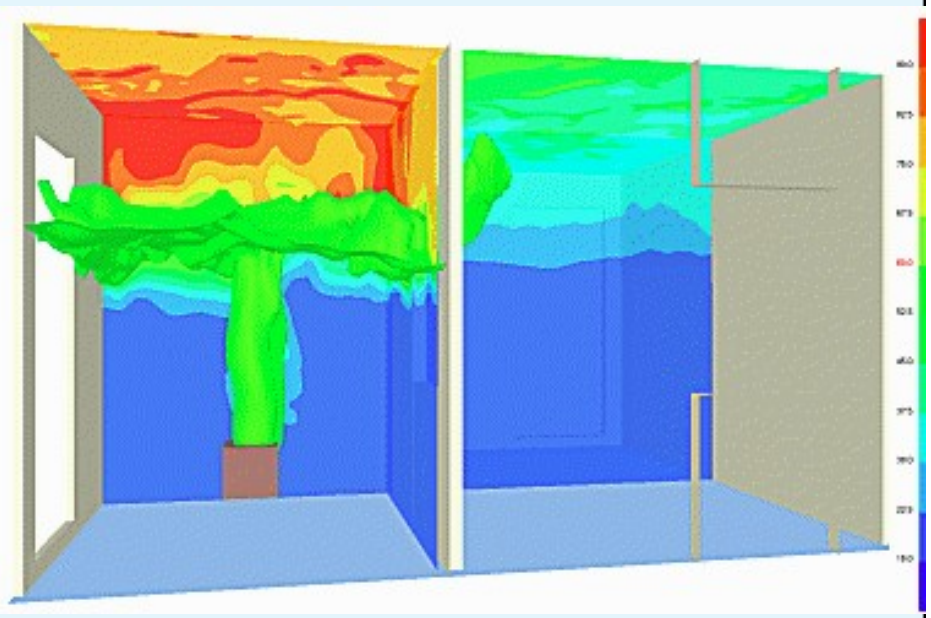

Dimyadi, Spearpoint and Amor 2007

Coverage of Domains

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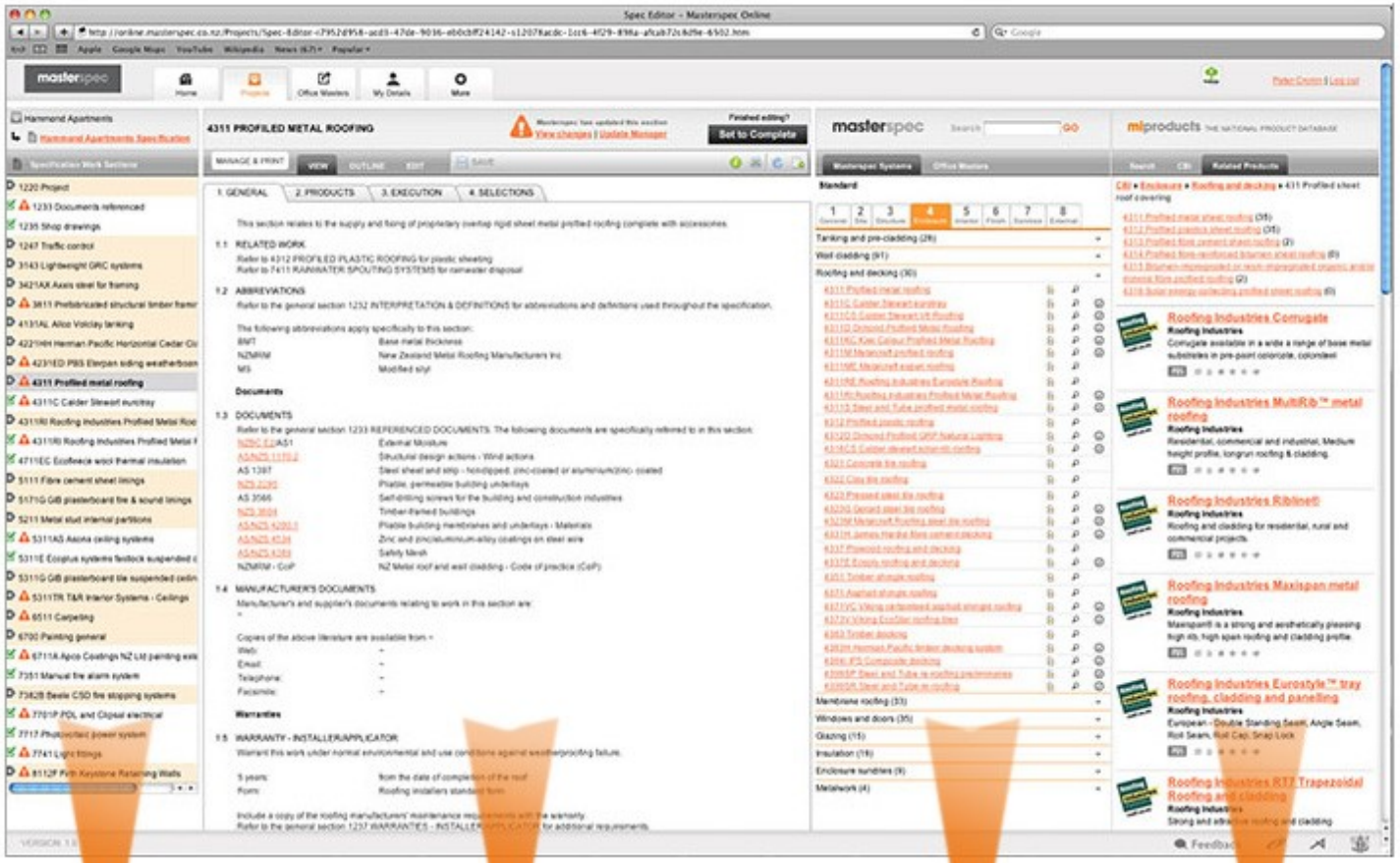

Views and Interfaces

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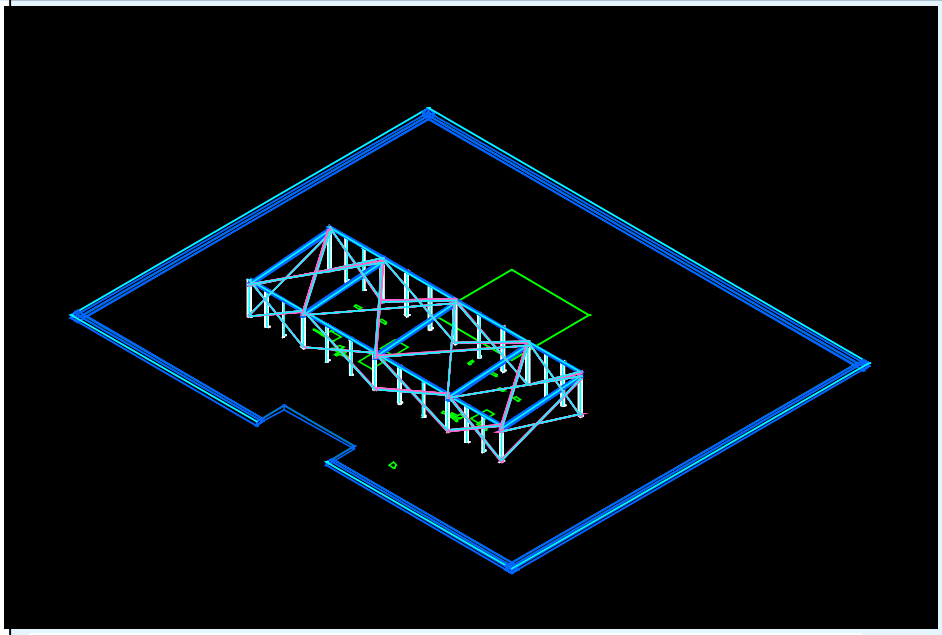

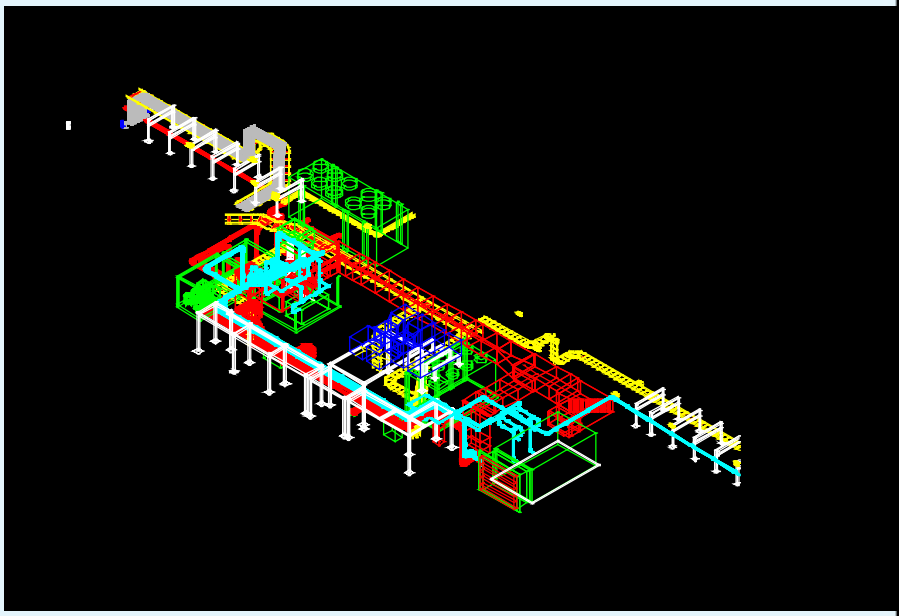

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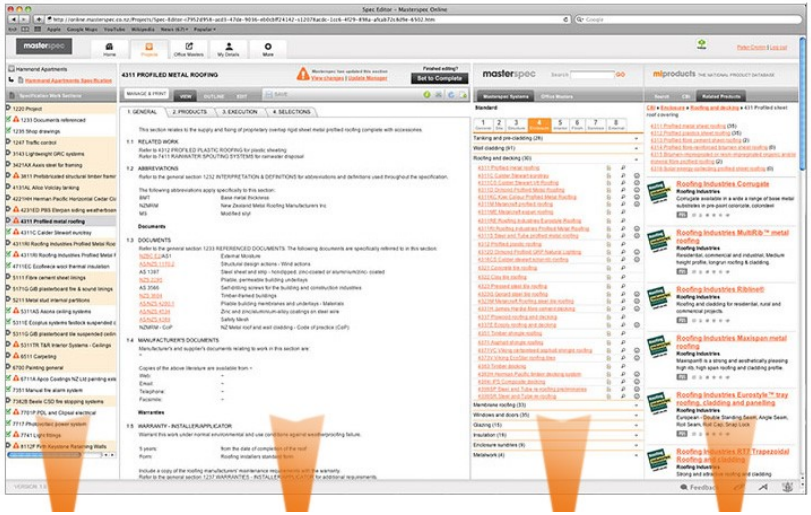

Masterspec

Define Detail Representations for Different Project Stages

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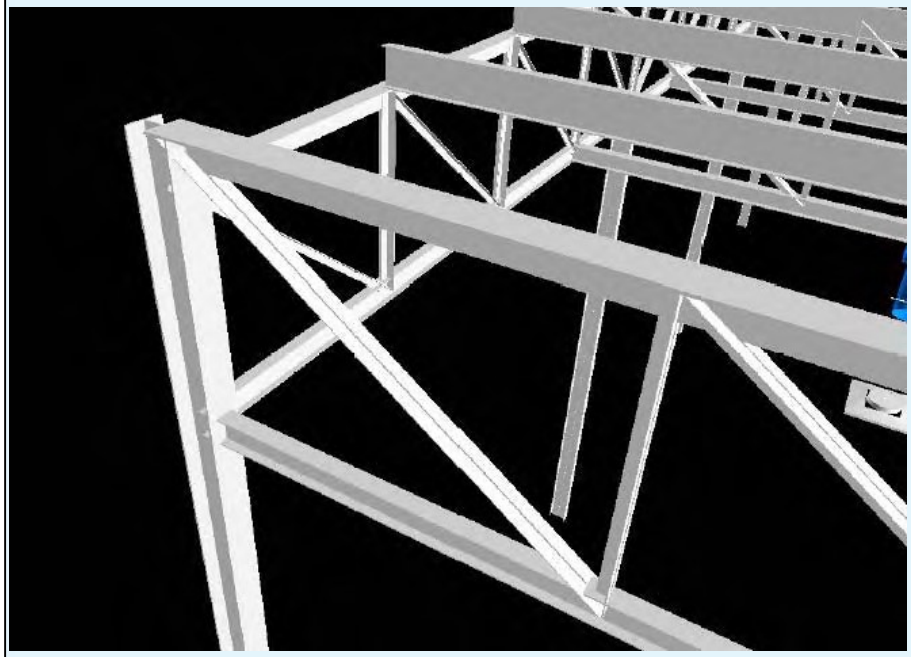
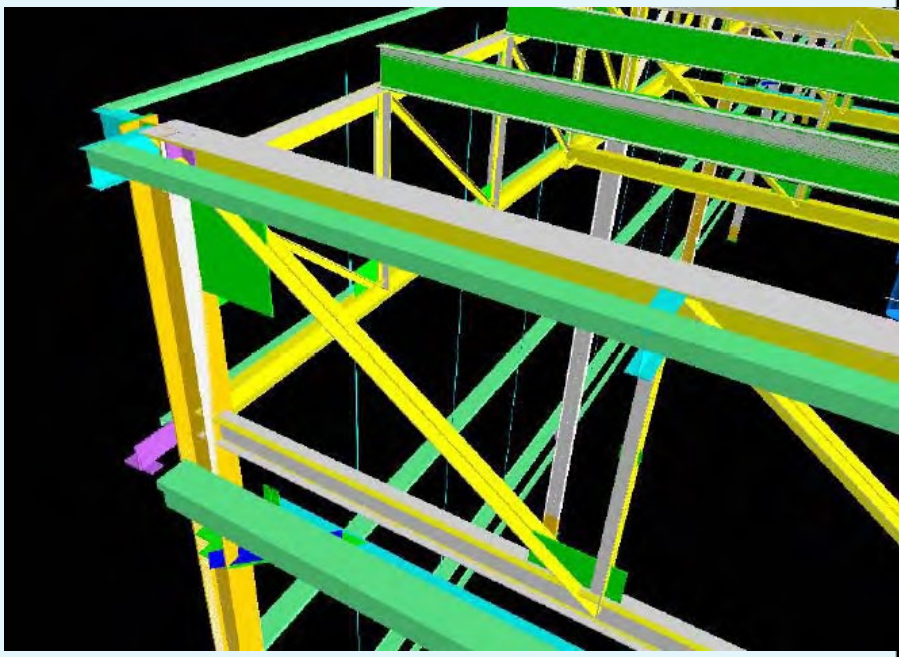
Preliminary design



Steel fabricator model



Moving Away From Complete Data File Transfer

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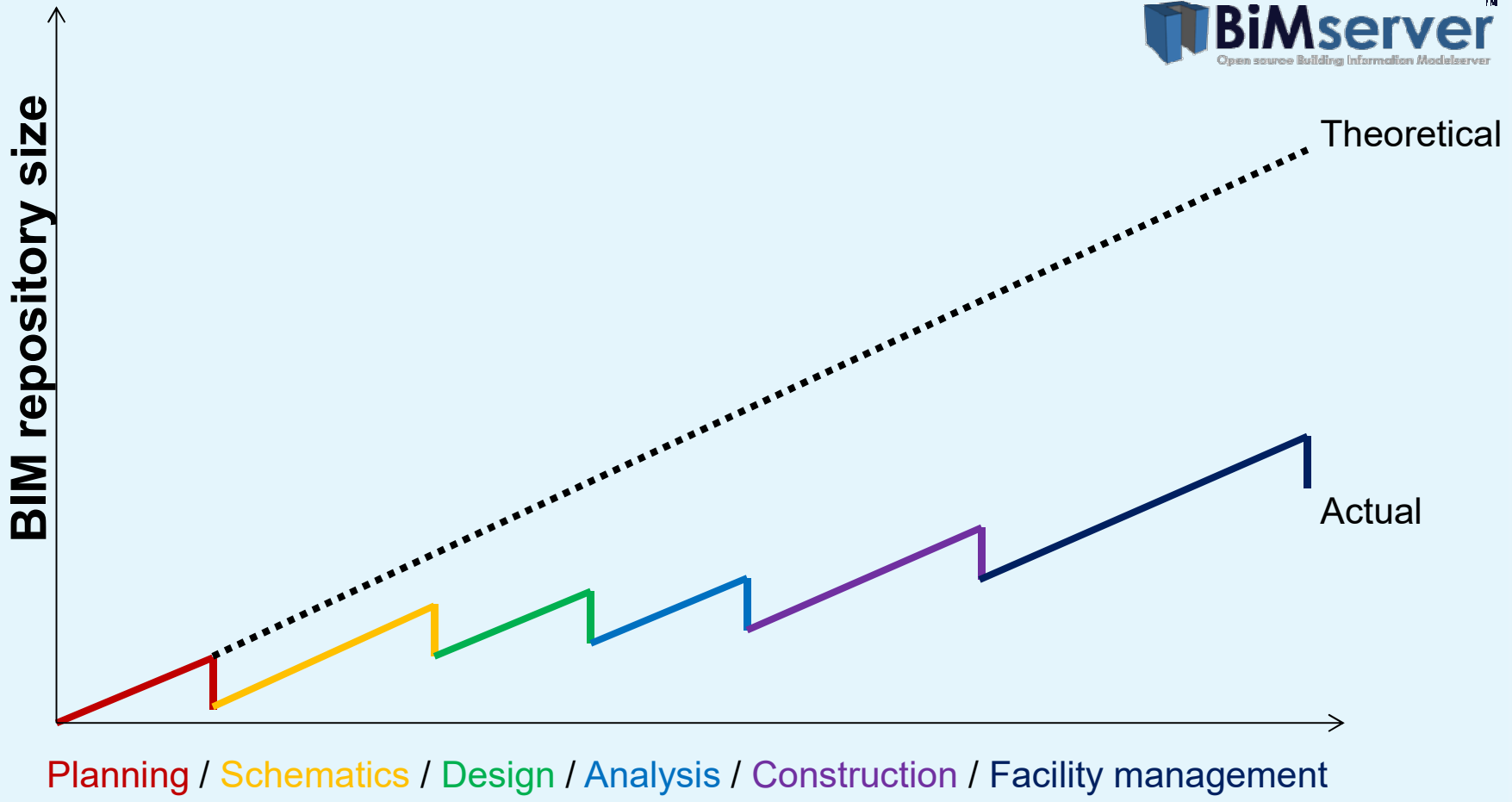
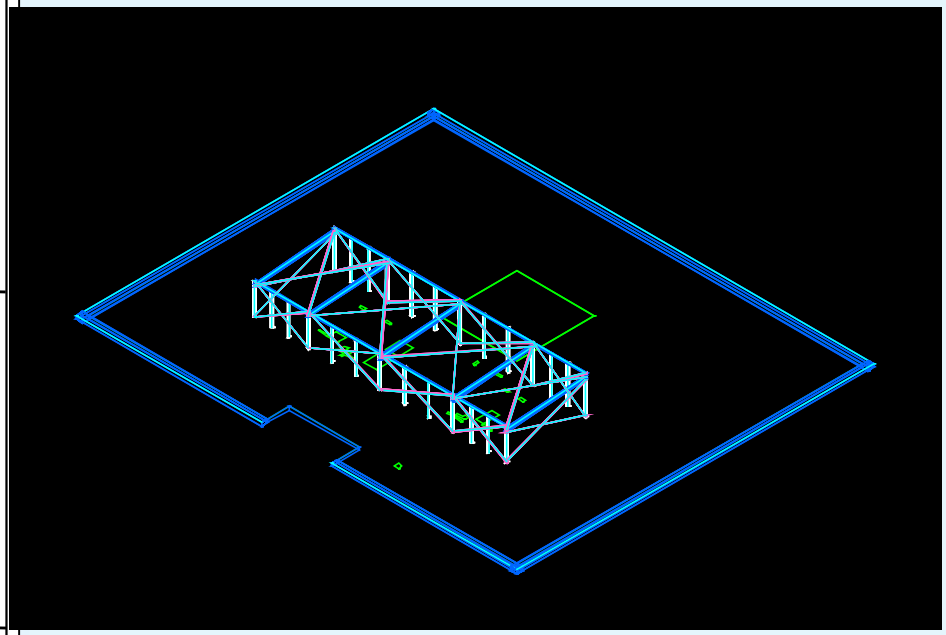
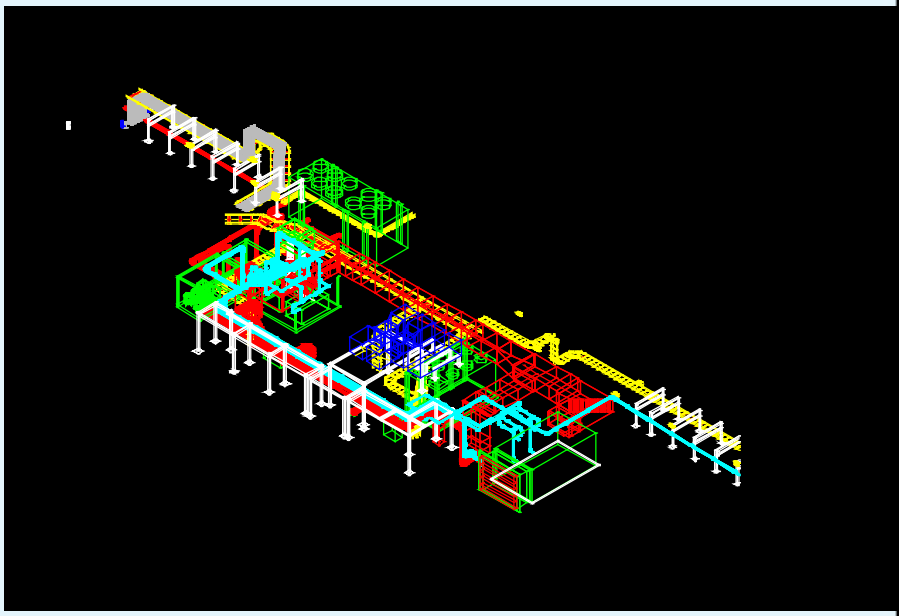
BIMserver™
Open source Building Information Modelserver



Multi-Models





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BIM Philosophy 101

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- Where to now for IFC5?
  - In 2020, 7 years from IFC4 release…

Instantiable and Abstract Entities

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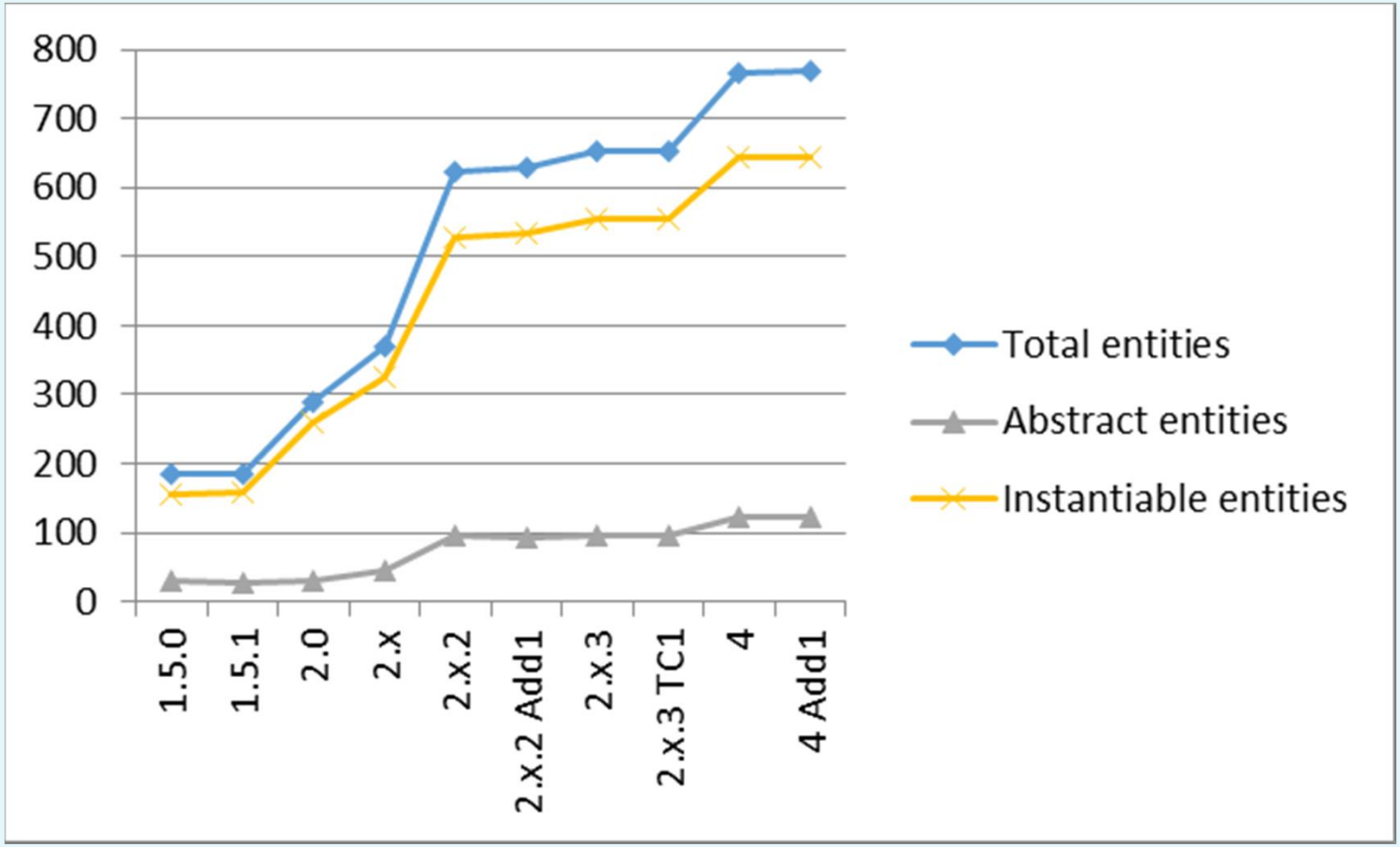

% Optional and Required Attributes

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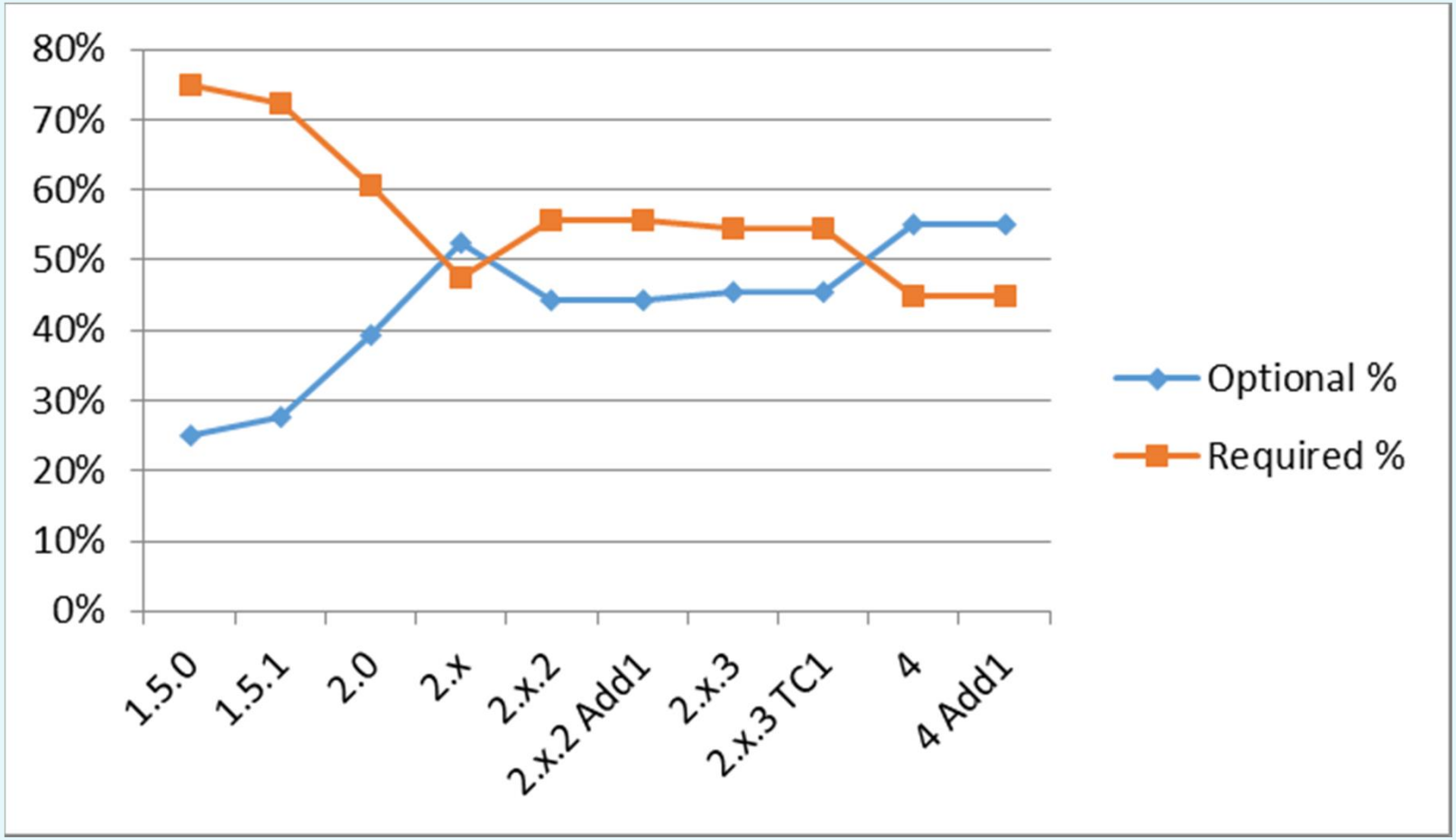

Semantic Structures in IFC

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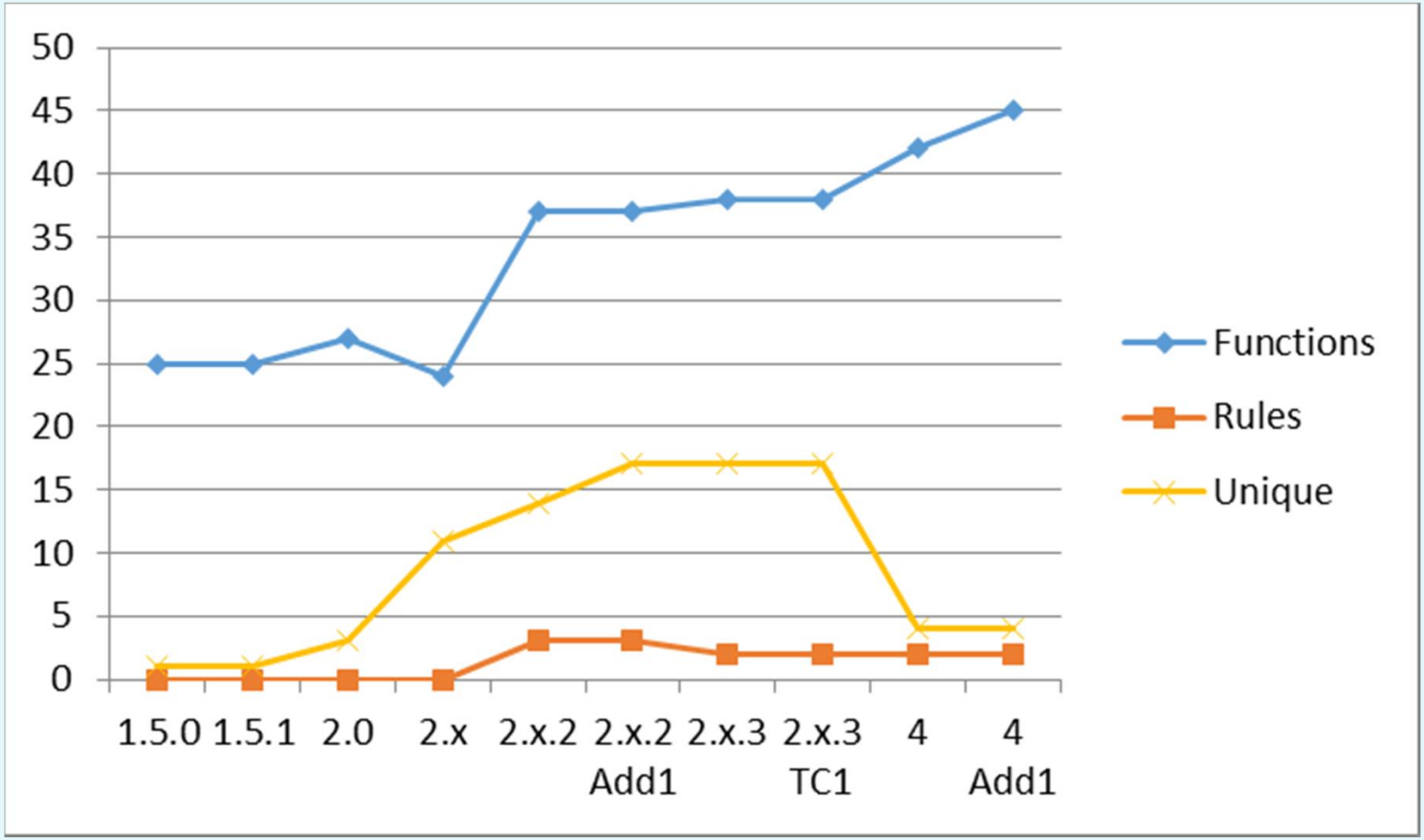
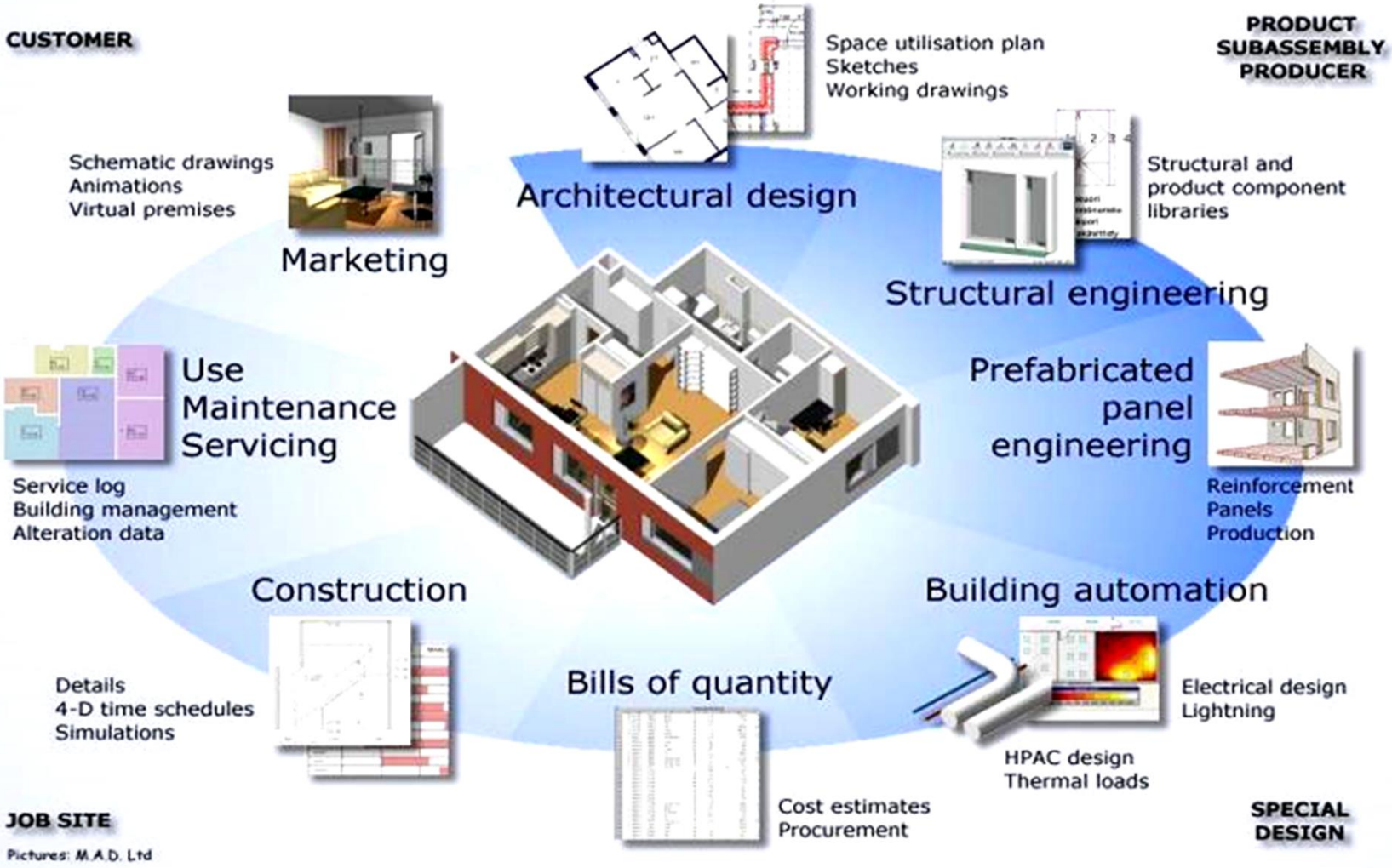


Handling Partial Views and View Merging



Libraries and Product Data

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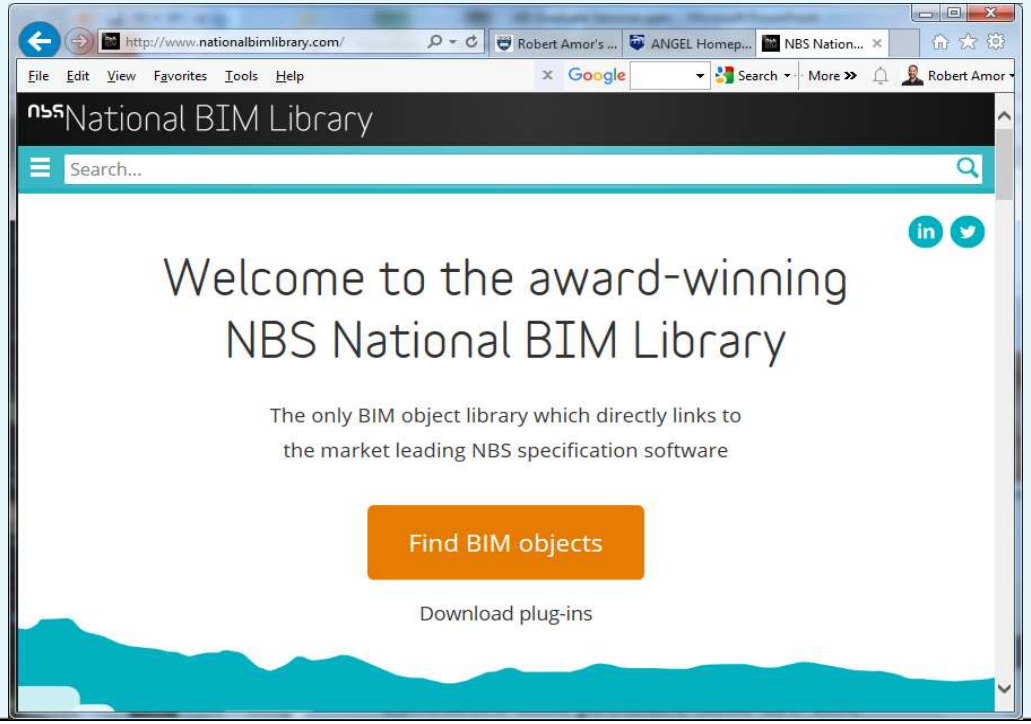
- Manufacturer supplied BIM objects
- National BIM Libraries?
  - Generics
  - Manufacturer Specific

IAI 2001



Certification of BIM and Analysis Tools

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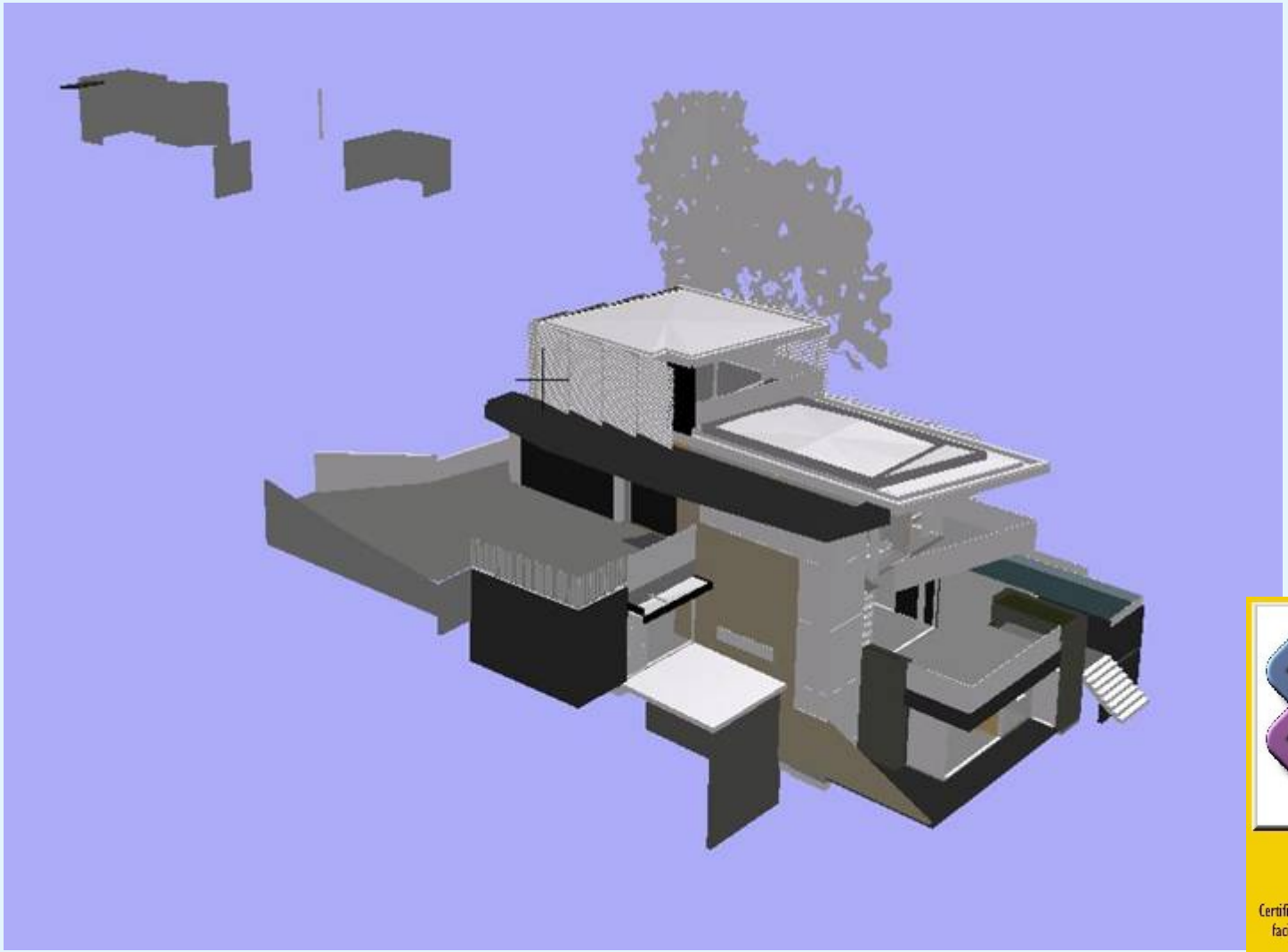

IFC™2x
IMPLEMENTATION
Certified in accordance with official IAI facilitated approval procedures for IFC™2x

The University of Auckland | New Zealand | 14 March 2016

Software Tool Inclusiveness

4,500 software tools for A/E/C-FM

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Autodesk Navisworks Products

Sage Timberline Office

Primavera P6 Professional Project Management

STAAD.Pro V8i

Total Stations

© C. Eastman

Software Tool Inclusiveness
Parametric CAD

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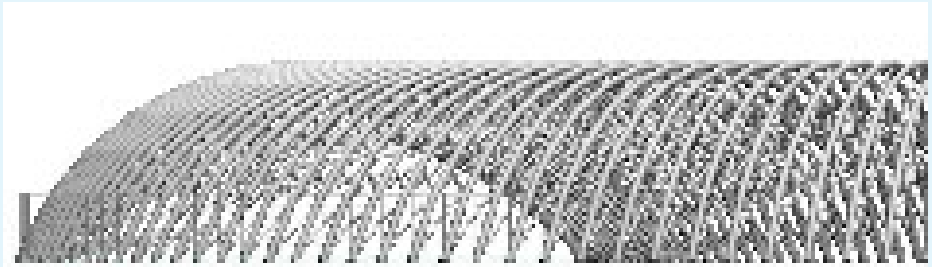

Bentley 2009

Simulation vs. Reality

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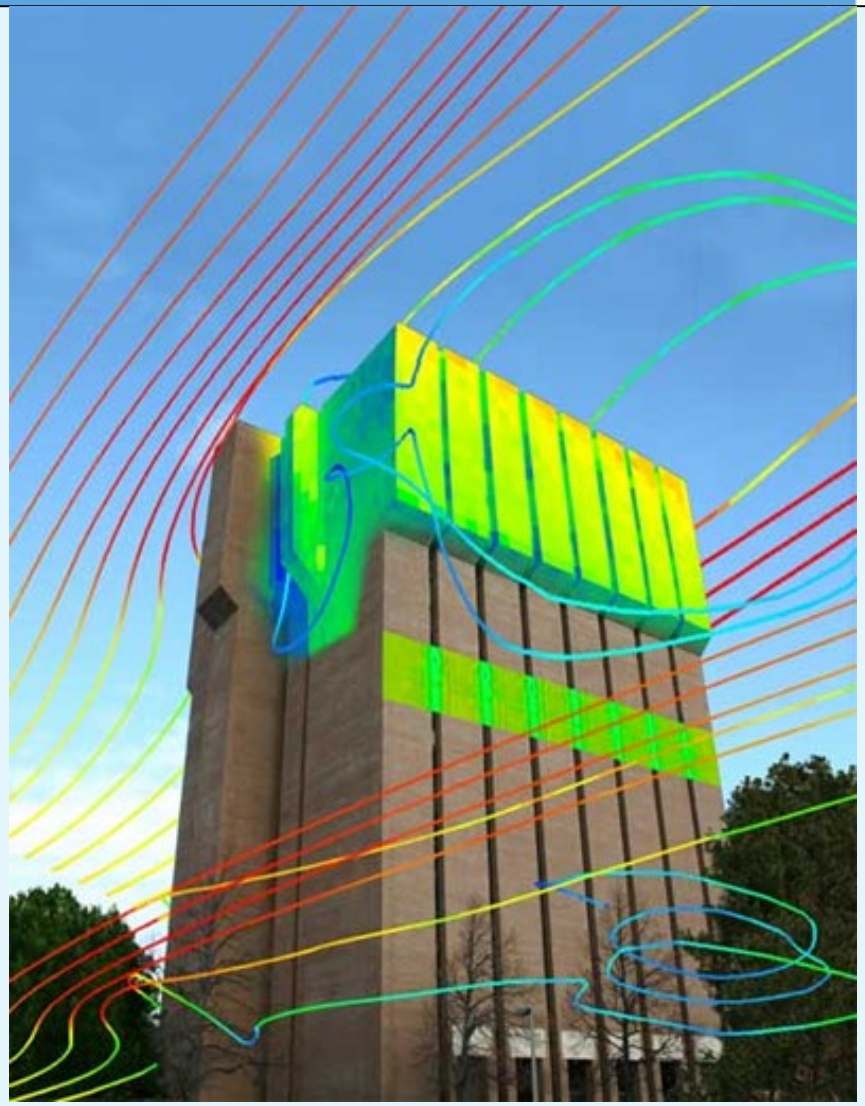

Moving to Mobile Devices
E.g., Augmented reality and snagging

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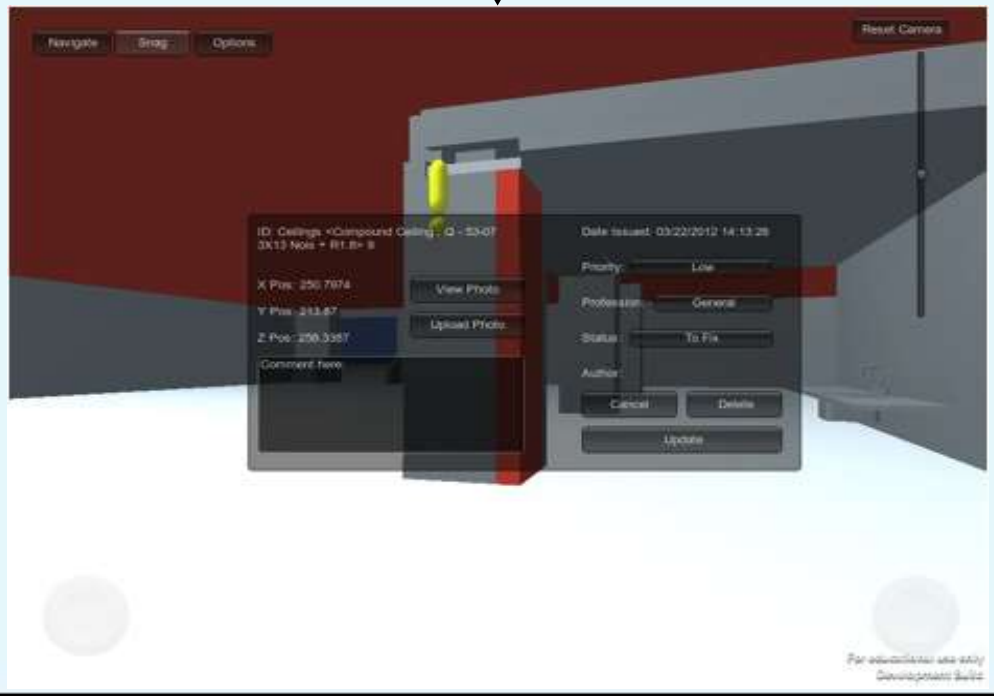

Amor et al 2012

More Robust Consultation

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http://www.youtube.com/nextspacenz#p/a/u/0/NBD2QWyBvlg

Moving to the Cloud

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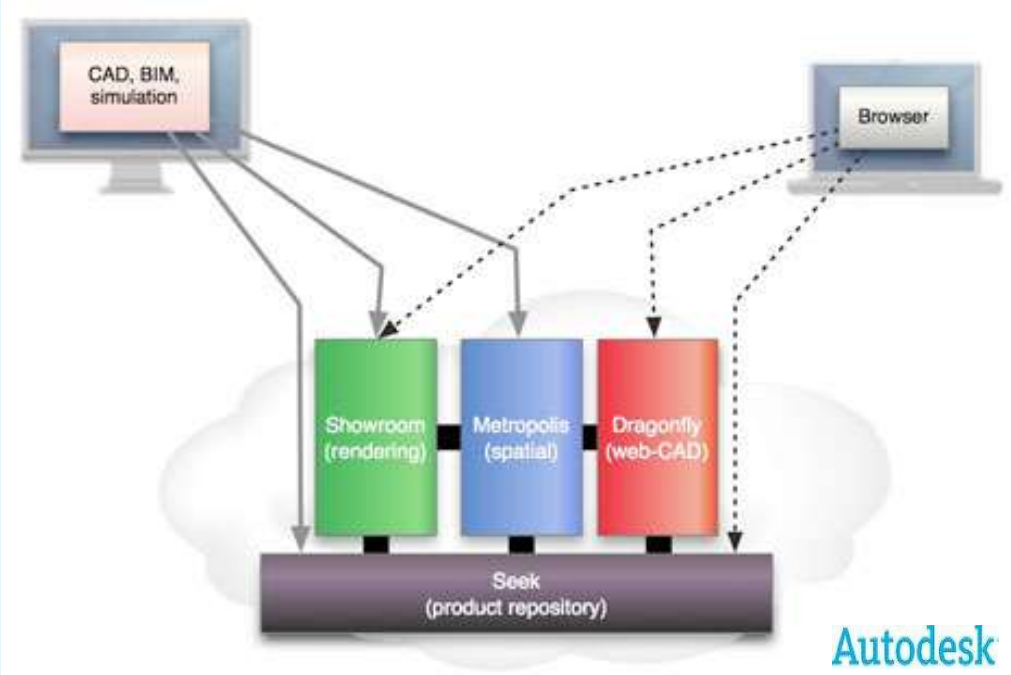
- Need models for business in the cloud
- Trust models are still to be developed



LiDAR

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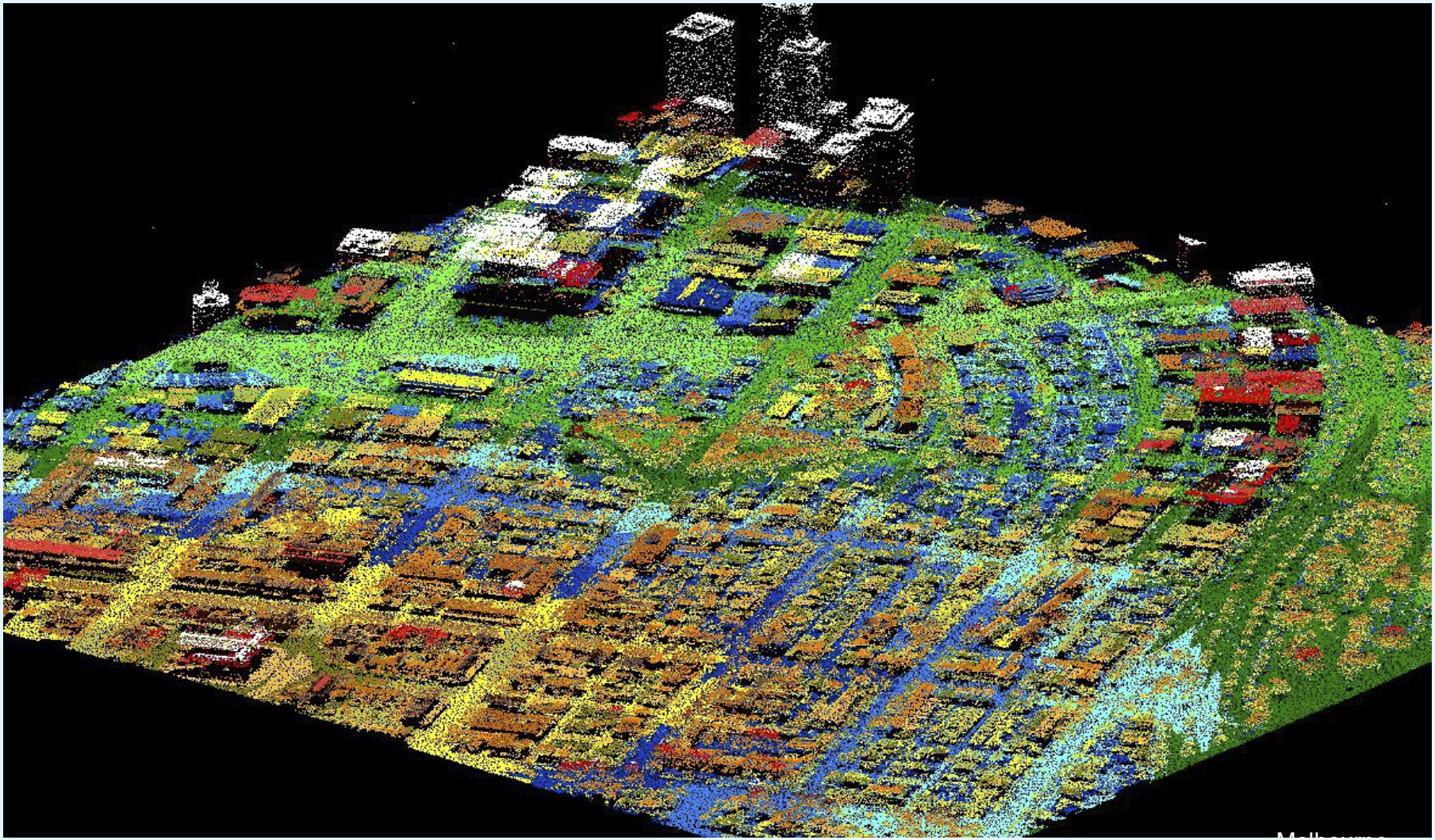

3D Printing, Robots, etc.

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Smarter Infrastructure

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New Zealand

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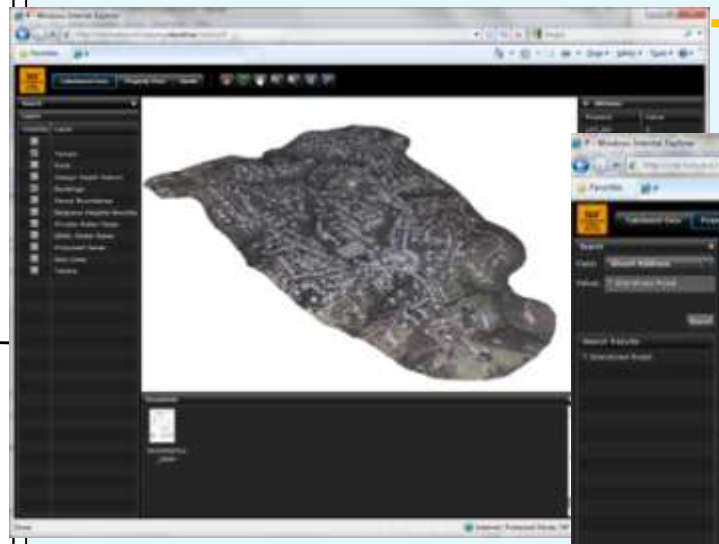
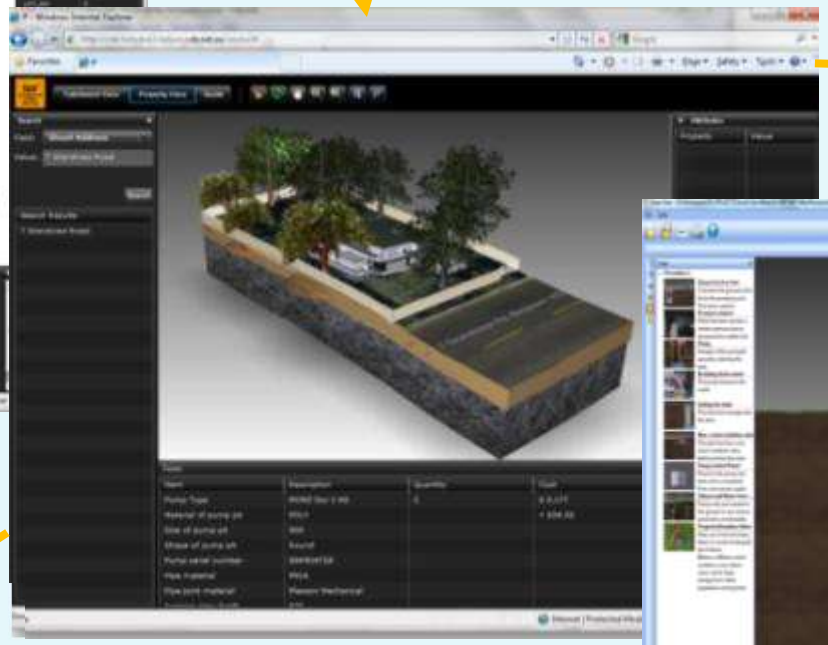
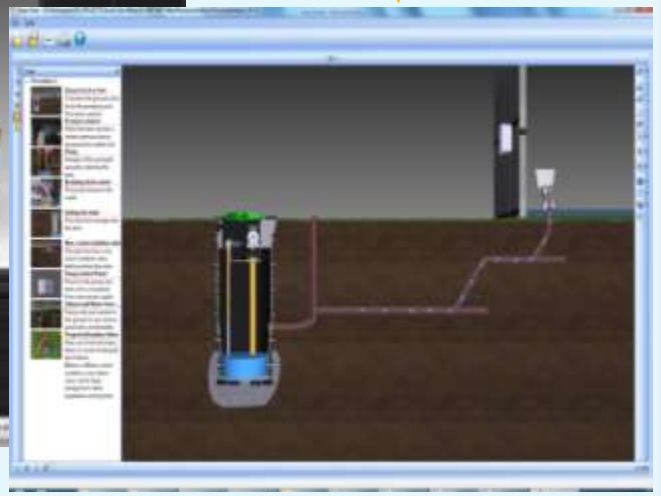


3D Catchment View .

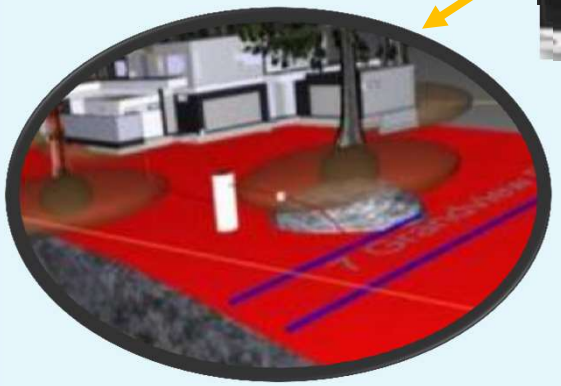
Automated derivative synthesis



3D Property View – for home owner, inspectors,



3D Operations View



Visual Water- South East Water (Melbourne) - Nextspace

Summary

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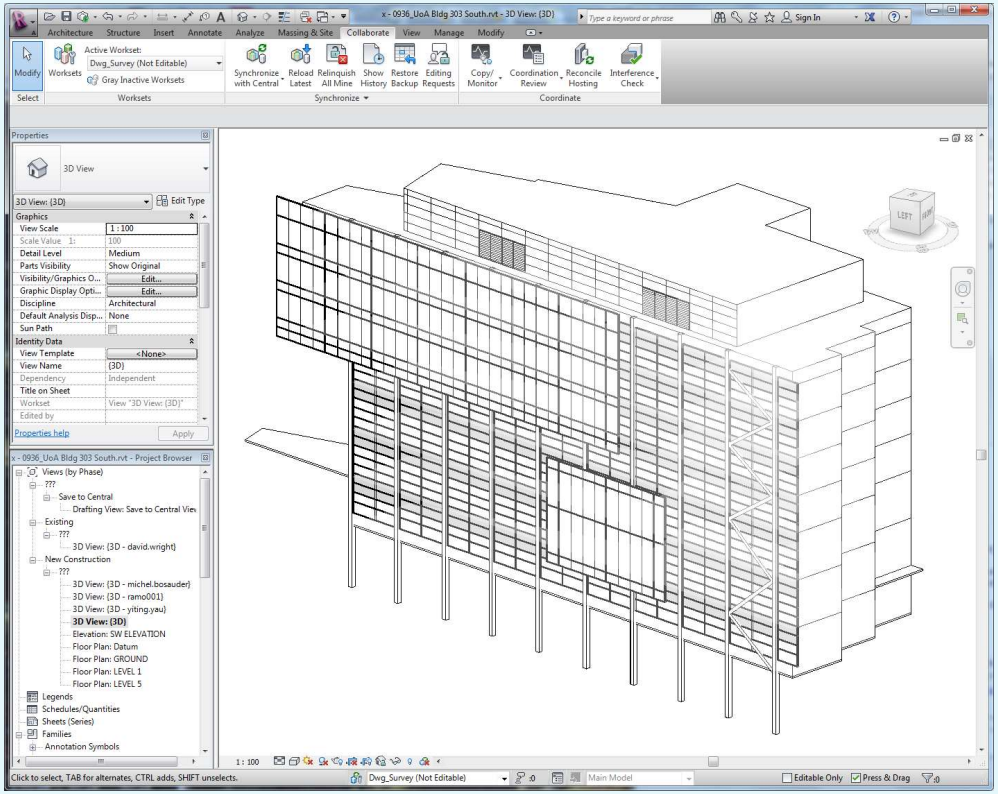
- Technical infrastructure is good
- BIM underpins everything
- BIM development required
- Processes need to adapt
- Direction needs to be charted by AEC-FM



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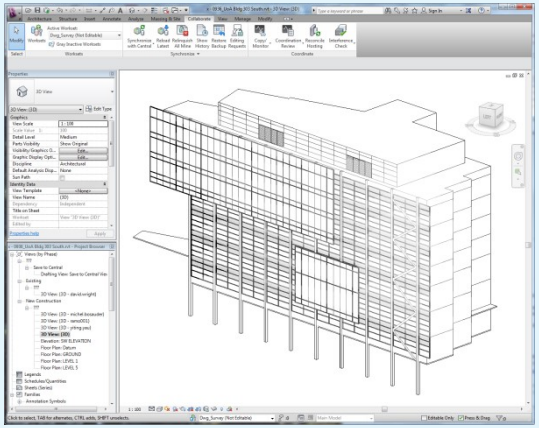

QUESTIONS?