



# Born digital: a symposium exploring digital architectural and built environment records

Monday 18 + Tuesday 19 April 2016

STOREY HALL

ANNEXE

SINGER

# BIM Digital

## Problem and solution ...

*Born Digital*

UniSA, April 2016

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# PROBLEM

# BIM is not your everyday digital

- Built-environment information modelling (BIM) is not digital word-processed material, nor is it the output from digital 2D CAD software.
  - Digital architectural records in these formats need archiving, but they are common to other industries, and have been around a long time now.
  - The archiving problems they pose are well understood (?).

# BIM ecology – a web of digital linkages

- ‘BIM ecology’: the set of interrelated software and content tools for producing, managing & accessing the building information model.
- BIM vendors collectively produce many tools – it is a **vast** ecology.
- For example, RIBA Enterprises (UK) tools in this ecology include:
  - [Uniclass 2015](#), and the NBS [BIM Toolkit](#) – both part of the UK government’s suite of BIM standards, for ‘BIM level 2’, which also include [Government Soft Landings](#)\* and the [BS/PAS 1192](#) series\*.
  - NBS [Create](#), NBS [Plus](#), [Construction Information Service](#), NBS [BIM Object Standard](#)\*, [National BIM Library](#), and the NBS [Plug-in for Autodesk Revit](#).
- An archive might need to deal with the ecology, as well as the model itself.

\*Adaption in Australasia: [CIBSE ANZ 1/2014](#), [Standards Australia BD-104](#) ([ISO 19650](#), based on PAS 1192-2), and [NATSPEC/Masterspec](#).

# BIM and change

- BIM is beyond the software ecology – cultural change, role change, technical change.
- More radical than automotive or aerospace technologies.\*
- BIM itself is changing – we are in the middle of a revolution akin to the Renaissance, but much faster.
  - The UK's mandate for [BIM level 2](#) has just come into force, but [BIM level 3](#) targets are already being defined – very ambitious.
- Marrying immersive digital technologies, such as [Oculus Rift](#) VR headsets (which have just become available), to BIM will change design and construction yet again.

\*Every country has construction, its IT is globally common, construction has been very conservative.



## Actions – Commercial

1. Level 3 A (Enabling Improvements in the Level 2 Model)
  - a. Improve Level 2 from lessons learnt – including more effective data exchange and data-enabled collaborative working based on transactional contracts
  - b. New protocol to address certainty associated with asset performance – including validated data and digital briefing, building on the foundations of Government Soft Landings
  - c. Build new E-Briefing Methods using new data capabilities (IFC and MVD) – enabling the electronic testing of compliance with business requirements
  - d. Development of BIM and asset data enabled FM and AM Contracts – including the FM and AM roles in using and maintaining BIM models
  - e. Insurance – supporting wider adoption of integrated project team insurance models
  - f. Development work associated with data rights, use of data to support performance contracts, use of data associated with existing assets, Totex contracts, carbon performance etc.
2. Level 3 B (Enable new technologies and systems)
  - a. Extend the scope of data exchange – including contract changes to support the adoption of upgraded IFC-based data, digital dictionaries etc.
  - b. Create new incentives for data capture and the wider utilisation of project and programme data across the asset lifecycle
  - c. Target new contracts and commercial models to encourage new market entrants and the development of valuable, exportable skills and capabilities in the UK industry
  - d. Development work associated with transparent, data-enabled contracts, including paper-less trading
  - e. Development work associated with asset operation including Totex and the Incentivisation of asset operators to deliver enhanced infrastructure capability
  - f. Development work on use of widely sourced data, digital risks and security
3. Level 3 C (Enable the development of new business models)
  - a. Development of paperless contract models
  - b. Development and implementation of data-enabled performance contracting
  - c. Development of integrated Totex-based contracting models for new and existing infrastructure
  - d. Creation of commercial models based on transactions enabled by the Internet of Things
  - e. Integration of access and security control solutions into commercial arrangements including contracts and insurance
4. Level 3 D (Become a world leader)
  - a. Development of international contract models for Level 3 working



# Cultural change

- Construction being worth some 10% of GDP\* in every country (not just the few with automotive or aerospace industries), governments in developed economies are taking an interest in it and mandating its use – no-one told us we had to use Rotring pens ...
- BIM is based on a common dataset developed and used by all through the timeline – we used to all develop our own datasets, which were dumb things, and operate in silos, also dumb.
- This can only happen if all cooperate – ‘traditional’ adversarial contracting is a barrier to BIM, but our contracts and training generally assume this.
- Trust is needed, e.g. architects must trust builders to actively manage a working model, rather than to passively receive paper or .pdf files – a major barrier.

\* World Bank data has ‘industry’ mostly between 20-40% of national GDP.

# Role change

- Private siloed datasets (mini-BIMs) are being replaced by federated or central datasets – shared by all.
- BIM is spreading beyond the design and documentation of buildings to deal with land [surveying](#), building [compliance](#), [civil engineering](#), [landscape](#), [archaeology](#) and [ecology](#), and off-site [fabrication](#) and on-site [construction](#).
- It cuts across all sectors and disciplines – hence [Uniclass 2015](#).
- Roles are changing or disappearing – [quantity take-off](#), [perspective drawing](#), [project management](#), [programming](#), [structural engineering](#), architectural design, surveying ...



# Technical change: 1

- The project BIM includes the project's complete history, through meta-data and 'snapshots'.
- If BIM has been used from the start, then the archived BIM comprises the entire project life to the point of archiving.
- At what point is the BIM archived?
  - At start of construction contract – the design team's model.
  - At end of construction contract (as-built) – the contractor's model.
  - At end of project life (includes all alts & adds, operation and maintenance records, building performance in use, etc) – the occupier's model.

# Technical change: 2

- The specification is part of the BIM – the ‘I’ in BIM, e.g. NBS Create in the UK.
  - The National Construction Code could be delivered using NBS Create, too – part of the BIM.
  - Australian Standards could be delivered using NBS Create, too – also part of the BIM.
  - Manufacturer’s specification and instructions, likewise.
  - Contracts too, in principle – BIM is not just for physical objects.
  - Also, any geometrical requirements in these, e.g. via the National BIM Library.
- Currently these sets of documents are outside the BIM, but this will change – the archive will include the versions contemporary with the project.
- The project BIM will be all-embracing.

SOLUTION

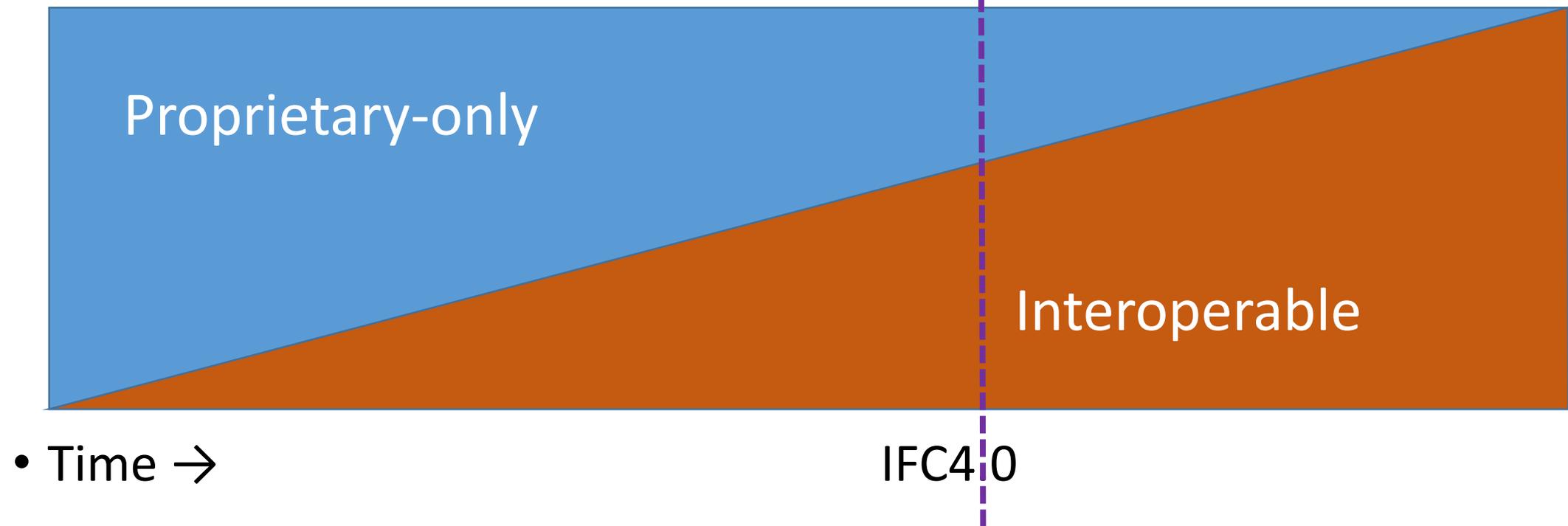
# Open BIM

- BIM software could comprise a collection of non-compatible proprietary tools, so that project teams must choose between using the suite of [Autodesk](#) products or the suite of [Trimble](#) products, for example.
- Instead software vendors in 1994 created the International Alliance for Interoperability (IAI), now known as [buildingSMART](#).
- IAI initiated the development of the IFC file exchange format, version 1 published in 1994, [version 4](#) published in 2015.
- As IFC covers more object types and properties with each iteration, and as more developers ensure their software can export and import using the format, the industry is increasingly blessed with ‘open BIM’.
- This simplifies the requirements for data management. Archivists will only need to manage IFC-based information.



# .ifc file exchange: 1994 and beyond

- Interoperability increasing.
- Proprietary-only diminishing.



## Participants of the official buildingSMART IFC2x3 Coordination View V2.0 certification process

Software Developer	Software Application	Exchange Requirement	Export/Import	Status
4Projects Ltd.	4Projects	- (*)	Import	in progress
ACCA Software S.p.A	Edificius	Architecture	Import & Export	<b>Export: certified</b> Import: in progress
Aconex BIM Cloud	Aconex	- (*)	Import	in progress
Archimen	Active3D	- (*)	Import	in progress
Autodesk	Advanced Steel	Structural	Export	in progress
Autodesk	AutoCAD Architecture	Architecture	Import & Export	<b>Export: certified</b> Import: in progress
Autodesk	AutoCAD MEP	BuildingServices	Export	in progress
Autodesk	Revit Architecture	Architecture	Import & Export	<b>Export: certified</b> <b>Import: certified</b>
Autodesk	Revit MEP	BuildingService	Import & Export	<b>Export: certified</b> <b>Import: certified</b>
Autodesk	Revit Structure	Structural	Import & Export	<b>Export: certified</b> <b>Import: certified</b>
Autodesk	Revit LT	Architecture	Import & Export	<b>Export certified</b> Import: in progress
Bentley Systems	AECOsim Building Designer	Architecture, BuildingService, Structural	Import & Export	<b>Export: certified</b> <b>Import: certified</b>
CadLine Ltd	ARCHLine.XP	Architecture	Import & Export	<b>Export: certified</b> Import: in progress
DICAD Systeme GmbH	STRAKON	- (*)	Import	in progress



# BIM and operation & maintenance (O&M)

- Some occupiers and others are able to use BIM for O&M.
- Many are not, at the moment anyway, e.g. UniSA FMU.
- The on-cost of maintaining the model could be offset by making it available, for a fee, for O&M purposes during the life of the building.
- Demand for BIM in O&M is currently low – FMA etc. are getting up to speed: [www.fma.com.au/resources/using-bim-enabler-smarter-building-management-maintenance-and-operations-required-low-carb](http://www.fma.com.au/resources/using-bim-enabler-smarter-building-management-maintenance-and-operations-required-low-carb) .
- But [BIM-BAM-BOOM](#) (P McLeamy, HOK, 2010) suggests that the occupancy phase is where the biggest pay-off is.
- Folk operating a BIM for O&M are de facto ***maintaining a working archive*** – not a passive archive.

# Working O&M archive: user vs archivist

Owner-occupier

Tenant

Maintenance  
contractor

BIM O&M specialist

Occupier

Designer

Contractor

Local authority



# Who produces the O&M BIM?

- The contractor, not the design team.
- Two components – the ‘as-built’ BIM, and the O&M Manual.
- The ‘as-built’ BIM builds on the design team’s contract BIM – all generic objects converted to proprietary, for example – it is the contractor who makes these brand decisions.
- The contractor is usually required to assemble the O&M Manual.
- In the UK: The branded ‘as-built’ specification plus the O&M subsection in NBS Create System sections become the basis for the BIM O&M Manual – it is an extension of the specification, and so is a part of the BIM.

# Who maintains the O&M BIM?

- Maintenance involves:
  - Rolling the model (and ecology) from hardware to hardware, software to software – easier if all such models are in the same software.
  - Tracking changing regulations, standards, manufacturers, recommendations, liabilities, risks – reporting on these changes.
  - Tracking the ‘real’ – links to BMS (building management system) & O&M logs can give some real-time data, but any changes to the ‘real’ (e.g. alts & adds) must be implemented in the model.
  - Reporting O&M requirements from the model, to the calendar (for manual action), and to the ‘real’ (for automatic action).
- A task for specialists.

# Three archives

Archivist	Rationale	Active/ Passive	Funding	Duration in years	
Designer (architect)	Liability	Passive	Legal fees, if a case arises	7	
Operator & maintenance provider	Operation & maintenance (BOOM)	Active (content maintained, linked to BMS)	O&M budget	50-100	
Professional archivist	Research	Passive (content added)*	None	50-100+	

DEMOLITION

\*For example, articles and 'tweets' on the building during its life.

# Authentic or usable

Archive management (ingestion)	Model authenticity Important for legal and historical archives	Model usability Essential for active O&M archives, especially if an agency is responsible for many of them
<b>Variable</b> (using original hardware & software, perhaps using emulators)	<b>Yes</b>	<b>Low</b>
<b>Standardized</b> (model migrated to a single hardware & software, with some data loss)	<b>No</b>	<b>High</b>