

# **Preserving Computer Aided Design: A briefing**

**DPC event 26<sup>th</sup> July 2013**

## **Emerging trends - ARCHITECTURE**

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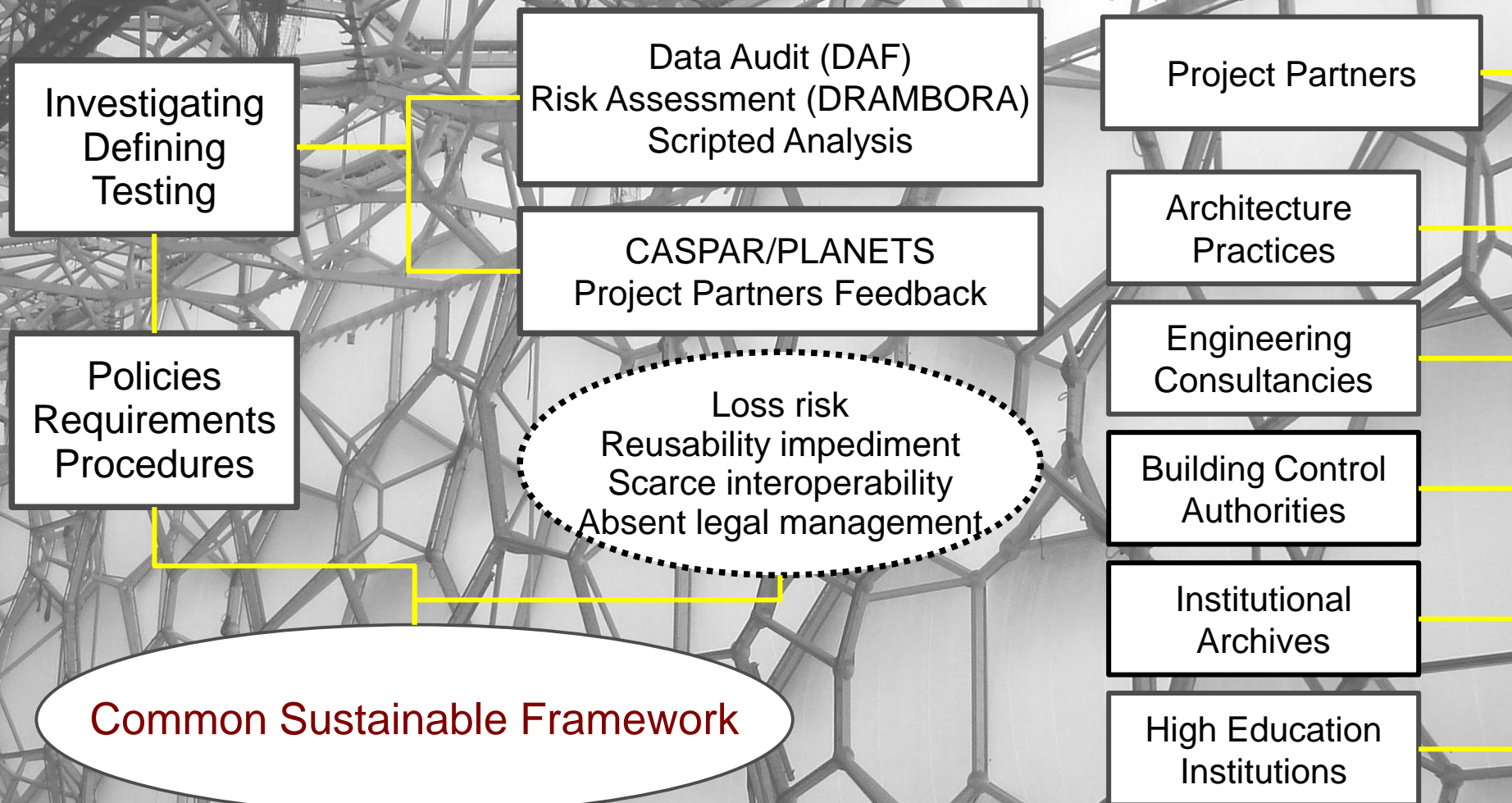


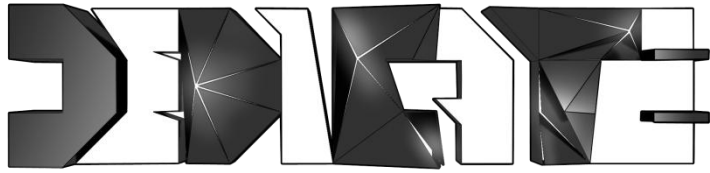
Arts & Humanities  
Research Council



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Project Supervisor Dr Ian Anderson

## DEsign DIgital Curation for ArchitecTurE





**our approach:**

**the Digital Curation of Built Environment related data is a shared responsibility of all its stakeholders across the entire data lifecycle (sheer curation) and it must insure perpetual relation with the actual space it is related to.**

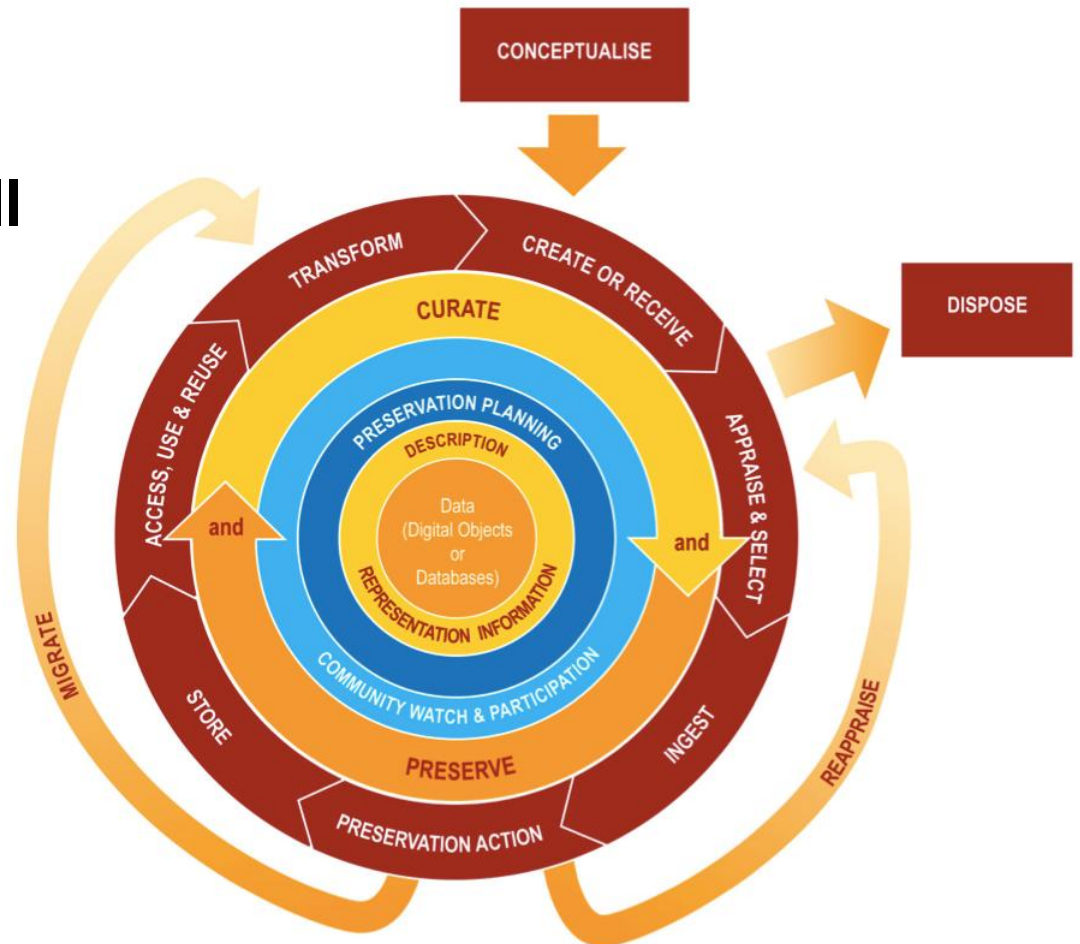
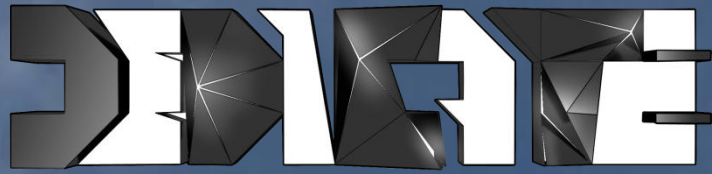


IMAGE: DCC Curation Lifecycle Model





As a final DEDICATE event, a seminar will take place at end of October at the University of Glasgow to present the project results. The seminar will address the Digital Curation of Built Environment related data and will be complemented by workshop sessions. In this occasion, we hope to discuss this subject with professionals from the AEC sector, the institutional Libraries and Archives, the Higher Education and the Digital Curation research.

**WE HOPE TO SEE YOU THERE!**

IMAGE: "New York by Gehry", residential tower

# **Renewed Methodologies and Processes in Architecture Depending on the ICT applications**

## **theme 1: The Architectural Product**

- Product Lifecycle Management (PLM) in Architecture – BIM**
- Generative Modelling – the process is the product**

## **theme 2: Digital Fabrication**

- Expanding Small Scale CNC Manufacturing applications**



# PLM in Architecture - BIM

## BIM

'Building Information Modelling is digital representation of physical and functional characteristics of a facility creating a shared knowledge resource for information about it forming a reliable basis for decisions during its life cycle, from earliest conception to demolition.' (RIBA-CPIC-buildingSMART)

## buildingSMART openBIM:

'Open BIM is a universal approach to the collaborative design, realization and operation of buildings based on open standards and workflows. Open BIM is an initiative of buildingSMART and several leading software vendors using the open buildingSMART Data Model.' (buildingSMART)

IMAGE: Beijing National Aquatic Center, detail

# BIM - Industry Foundation Classes (IFC)

## IFC4 (ISO 16739:2013)

‘The data schema comprises information covering the many disciplines that contribute to a building throughout its lifecycle: from conception, through design, construction and operation to refurbishment or demolition.’ (buildingSMART)

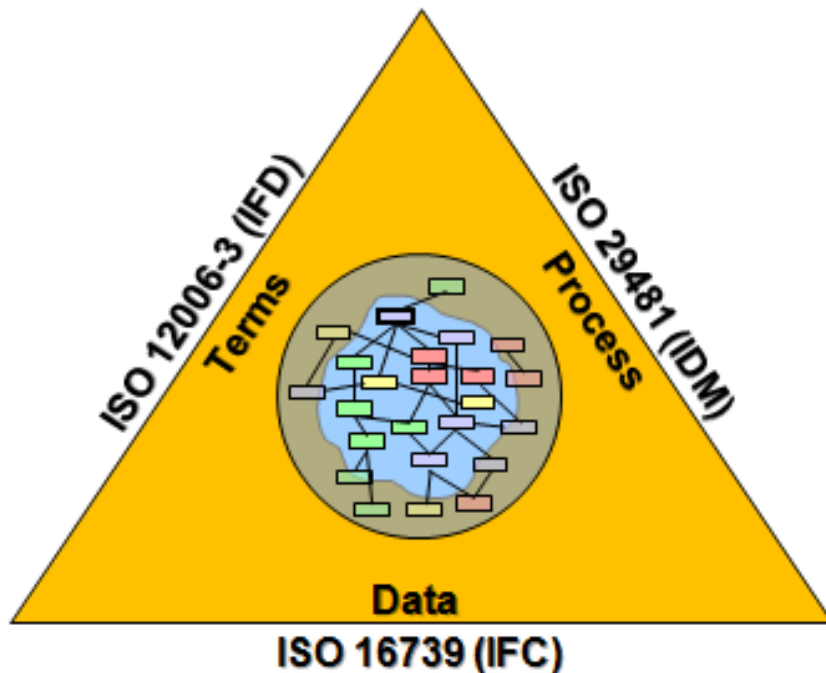


IMAGE: buildingSMART family of corresponding standards – IFC/IFD/IDM

# BIM - collaboration in concurrent design

... from the Electronic Document Management System (EDMS) to the Model Server (BIM Hub or BIM in the Cloud) ...

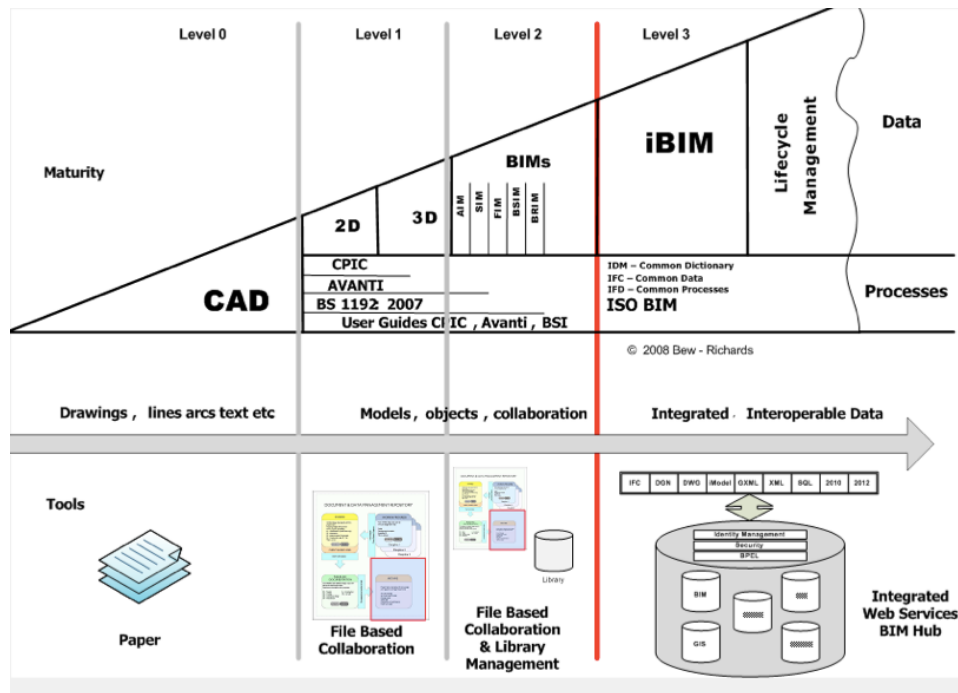


IMAGE: staged BIM implementation by BIM Task Group of the UK Cabinet Office

## Collaboration scenarios

- Unified building model
- Separated models + aggregated model
- Separated models



# Characterisation of scenarios

Redundancy	Redundant model data is systematically produced within the collaboration scenario
Integrity/Consistency	Integrity refers to the accuracy or correctness of data. Consistency refers to their logical coherence.
Accessibility	The aggregated model data can be accessed by different users or clients according to their privileges and tasks.
Versioning	The scenario allows for multiple design solutions' documentation.
Responsibility	Responsibilities over data are clearly identified and recorded for the collaboration management.
Ownership	Data ownership is declared at the sub-model level and IPR are detailed.
Performance	Performance refers in this context to the use of resources for creation and maintenance of data, both on the long and on the short term.

# Scenarios Characteristics Resulting from these Collaboration Strategies:

	Unified Building Model	Separated models + an aggregated model	Separated models
Redundancy	X	V	V
Integrity/Consistency	V	V	X
Accessibility	V	V	X
Versioning	X	V	V
Responsibility	Shared (through contract)	Shared + individual (through contract)	Individual (through contract)
Ownership	Shared (through contract)	Shared (through contract)	Individual (through contract)
Performance	High	Average	Low

# The openBim collaboration case



## Relative IFC4 shortcomings:

- IFC is static – still lacking a parametric tier (future extension);
- IFC inconsistently records authorship at the objects level allowing for transferrable ownership at a single level of history record;
- IFC cannot explicitly record access privileges;
- weakness in the IFC import/export process in existing software products are often reported – in particular, the elements GUID is often inconsistent between data 'drops'.



# Consequences for Preservation of the openBIM workflow

Unified Building Model	Legal management of IPR (Ownership) is based on external documents.	Onerous preservation strategy (multiple digital surrogates of the original file and extended curatorial intervention).	External references for libraries and documents might be maintained also through local copies of the sources.	Authorship and responsibilities might be documented through external documents.
Separated models + an aggregated model	The same preservation issue is aggravated by the redundancy of files.	The same preservation issue is aggravated by the redundancy of files.	The same preservation issue is aggravated by the redundancy of files.	The same preservation issue is aggravated by the redundancy of files.
Separated models	The IPR legal management is simplified but still dependent on external documents	A less onerous preservation strategy is demanded.	The same preservation issue stated above.	Authorship and responsibilities over data are more transparent.

# Partial Conclusions – Collaborative Procedures through openBIM

- Unless IFC matches the functions of the major BIM and CAD editors, it cannot guaranty the original data authoritativeness retention and for this reason cannot still be considered a viable resource for long-retention of professional liability documentation in commercial repositories.
- IFC might offer granular IPR management to support the legal management of the model across its entire lifecycle without recurring extensively to external documentation.
- Currently, the archival use of IFC demands extensive curatorial activities for both the reconstruction of the contextual information of the data and the maintenance of both the external documents and redundant data that can be afforded exclusively by institutional archives.

IMAGE: Multifunctional dwelling complex by Sergey Skuratov



# Generative modelling – the process is the product

## Performative simulation, form finding and design automation – tools and languages

- Grasshopper (RhinoCeros plug-in by Robert McNeill & Associates), GenerativeComponents (by Bentley Systems), Dynamo (Revit and Vasari plug-in by Autodesk).
- MATLAB, VBA, Visual Basic .NET (VB.NET), Python, Processing, RhinoScript, AutoLISP, VectorScript, Ruby.

IMAGE: Grasshopper study by Chris Wilkins



# Generative modelling – Preservation Issues

- In the most popular cases dependencies are numerous and often involving different proprietary systems, such as software, software components and OS.
- The most popular Visual Programming Languages are embedded within CAD packages which have more than one update released per year, as a result scripts are exposed to rapid obsolescence of formats and libraries.
- Because of the predominantly graphic manipulation of program elements these scripts tend to be poorly documented.

## Partial Conclusions:

- Since in many common scenarios software preservation is unfeasible, script documentation might be used to facilitate programs migration and their significant properties retention – *preservation awareness for coders*.
- Contextual documentation, referenced programs and models and additional modules are fundamental aspect of these digital architectural products, necessarily – *OAIS compliant repositories for these packages*.

IMAGE: Pylons for TERN S.p.a by HDA

# Digital Fabrication - Expanding Small Scale CNC Manufacturing applications

- File-to-Factory envisaged revolution
- Architects and fabricators are even more separated by the increasing specialization going along with the use of modern fabrication technology.

## Tools and Languages

- G-code ( ISO 6983/RS274D) numerical control programming language is particularly diffused across the machines adopted in these practices. Other CNC programs files used in these applications are: PRG files (LRA bending), MB4 (MELFA-BASIC files) and POS (Teach point files).
- STEP-NC ( ISO 10303-238) as device independent communication format between CAM and CNC machines.

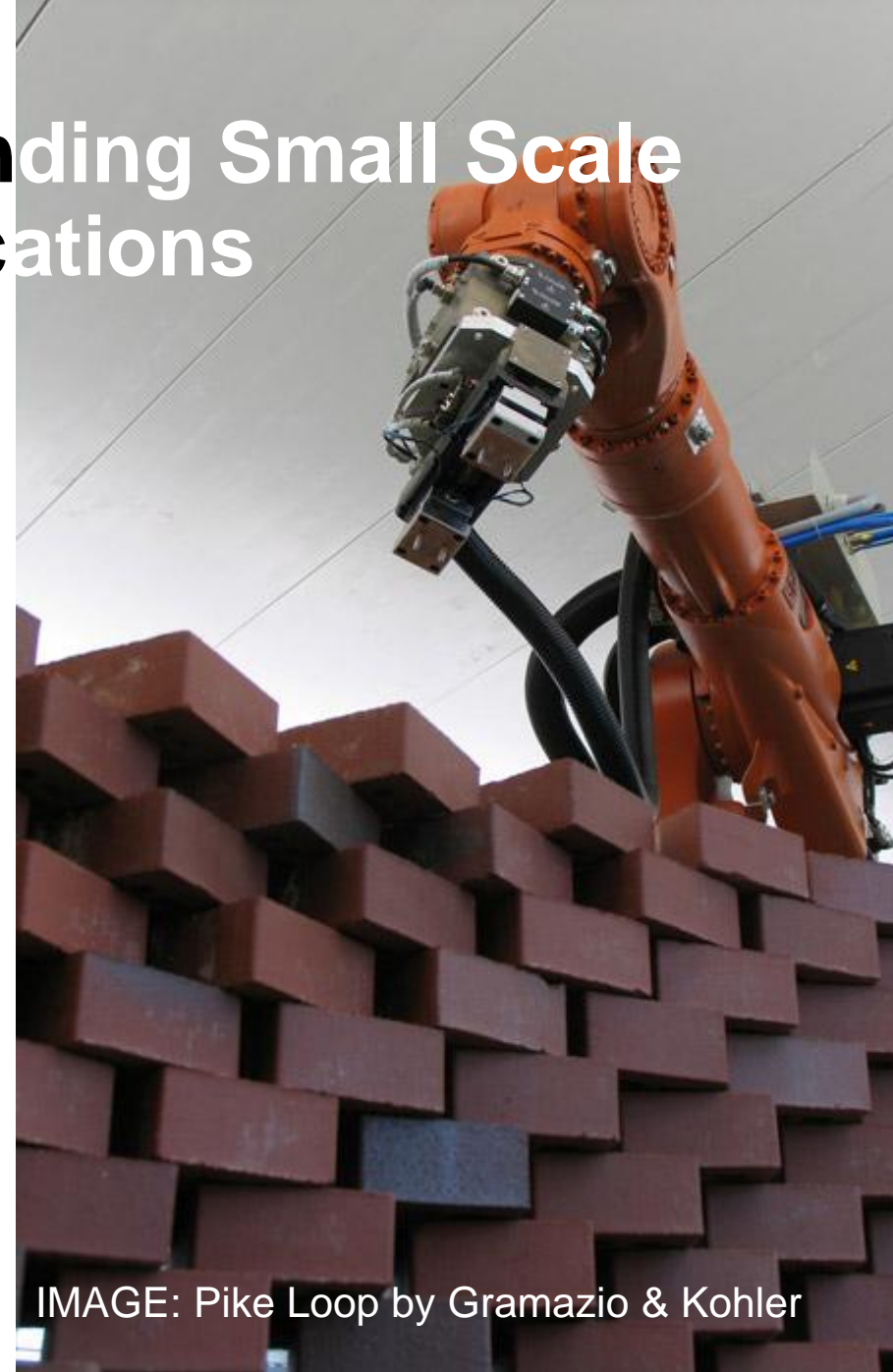


IMAGE: Pike Loop by Gramazio & Kohler

# Digital Fabrication – Preservation Issues

- From G-code to STEP-NC (difficulty to migrate g-code scripts to STEP-NC for legacy data reuse).
- STEP-NC does not define any monitoring or traceability capability.



IMAGE: Puppet Theatre by MOS

## Partial Conclusions:

- Since the conversion from G-code programs into STEP-NC files implies inferences based on contextual information (i.e. knowledge base on specific machine operations), the migration of legacy G-code files depends on the retention of rich contextual information.
- To monitor the production events, manufacturers usually recur to customised or idiosyncratic solutions. The adoption of STEP-NC will not resolve the need for retaining external documentation.



# General Conclusions

- The new professional roles emerging from these trends are largely the result of both their digital assets curatorial weaknesses and the AEC sector peculiar scarce demand for innovation. The Digital Design Manager and the BIM manager are temporary stages of the Architect profession evolution. Architects need curatorial competences over their digital products.
- The phenomena presented are part of the same convergence process toward extended interoperability of contents across domains.
- Open standards still lack the appropriate forensic depth to document professional liability – this will slow down their use and complicate the preservation with redundancy of information.
- Paper based practices still survive, especially in UK; the phenomena presented will likely parallel more conservative process on the long-term – preservation tasks will be manifold.
- We need to test the recent solutions for Architecture CAD preservation against both the requirements demanded by these emerging trends and their feasibility in contexts of informal data retention and/or scarce resources – i.e. FACADE tools and procedures for digital generative modelling retention.

IMAGE: Metropol Parasol by J. Mayer H.

# Thank you for your attention!

For more information on **DEDICATE**, please, visit its website

<http://architecturedigitalcuration.blogspot.co.uk>

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