Historic England

BIM - using data for managing heritage assets in 21st Century

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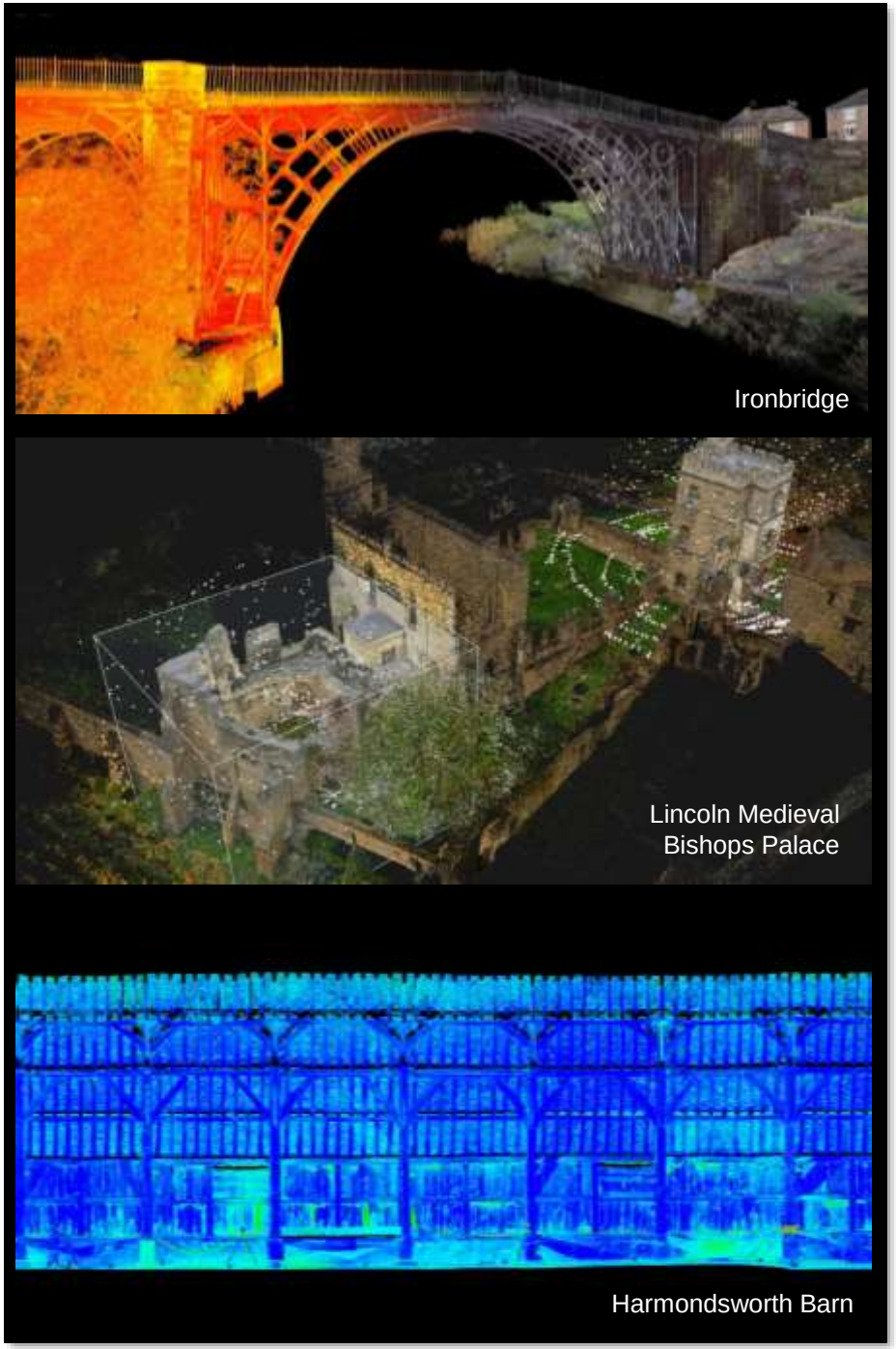

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Geospatial Imaging Team

- Based in York I run a team of five surveyors that specialise in applying geospatial survey technologies to heritage
  - Jon Bedford
    Senior Geospatial Imaging Analyst
  - David Andrews
    Geospatial Imaging Analyst
  - Gary Young
    Geospatial Imaging Analyst on 12 month fixed term contract
  - Elizabeth Stephens
    Geospatial Survey Technician Apprentice on 2 year apprenticeship with Historic England – ***our first heritage apprentice****!*

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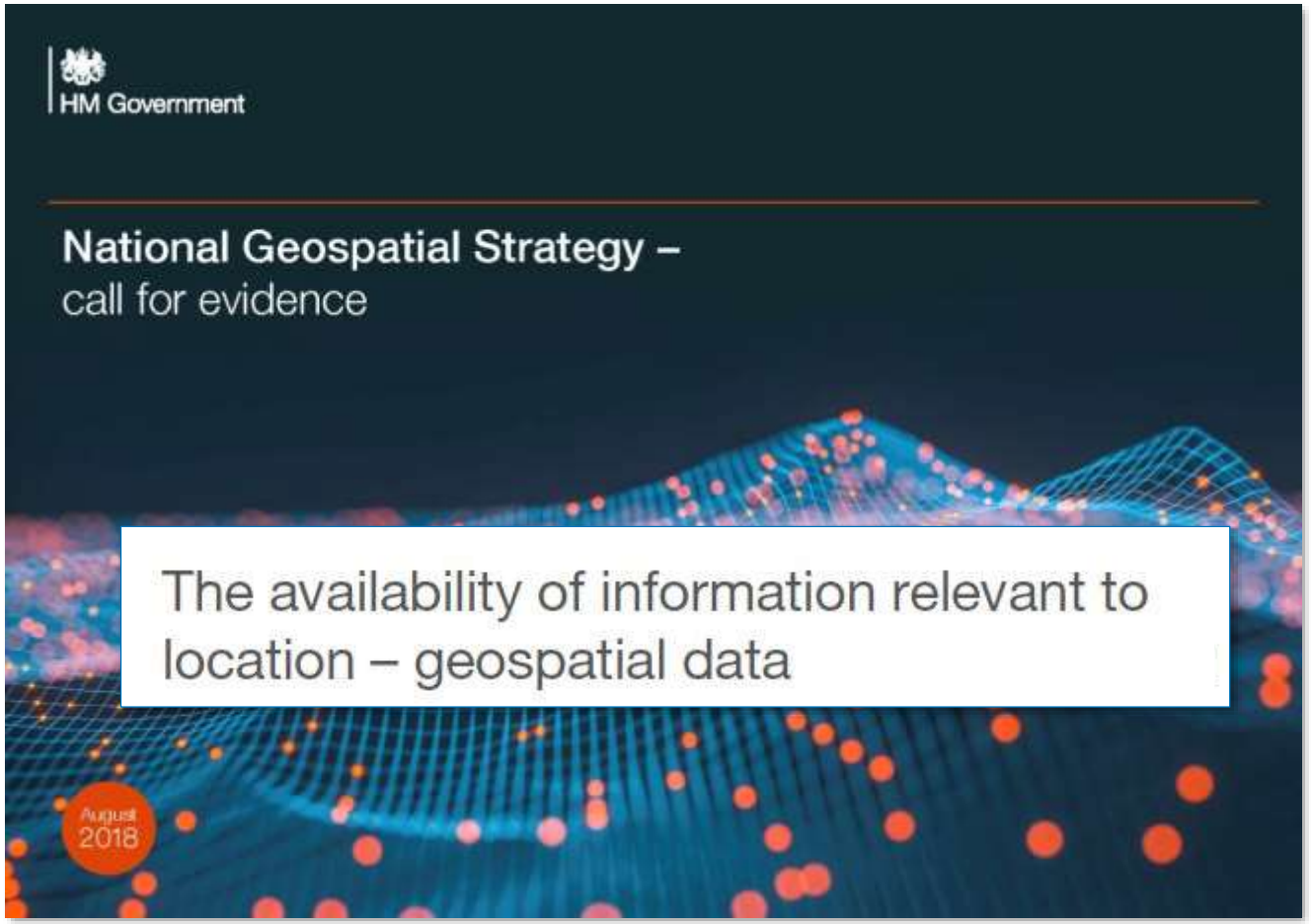
What is Geospatial Data?

The Geospatial Commision

Geospatial Data

"*the availability of information relevant to location*"



https://www.gov.uk/government/news/government-launch-call-for-evidence-to-be-geospatial-world-leader

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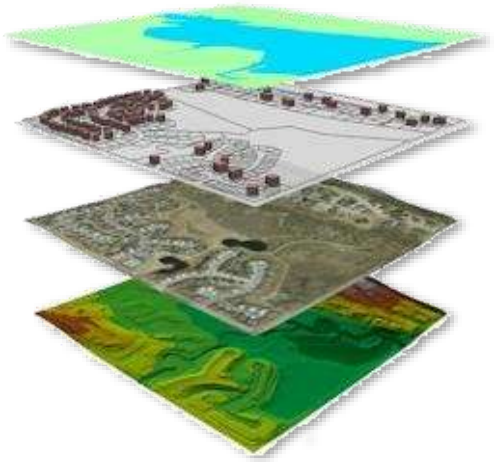
What is Geospatial Imaging?

Geospatial Data

"*the availability of information relevant to location*"



Geospatial Imaging

"*The technologies used to extract geospatial information from remotely sensed imagery and other raster data types*"

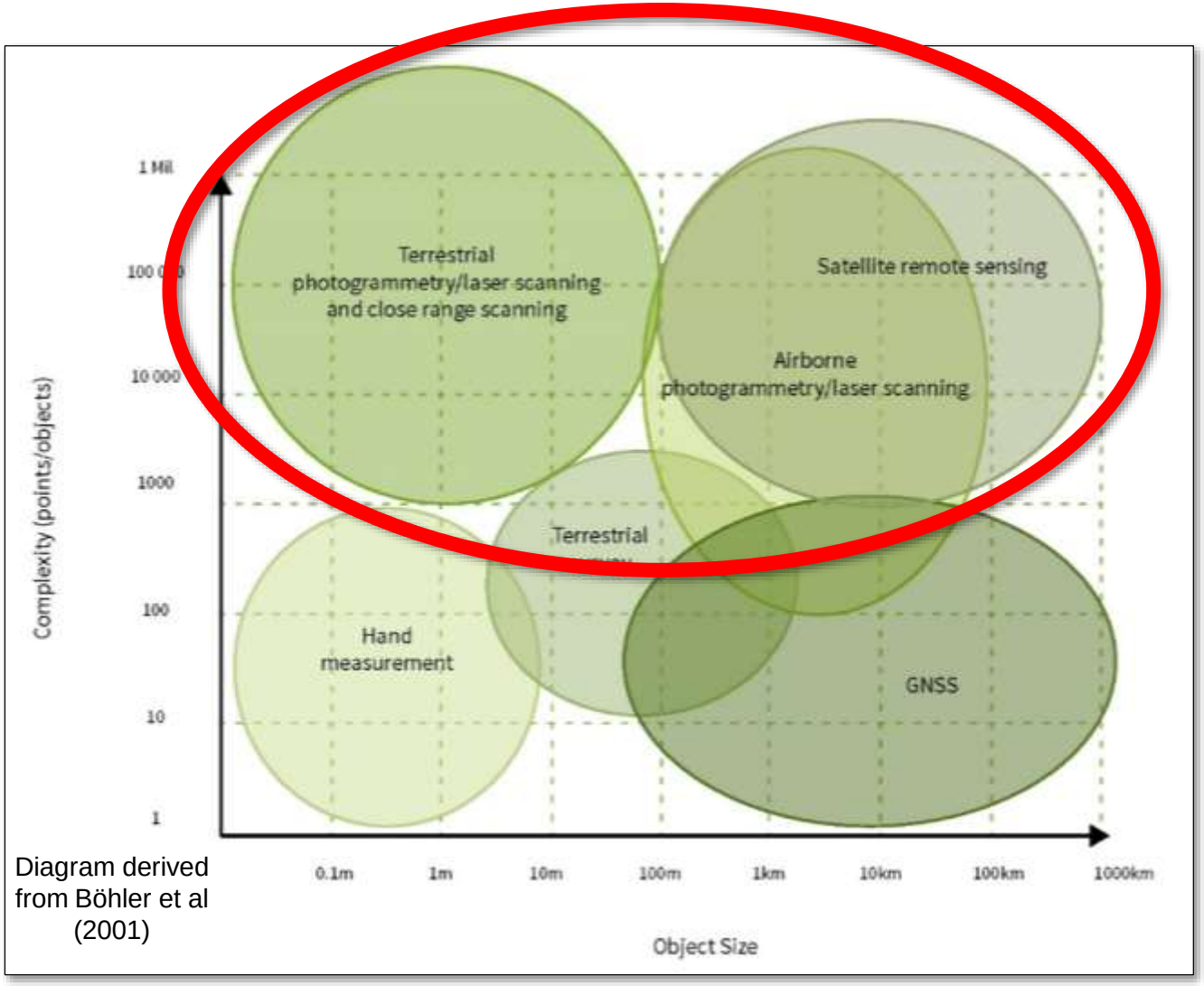


Diagram derived from Böhler et al (2001)

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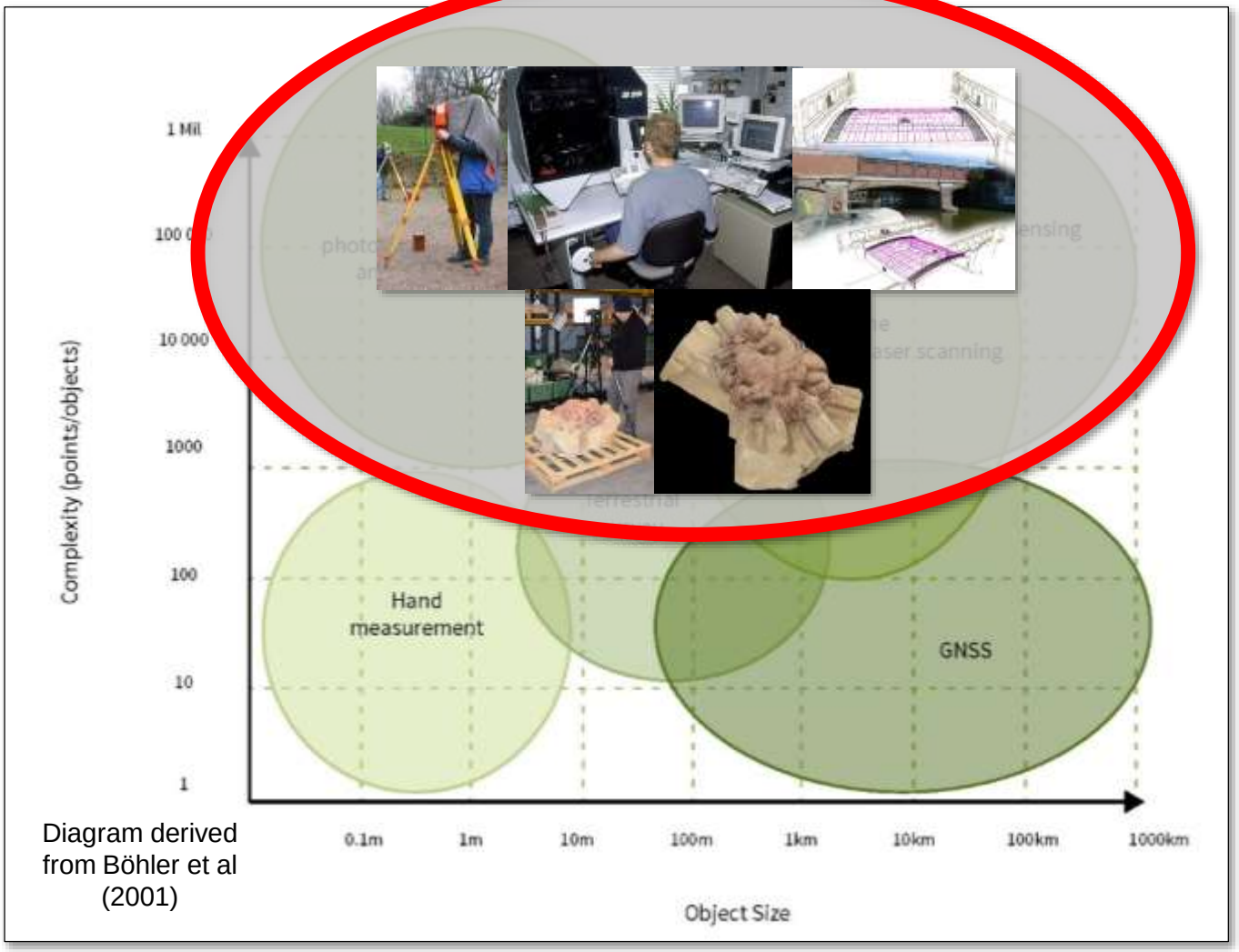
Geospatial Imaging technologies for heritage asset management

Photogrammetry

"The art, science and technology of determining size, shape and identification of objects by analysing terrestrial or aerial imagery"

Boardman 2016



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Geospatial Imaging technologies for heritage asset management

Photogrammetry and SfM

Advantages

- Applicable on all 2D and 3D surfaces
- Multi-image photography excellent archival record
- Modern approaches use ‘off-the-shelf’ cameras
- Does not rely on calibrated metric cameras
- Can generate high-resolution 3D ‘point clouds’
- Structure from Motion (SfM) is low cost and making photogrammetry fashionable again

Disadvantages

- Requires multi-overlap imagery – ideally 80% forward & 60% side
- Correlation needs visible texture within imagery
- Accurate data relies on good imagery & control
- Black-box software may simplify photogrammetric processing but beware
- Beware ***Rubbish (image) in = Rubbish (data) out!***

https://historicengland.org.uk/images-books/publications/photogrammetric-applications-for-cultural-heritage/

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Geospatial Imaging technologies for heritage asset management

Laser scanning

"Laser scanning is an active, fast and automatic acquisition technique using laser light for measuring, without any contact, and in a dense regular pattern, 3D coordinates of points on surfaces"

Grussenmeyer 2016

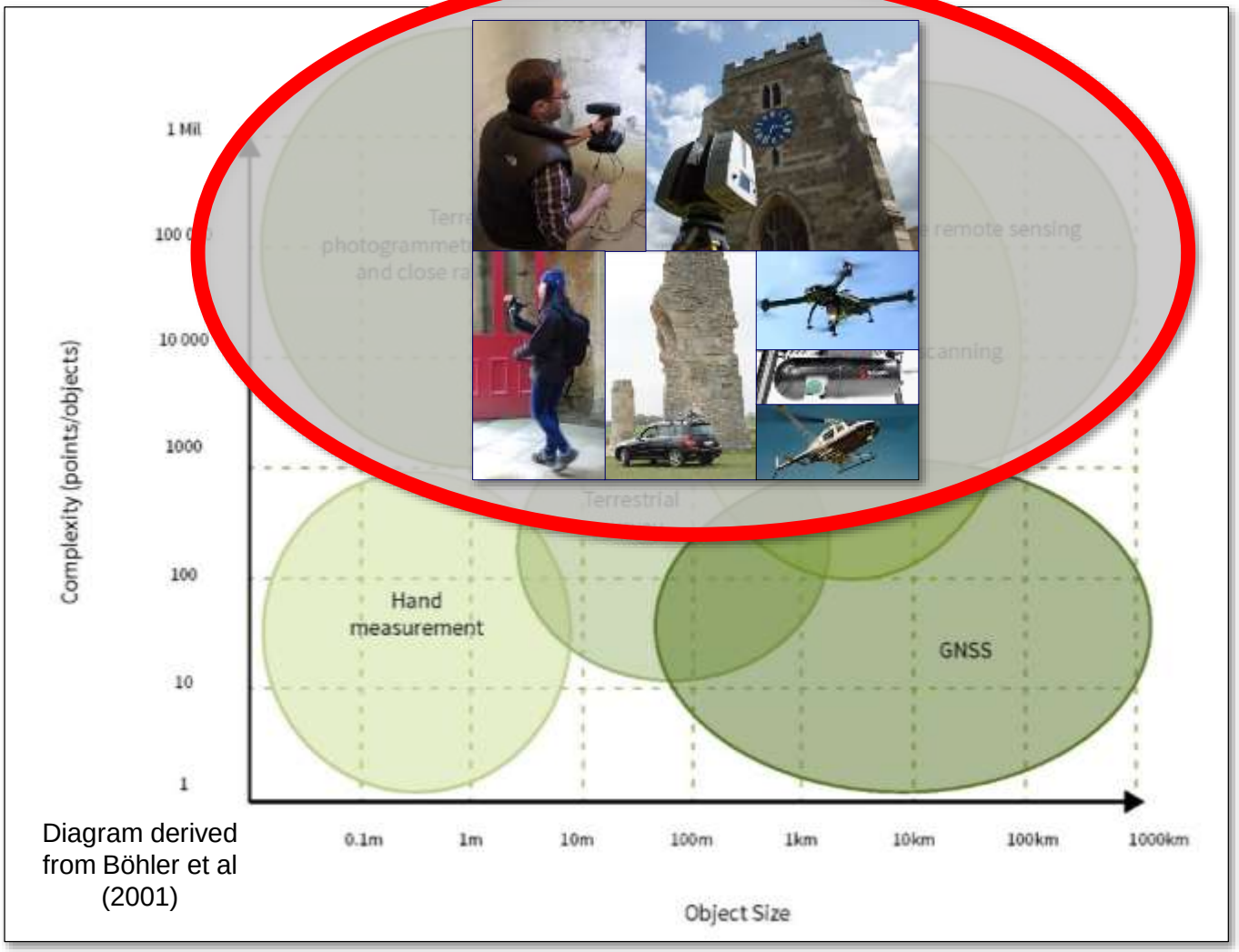

Diagram derived from Böhler et al (2001)

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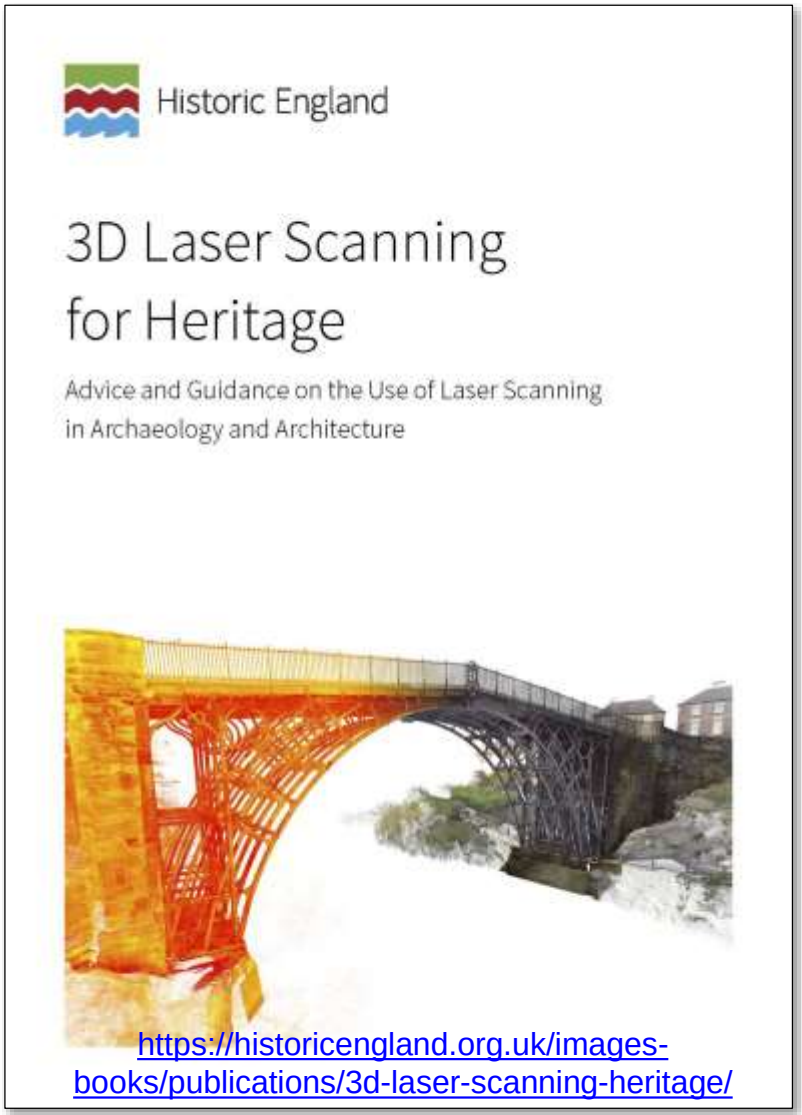
Geospatial Imaging technologies for heritage asset management

Laser scanning

Advantages

- Applicable on all 2D and 3D surfaces
- Very fast – over 1,000,000 pts per second
- High resolution – millimetre point spacing
- Mobile scanning solutions allow data capture ‘on the move’
- Now integrating point data with imagery from on-board sensors - RGB, 360° & thermal



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Geospatial Imaging technologies for heritage asset management

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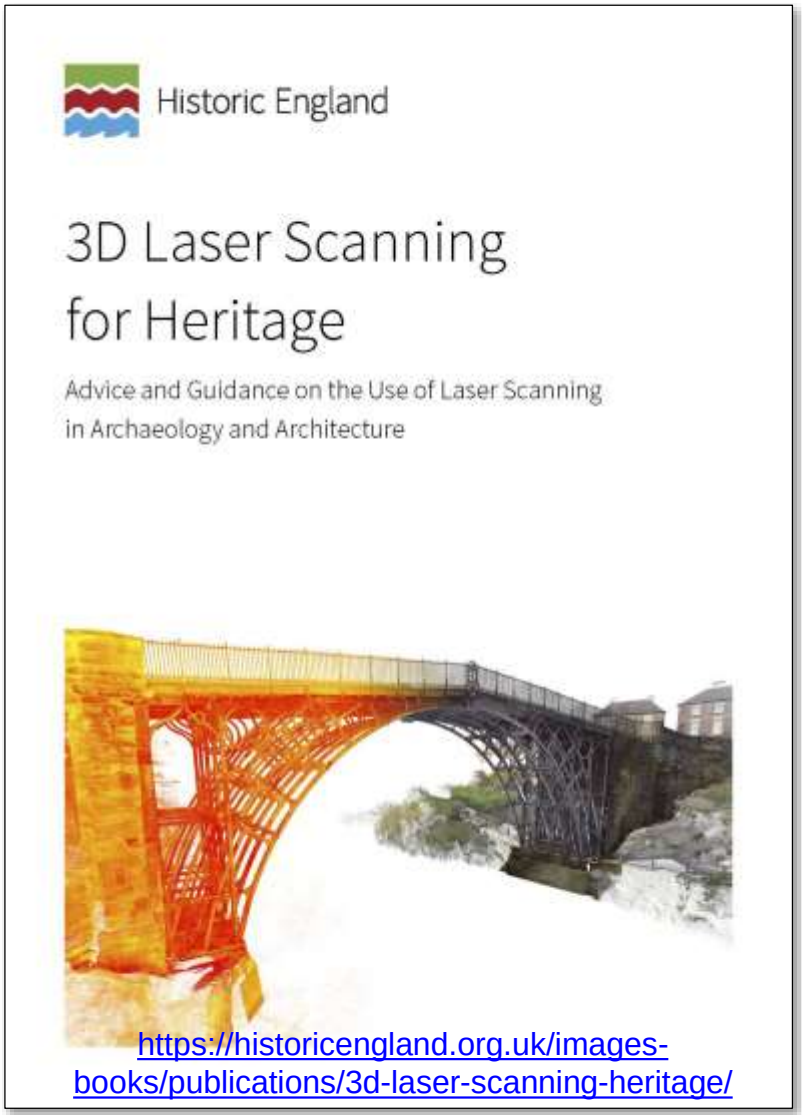
- Now integrating point data with imagery from on-board sensors - RGB, 360° & thermal

Disadvantages

- Generates large data files often difficult to view without high-end computers
- Scanners expensive between £15K - £90K
- Sophisticated post-processing software needed to generate useable output
- Line drawings still require manual digitisation



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Geospatial Imaging technologies for heritage asset management

Drones

Advantages

- Provide unique vantage point for low-level aerial photography
- Useful for mapping, inspection, monitoring, presentation and research
- Rotary wing – carry a range of sensors, ability to hover and operate in confined spaces
- Fixed wing - shape gives good stability, can glide over long distances and survey larger areas
- We now possess two drones – post April ‘lift-off’

Lincoln Bishops Palace flown by Kestrel Cam © Historic England 2018

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Geospatial Imaging technologies for heritage asset management

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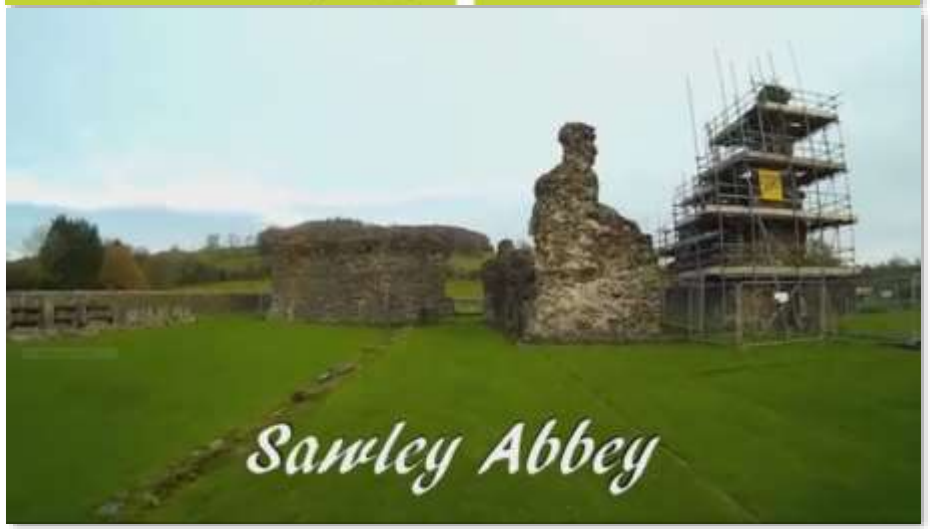
Disadvantages

- Require CAA-UK Permission to fly commercially
- Fixed wing typically carry compact digital camera
- Limited battery life reduces operating time ‘in air’
- Health & safety concerns must be considered
- Public/hobbyist flying increasingly difficult to control!



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Geospatial Imaging technologies for heritage asset management

Reality capture

"*the process of scanning an object, building, or site and producing a digital model representation*"

(Leica Geosystems 2018)

or

"the direct integration of data derived from both photogrammetry and 3D laser scanning"

(Historic England 2018)

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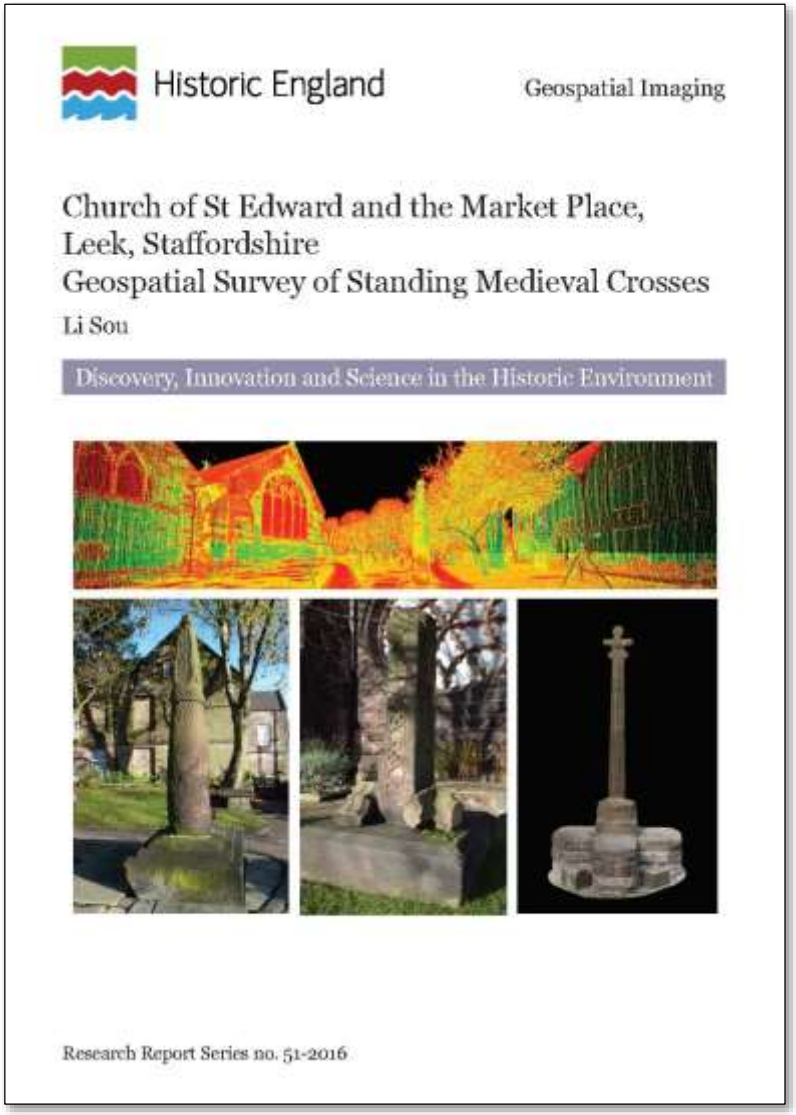
Geospatial Imaging data Heritage applications

Recording & Documentation

- Recording & Documentation
  - ➢ base data for historical analysis



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Geospatial Imaging data Heritage applications

Conservation Planning

- Recording & Documentation
  - base data for historical analysis
- Conservation Planning
  - works specifications
  - condition assessments

Observation Post, Hurst Castle, Hampshire
deterioration of concrete structures

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Geospatial Imaging data Heritage applications

Illustration and presentation

- Recording & documentation
  - base data for historical analysis
- Conservation planning
  - works specifications
  - condition assessments
- Illustration and presentation
  - visitor centre display
  - guidebooks
  - website

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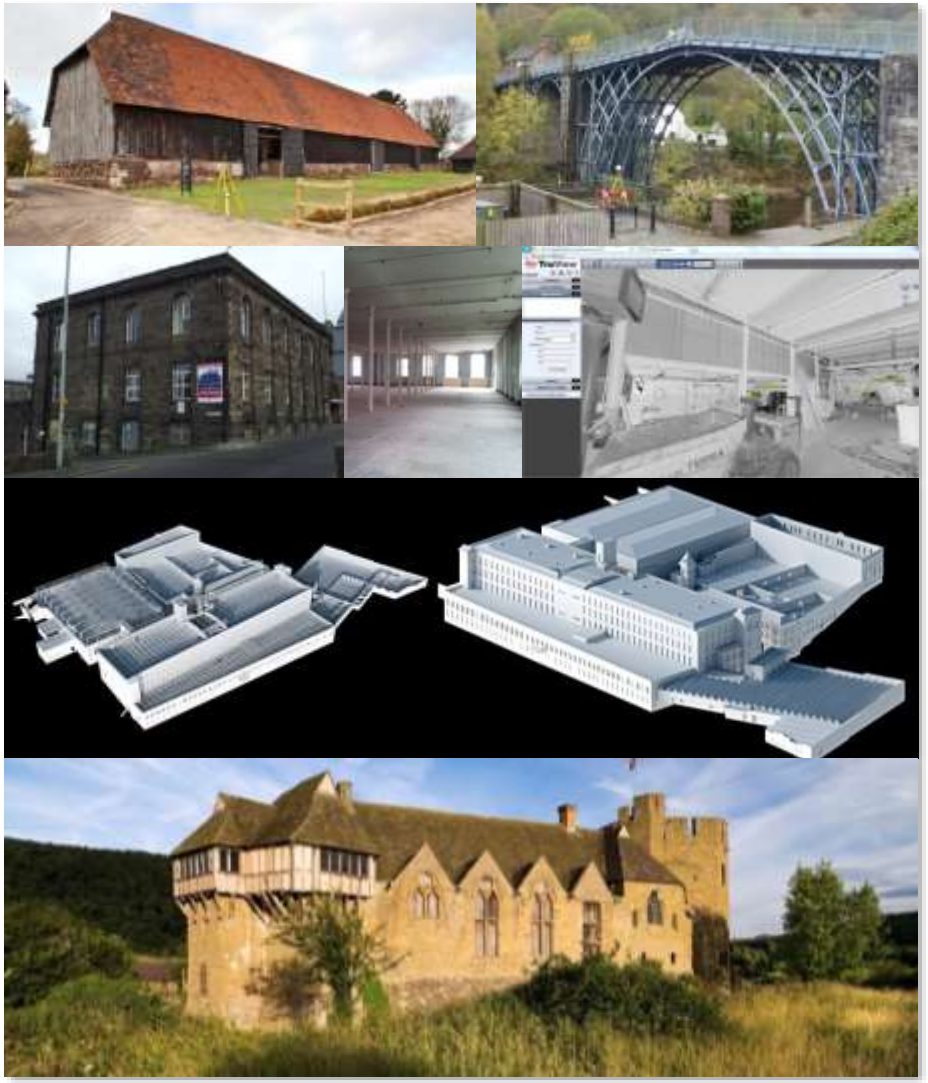
Geospatial Imaging data Heritage applications

Building Information Modelling (BIM)

- Recording & documentation
  - base data for historical analysis
- Conservation planning
  - works specifications
  - condition assessments
- Illustration and presentation
  - visitor centre display
  - guidebooks
  - website
- Building Information Modelling (BIM)
  - construction planning
  - building performance analysis
  - heritage science research



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Building Information Modelling (BIM)

Building Information Modelling

- *"A 3D model formed as an assembly of native BIM components which represents the geometry of the existing fabric"*

  (Historic England 2017)

- *"A collaborative process for the production and management of structured electronic information and illustrating, in digital terms, all the elements that compose a building"*

  (Historic England 2017)

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Building Information Modelling (BIM)

Scan-to-BIM

- BIM representation requires detailed and accurate knowledge of the physical shape of the historic asset – *metric survey*

- Can be generated from any metric survey dataset but commonly associated with laser scanning

Scan-to-BIM

"The process of creating, manipulating and placing native BIM components by directly referencing the underlying point cloud"

(Historic England 2017)

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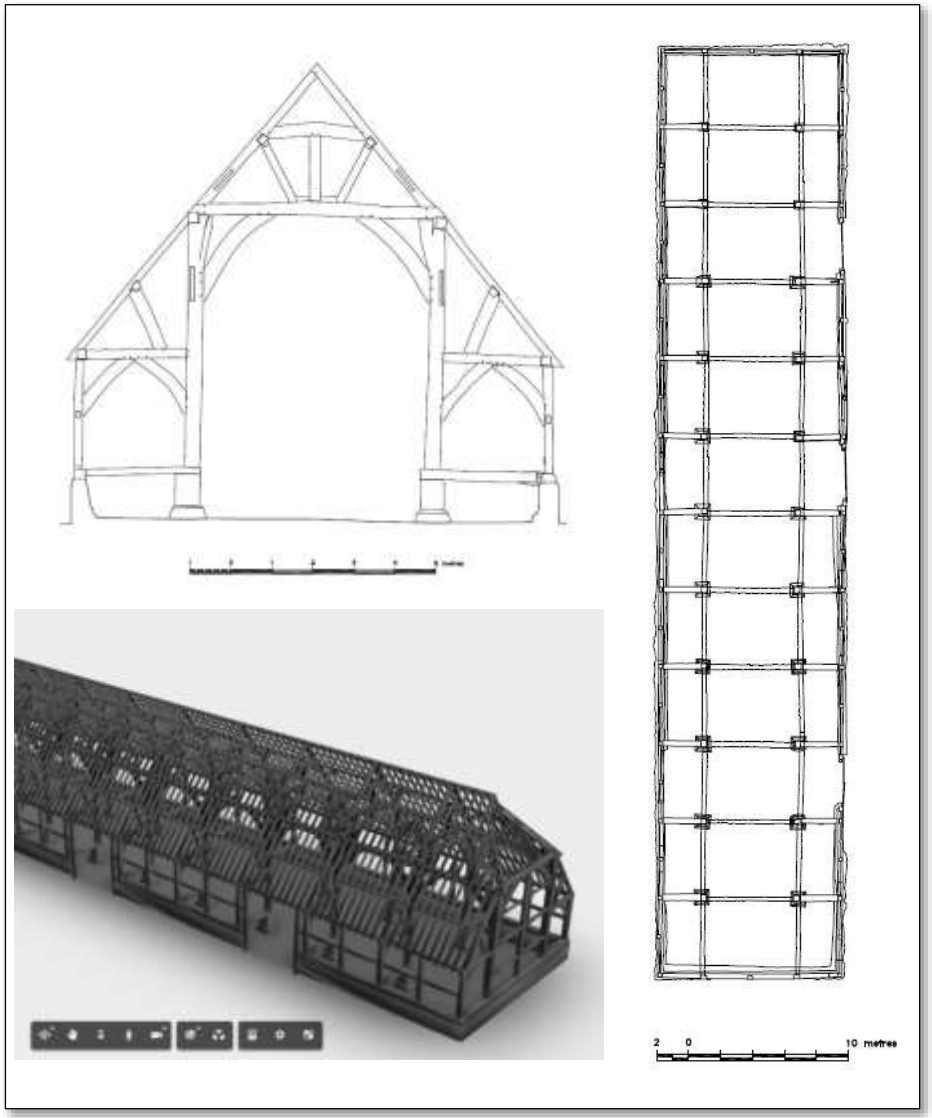
Building Information Modelling (BIM)

Geometric Information

- Geometric information (2D and 3D)
  - Level of detail (LOD) - describes how much geometric detail is included in the derived BIM components
  - Level of Information (LOI) - describes the non-graphical content of models and associated data
  - 2D is appropriate for linking documents & data within small, less complex sites
  - 3D enables a better understanding of spaces and components that constitute an historic building



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Building Information Modelling (BIM)

Non-geometric Information

- Geometric information (2D and 3D)

- Non-geometric information
  - physical building characteristics
  - materials, appearance and condition

  - *accurate information = accurate analysis*

Images supplied by Iain McCaig, HE Building Conservation & Research Team

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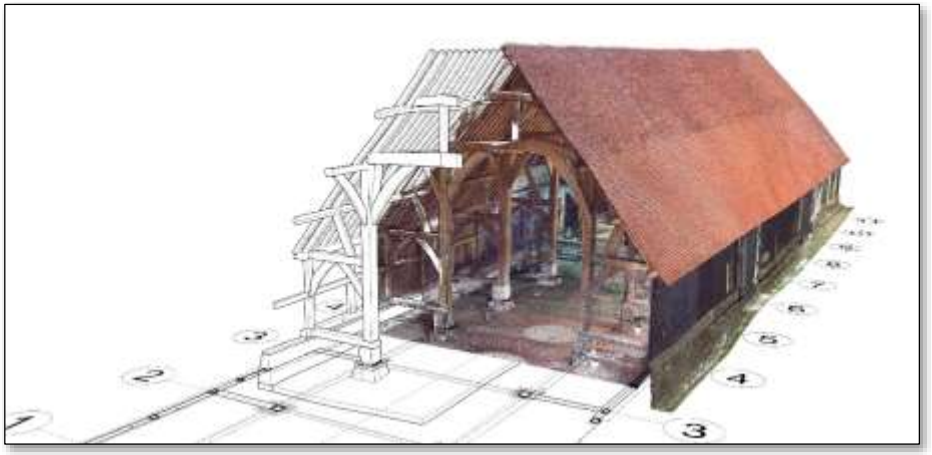
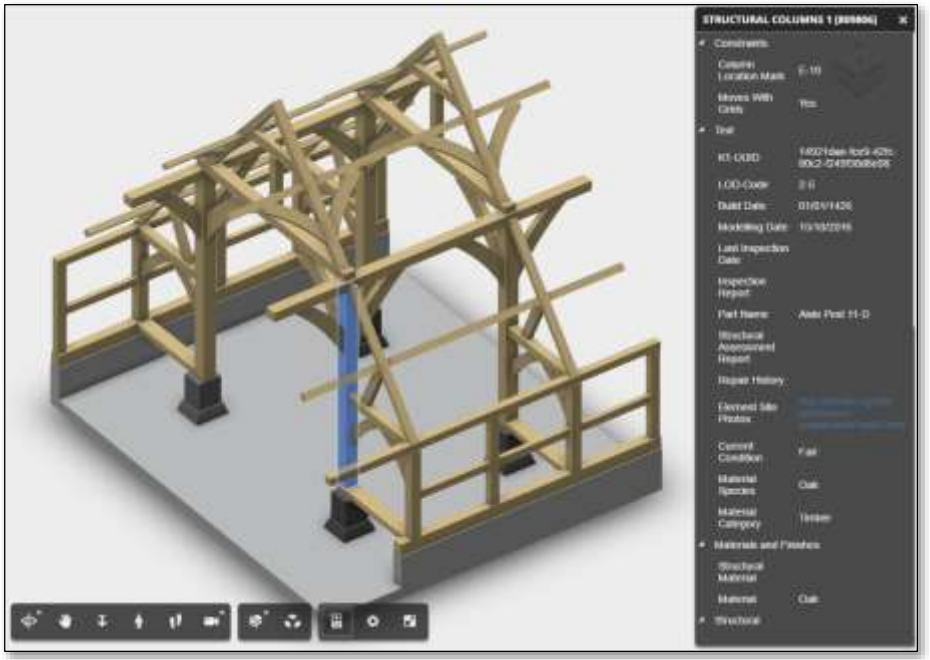
Building Information Modelling (BIM)

Linked documents and data

- Geometric information (2D and 3D)
- Non-geometric information
  - physical building characteristics
  - materials, appearance and condition
- Linked documents and data
  - archival data
  - product specifications
  - operation and maintenance manuals
  - condition surveys
  - audio and video recordings
  - inspection logs





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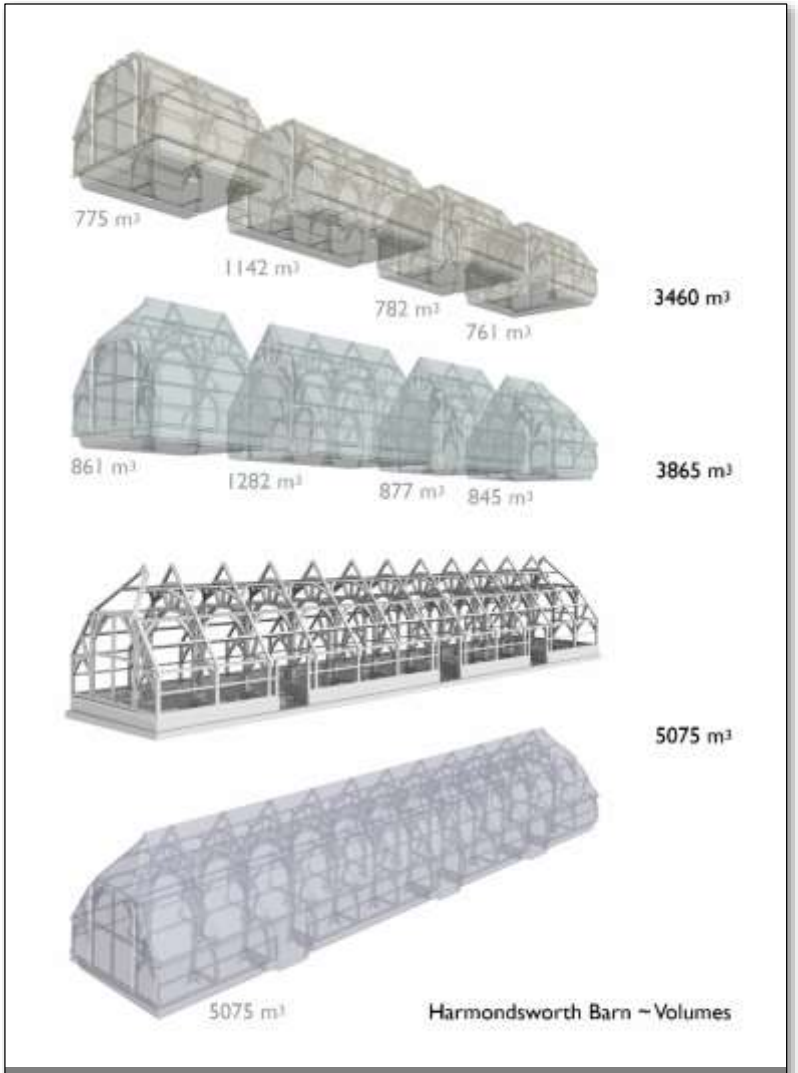
Building Information Modelling (BIM)

How does this help asset management?

- Historical analysis
  - volumetric analysis
  - construction sequence
- Property curation
  - building performance
  - heritage science analysis
  - presentation & education
- Engineers
  - structural assessment
  - conservation planning



Images supplied by Andy Crispe, HE Graphics team

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Building Information Modelling (BIM)

How is research assisting asset management?

- Research

https://historicengland.org.uk/research/agenda

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Building Information Modelling (BIM)

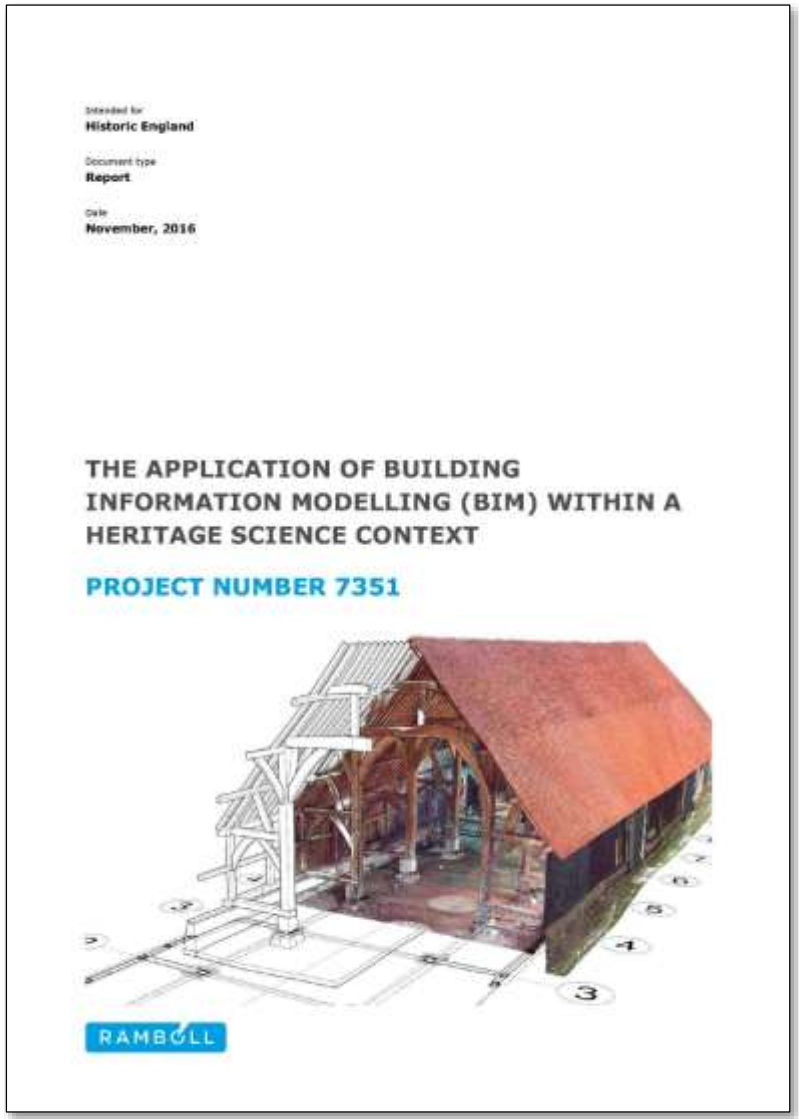
BIM & Heritage Science

The application of Building Information Modelling (BIM) within a heritage science context

"The overall finding of this project is that BIM within a heritage context is likely to be more complex than for New-Build as it nearly always involves measurement to establish any kind of model, the coordination of different types of legacy information and the organisation of often unique objects"

Carl Brookes, Tiziana Meciani, Dan Niziolek – Ramboll

November 2016



Building Information Modelling (BIM)

BIM & Weathering prediction

Building Information Models from monitoring and simulation data in heritage buildings

"Aims to develop a new Building Information Modelling (BIM) paradigm that supports the management and future-proofing of the built heritage. Research will focus on exploring the integration of types of information that are relevant for heritage science, and which are not part of current BIM practice"

Danae Pocobelli, UCL/ISH

Completion in October 2019

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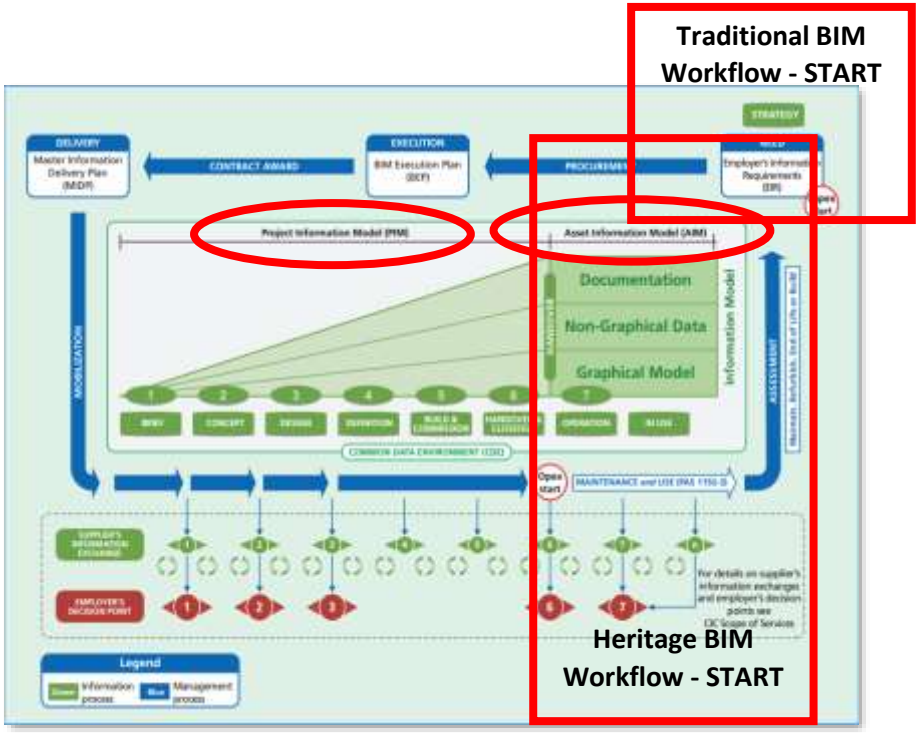
Building Information Modelling (BIM)

Heritage BIM – managing the data

Heritage BIM: New ways of digital data management for the historic built environment

"The aim of the project is to investigate how a widely-used IT system for the centralised storage and dissemination of information about a building (Building Information Modelling) can be applied to existing, and specifically historic, built environments"



Joanna Hull BSc MSc
Heritage Management Consultant
University of Reading
Completion in April 2020

University of Reading

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Building Information Modelling (BIM)

New BIM standard – BS EN ISO 19650

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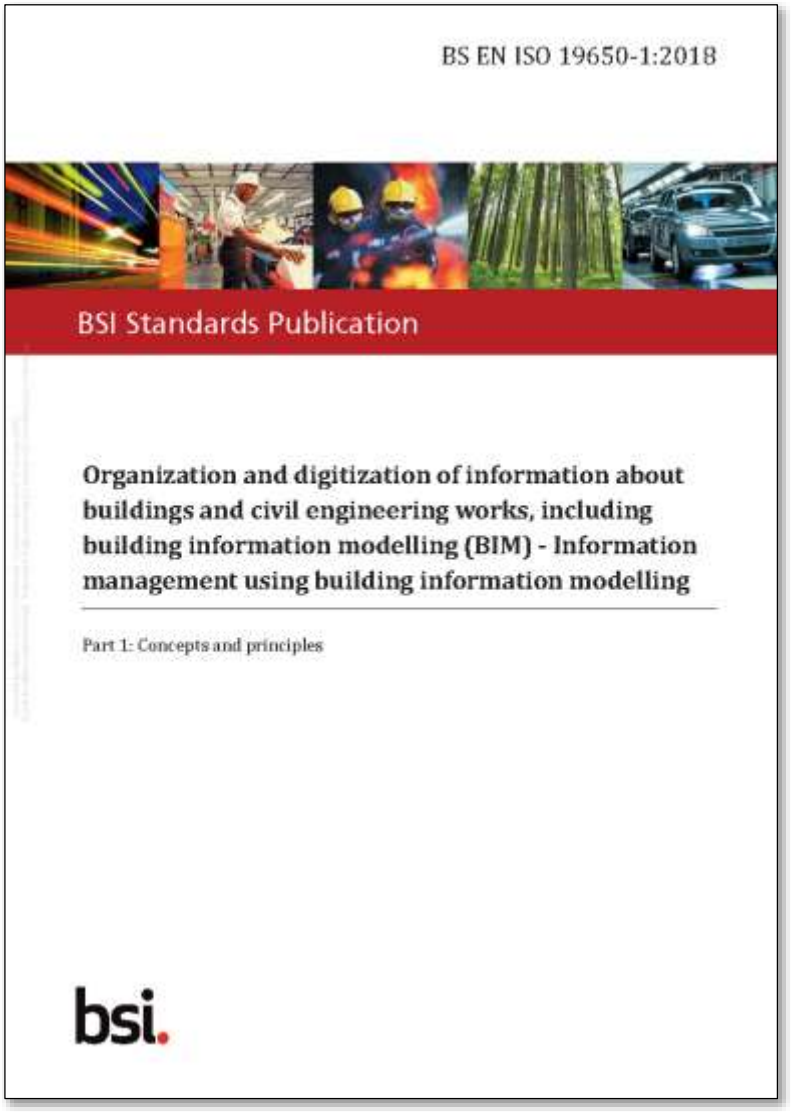

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Building Information Modelling (BIM)

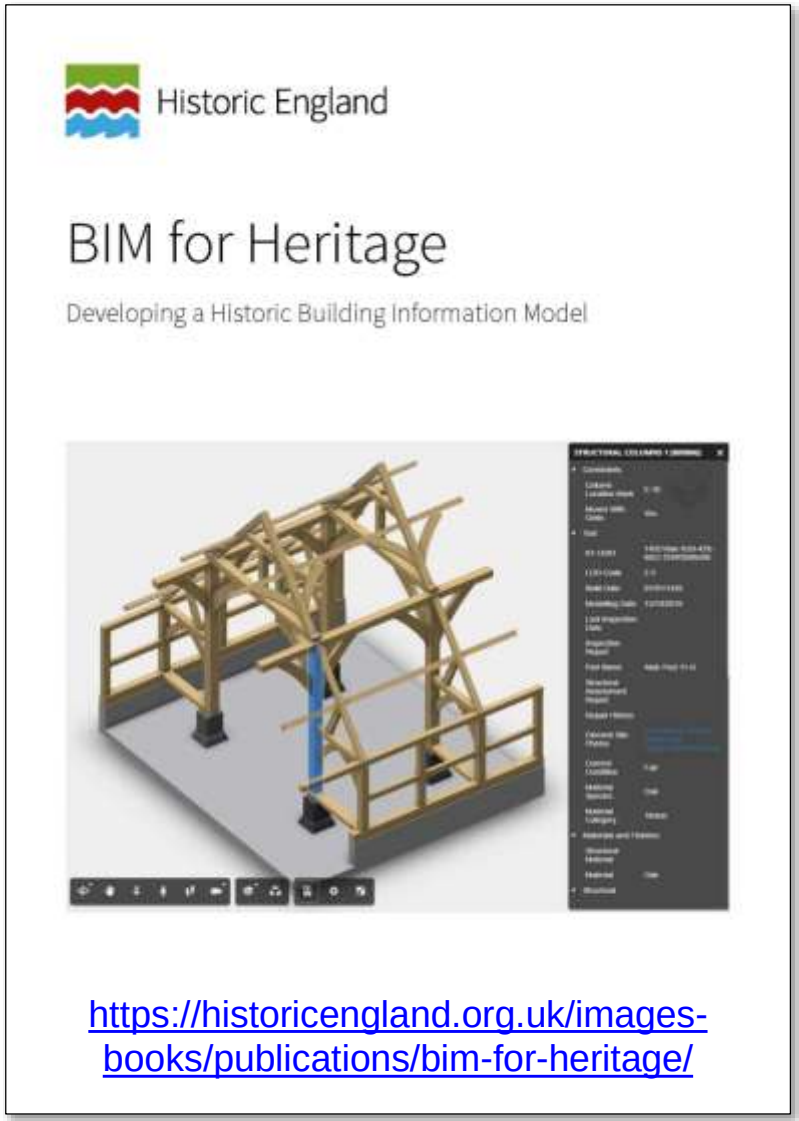
BIM for Heritage technical guidance

1. BIM for Heritage: Developing a Historic Building Information Model

Offers guidance on BIM for building owners, end-users, heritage and construction professionals and the potential advantages a BIM approach now offers across heritage projects.
Published July 2018

2. BIM for Heritage: Developing an Asset Information Model

This new guidance focuses on heritage asset management, in particular conservation repair and maintenance, and suggests the first task when adopting a BIM information management approach is to develop an Asset Information Model (AIM)
Due for publication April 2019



https://historicengland.org.uk/images-books/publications/bim-for-heritage/

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Building Information Modelling (BIM)

Research challenges

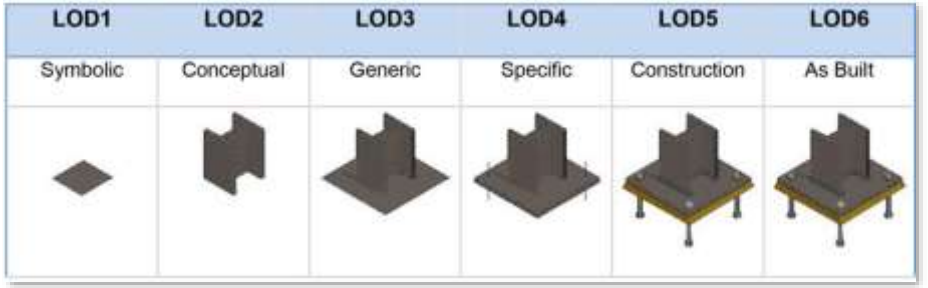
- **Parametric modelling** – increasing the resolution of the BIM model without inflating the project file size
- **Uniclass 2015** (Unified classification for the UK industry covering all construction sector) – liaison with National Building Specification (NBS) and Forum on Information Standards in Heritage (FISH) on naming conventions not specifically relevant to heritage
- **COBie** (Construction Operations Building Information Exchange) – improving the transfer of heritage related data between potential users of BIM data
- **Sharing of component libraries** – encourage heritage application of BIM
- **Costed illustrations of BIM** – lack of examples highlighting the cost/time resource needed to provide different Levels of Detail (LOD)…can you help?

Courtesy of Dublin Institute of Technology(DIT)

Courtesy BIM Task Group

Courtesy NBS

Courtesy Ramboll



Courtesy Ramboll

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Many thanks for listening

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