BIM & Heritage – are they a good match?

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• On 1st April 2015 English Heritage split into two separate organisations
• English Heritage
  • a new independent charity that looks after the National Heritage Collection of more than 400 historic properties
• Historic England
  • the English government’s independent expert advisory service for England’s historic environment
  • provides expert advice about it, helps people protect it & care for it

www.english-heritage.org.uk
Remote Sensing

“the acquisition of information about an object or phenomenon, without making physical contact with the object”

I work within the Remote Sensing Team of Historic England:

- Aerial Reconnaissance, Investigation & Mapping (Swindon & York)
- Geophysics (Portsmouth)
- Landscape Strategy (Portsmouth)
- Geospatial Imaging (York)
  - Team of 2½ - David Andrews, Fiona Gamble & me
  - Previously EH Photogrammetry Unit & EH Metric Survey Team
Geospatial

“of or relating to the relative position of things on the earth's surface”

Geospatial Imaging

“The technologies used to extract geospatial information from remotely sensed imagery and other raster data types.”
Survey techniques - areas of application

- Close range photogrammetry and 3D scanning
- Satellite remote sensing
- Aerial photogrammetry and laser scanning
- Tactile
- Simple hand measurements
- Tacheometry
- GPS

Object size: 0.1 m, 1 m, 10 m, 100 m, 1 km, 10 km, 100 km, 1 000 km
Scale (max): 1:1, 1:1000, 1:1 Mill.
Laser scanning

Advantages

- Applicable on all 2D and 3D surfaces
- Very fast – now over 1,000,000 points per second
- High resolution – typically millimetre point spacing
- Can integrate digital imaging with point data using on-board cameras, external DSLR or HDR panoramic sensor
- *Often associated with BIM creation*

Disadvantages

- Produces very large data files often difficult to view without high-end computers and dedicated viewers
- Scanners still expensive – between £30K - £70K
- Line drawings require manual digitisation – BIM?
- *Complementary or now competing with SfM?*
Survey techniques - areas of application

Multi-image photogrammetry “Structure from Motion”
Advantages

• Applicable on all 2D and 3D surfaces
• Multi-image photography excellent archival record
• Modern approaches use ‘off-the-shelf’ digital cameras
• Doesn’t rely on calibrated metric cameras being used

• **Structure from Motion (SfM) is low cost and making photogrammetry fashionable again**

Disadvantages

• Requires multi-overlap imagery 80% forward 60% side
• Relies on visible texture within imagery for correlation
• Accurate data relies on good imagery & ground control
• Rubbish in → Rubbish out!
• **Rarely associated with BIM – why not?**
“BIM allows the entire project team to **COLLABORATE** and create a single source of data that assists construction, estate & facilities management processes and the extraction of information throughout the **LIFE-CYCLE OF THE BUILDING**“ (Aedas 2013)

“A process of illustrating, in digital terms, all the elements that compose a building”

Sounds ideal for heritage especially if….

“It’s not a matter of if, but when your firm will implement BIM“

David Philp, Head of BIM UK Task Group
• Building Information Modelling (BIM) Task Group set up by Government to promote BIM across public sector and its supply chain

• BIM for Conservation (BIM4C) established in 2014 which aims to
  • raise awareness and understanding of BIM within the conservation and heritage sector of the built environment
  • promote the benefits that BIM brings to those who have stewardship of our existing building stock (*BIM4C Terms of Reference 14*)

• Follows on from the work of COTAC (The Conference on Training in Architectural Conservation)
In January 2013 English Heritage established its own BIM Special Interest Group (BIMSIG)

Linked to English Heritage Science Strategy & National Heritage Science Strategy

Comprised representatives from across EH:
- Estates
- Heritage Protection & Planning
- Archaeology & Architecture
- Remote Sensing
- Conservation & Science Coordination
- Archive

Chaired by Paul Bryan, Geospatial Imaging
Aimed to

- assess relevance and potential adoption of BIM across EH’s own estate

The Great Barn at Harmondsworth

- Largest intact 15th century medieval timber-framed barn in England
- Following years of neglect has a number of structural and conservation problems
- Acquired by EH in 2011
- Existing archive of measured survey data
- Supplemented by laser scanning in 2012
- BIM might aid the barn’s future analysis, conservation & long-term management?

Images courtesy of Pat Payne (EH) & Bev Kerr (PMT)
Aimed to

- assess relevance and potential adoption of BIM across EH’s own estate

Ironbridge

- The world’s first iron bridge erected over the River Severn in 1779
- 1999 survey indicated that parts were individually cast to fit using woodworking-style joints
- 2012 laser scanning undertaken to facilitate structural analysis & strength assessment
- **BIM might assist long-term analysis, management & presentation?**
Aimed to

- assess relevance and potential adoption of BIM across EH’s own estate

Swiss Cottage, Osborne House, IoW

- Built by Thomas Cubitt 1845 - 1851
- Part of £1.65m project to:
  - Make essential structural repairs
  - Conserve historic object collection
- Laser scanning used for base survey
- BIM model generated to test suitability
- …but not used by project team as already use asset management systems
Aimed to

• **assess impact on EH & HE’s external advice**

  Brierfield Mill, nr Nelson, Lancashire

• 19th century mill building - Grade 2 listed

• Adaptive reuse and regeneration

• Building condition, ecological and measured building surveys undertaken

• 3D laser scanning provided base survey

• BIM model generated to aid conservation planning, presentation & long-term management of regenerated site

• …but project highlighted specification issues and variable client expectation

Laser scanning undertaken by Digital Surveys, 2013
Images courtesy of Digital Surveys
Small size of internal team means the majority of survey data for Historic England and English Heritage is generated by external contractors.

Procured using EU-compliant Framework Agreement

1. Image-based survey
2. Low level aerial photography (UAV’s)
3. Topographic survey
4. Measured building survey

Requires performance based specification

- Metric Survey Specifications for Cultural Heritage

Getting the right survey for the right job is important

This specification provides a guide to the user & the supplier of metric survey data. It explains the services expected & performance indicators to ensure the successful management of metric survey projects.
Metric Survey Specifications for Cultural Heritage


- Image-based survey – rectified, photogrammetry and orthophotography
- Topographic survey – total stations & GPS
- Measured building survey – total stations and laser scanning

Revised edition published September 2015

- Widespread use of laser scanning
- Ubiquity of digital cameras
- Developments in photogrammetry (SfM)
- Use of Small Unmanned Aircraft (SUA)
- Adoption of BIM
BIM Task Group has generated a “Client Guide to 3D Scanning and Data Capture”

- Covers 3D data capture techniques and their integration within the BIM process

- A range of contractor prepared specifications for BIM data capture also now being used
  - Inform clients and end users of BIM data
BIM now included in latest version of the Historic England Metric Survey specification

- Highlights different levels of detail
- Modelling tolerances
- Importance of fabric information
- Required data formats and deliverables

BIM Specification

- Level 1 – basic outline of the building/structure represented as a solid object using representative component information but with no architectural detail depicted
- Level 2 – outline of the building/structure represented as a solid object with principal architectural features included using generic components
- Level 3 – outline of the building/structure represented as a solid object with all architectural features and major service detail included using generic components
- Level 4 – detailed survey of the building/structure represented as a solid object including all architectural detail, services and custom developed components to accurately represent fabric type.

Example of high level 3 BIM model

Animation courtesy of Greenhatch Group 2015
Understanding Historic Buildings (2006) - *A guide to good recording practice*

Geophysical Survey in Archaeological Field Evaluation (2008)

Measured and Drawn (2009) - Techniques and practice for the metric survey of historic buildings

Metric Survey Specifications for Cultural Heritage (2009 & 2015)

The Light Fantastic (2010) - *Using airborne lidar in archaeological survey*

Traversing the Past (2011) - *The total station theodolite in archaeological landscape survey*

3D Laser Scanning for Heritage (2011) – *Advice and guidance to users on laser scanning in archaeology and architecture*

Multi-light Imaging for Heritage Applications (2013) – *Practical guidance on applying Reflectance Transformation Imaging (RTI) & Polynomial Texture Mapping (PTM) in heritage*

Where on Earth Are We? (2015) - *GNSS in Archaeological Field Survey*
- Collaborative Doctoral Partnership (CDP) with the Arts and Humanities Research Council (AHRC) 2016-2018
  - Historic Building Information Modelling
  - Welcome research that looks at BIM applied to existing heritage structure
  - Deadline for proposals 27 Nov 2015
- Historic England funded research
  - Use existing survey datasets and derive BIM-ready models for test structures to consider their application across a range of heritage science processes
  - Due to be tendered early 2016 for completion in 2017

Future BIM research

https://historicengland.org.uk/research/support-and-collaboration/researchopportunities
Advantages

• Improved spatial analysis through digital illustration of building components
• Can generate 2D outputs directly from model
• Improved cost analysis and estimation
• Government support so here to stay!

Disadvantages

• Tries to fit irregular features into regular ‘box’
• Architectural depiction takes time to model
• Needs accurate understanding of fabric
• Increased modelling time = increased cost
• Can heritage really justify the expense?
• BIM – Building Information Modelling or simply Better Information Management?
• Adoption of BIM for existing buildings is still unclear in terms of process automation and business value
• Historic England & English Heritage still considering BIM and how they might utilise it
• BIM approaches try to fit irregular shaped features into a regular shaped framework
• The ‘I’ (Information) in BIM needs an accurate understanding of the building
• Increased modelling time = increased cost can the heritage sector really justify its wide-scale application?
Many thanks for listening

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