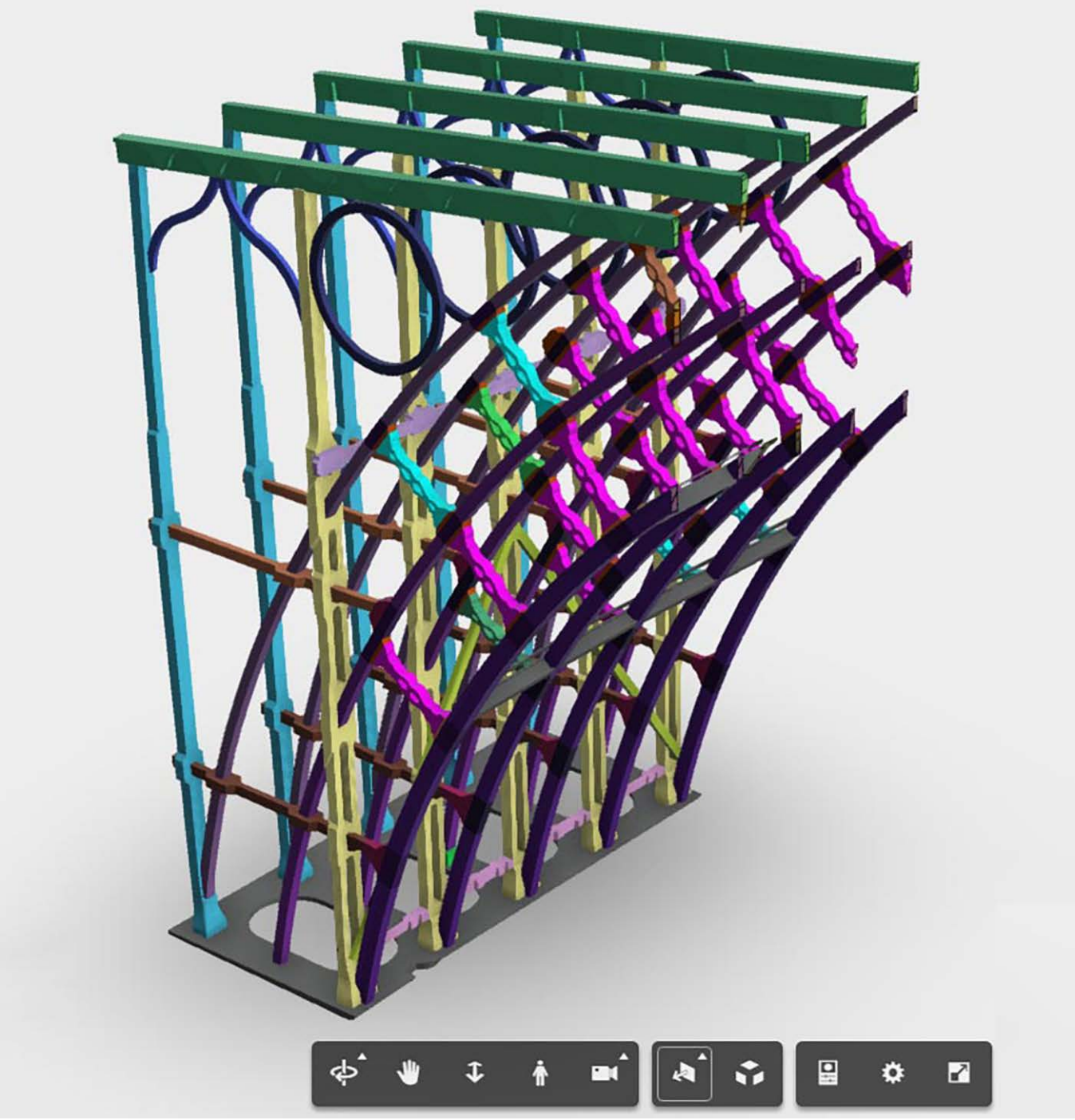
Historic England

BIM for Heritage

Developing the Asset Information Model



Summary

Historic England began to consider BIM in 2013 and published their first guidance document BIM for Heritage – Developing a historic building information model in 2018. BIM application in the heritage sector to date has had a heavy focus on digital documentation of heritage assets however, for the benefits of BIM as an information management process to be achieved, simple and relevant guidance is required.

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

It is for owners, heritage trusts and others involved in the conservation repair and maintenance of heritage assets. It gives an overview of the BIM for heritage journey, heritage asset management and the BIM information management process. It will help owners and organisations consider how BIM approaches may be used in the planning and delivery of conservation repair and maintenance and provides guidance in developing a heritage focused asset information model and the required suite of documents to assist those wishing to adopt BIM information management workflows in a heritage context.

Front cover: Section cut through the geometric model for The Iron Bridge.

A geometric model of the bridge was created in 2012 that was used to undertake stress analysis and strength assessment work. Based on point cloud data captured using laser scanning this highlighted the potential use of component geometry data for developing an asset information model for the structure.

This document has been prepared by Joanna Hull MSc MCIOB MAPM of the University of Reading and Paul Bryan BSc FRICS. This edition, published by Historic England in October 2019, is the second in a series of documents on Building Information Modelling (BIM) for heritage.

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HistoricEngland.org.uk/advice/technical-advice/recording-heritage

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1 Introduction

1.1 The BIM for Heritage journey

The UK's *Government Construction Strategy* was published on 31 May 2011, announcing the intention for 'collaborative 3D BIM (with all project and asset information, documentation and data being electronic) on its projects by 2016' (Cabinet Office 2011). The focus was principally on new-build construction, such that adoption of Building Information Modelling (BIM) for existing buildings, including heritage, was limited and unclear.

English Heritage started consideration of BIM in 2013 through inclusion within its heritage science strategy and establishment of its own internal BIM Special Interest Group (BIM SIG), which considered the relevance and potential adoption of BIM across its own historic estate and the impact BIM might have on its external advice. Since the split with English Heritage in 2015 this work has been taken forward by Historic England, the newly-named non-departmental public body dedicated to offering expert advice, championing the wider historic environment and providing support for stakeholders in the heritage sector.

In September 2017, a special interest group, BIM4Heritage, was set up within BIM4Communities to champion BIM within the historic environment and provide a forum for organisations and industry professionals to share knowledge and lessons learnt on the application of BIM in a heritage context. Historic England formed part of the original group and committee membership.

In 2017, Historic England published *BIM for Heritage: Developing a Historic Building Information Model* (Historic England 2017). This guidance offered the heritage industry an introduction to BIM and its application in a heritage context, including a number of case studies.

BIM application in the heritage sector to date has had a heavy focus on digital documentation of heritage assets, fuelled by technological developments in three-dimensional (3D) data capture such as photogrammetry and laser scanning over the last few years. Historic England has published technical advice documents on surveying and recording heritage, including guidance on photogrammetry, laser scanning, lidar, geophysics, measured survey, landscape survey, global navigation satellite systems (GNSS) and plane table survey). As noted in BIM for Heritage: Developing a Historic Building Information Model there are numerous case study examples of heritage assets being documented in this way, and the range of benefits in visualisation,

monitoring, education and research for conservation practice is becoming well understood. However, the application of BIM as an information management process (IMP) in both the operational phase of a building's lifecycle and in the delivery of conservation repair and maintenance (CRM) and restoration projects has yet to become established in the heritage sector.

In 2017, the BIM4Heritage group held their inaugural conference, which was followed by the publication of the BIM4Heritage Conference Report 2017 (COTAC). This report identified a range of requirements to encourage a greater degree of BIM uptake in the heritage sector:

- provide BIM guidance for owners and clients, including workflows and templates
- understand roles and responsibilities, as indicated in Publicly Available Specifications (PAS)
- guidance to be simple and relevant
- migrate easily from existing workflow patterns
- ensure competence at Level 1 first
- reduce confusion surrounding the 3D modelling aspect of BIM.

1.2 Current BIM guidance

There are a number of 'levels of maturity' of BIM:

- Level 0 describes unmanaged CAD (Computer Aided Design)
- Level 1 describes managed CAD in 2D or 3D
- Level 2 involves developing building information in a collaborative 3D environment with data attached, but created in separate discipline models
- Level 3 has yet to be defined in detail, but it is thought that it will include a single, collaborative, online, project model including construction sequencing, cost and life cycle management information.
- The BIM Level 2 suite of documents was produced to help the construction industry adopt BIM and includes the following British Standards (BS) and Publicly Available Specifications (PAS). BS EN ISO 19650-1:2018: *Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling - Information Management using Building Information Modelling: Concepts and Principles* (BSI 2019a)

- BS EN ISO 19650-2:2018: *Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling - Information Management using Building Information Modelling: Delivery Phase of the Assets* (BSI 2019b)

- PAS 1192-3:2014: *Specification for Information Management for the Operational Phase of Assets using Building Information Modelling (BIM)* (BSI 2014; available as a free download from https://bim-level2.org/en/standards/).

(BS 1192:2007 + A2:2016 and PAS 1192-2 are superseded by BS EN ISO 19650.)

PAS 1192-3:2014 (BSI 2014) provides guidance for asset managers on how to integrate the management of information across the longer term activity of asset management with the shorter term activity of asset construction for a portfolio of assets. PAS 1192-3:2014 is the principal document used in developing this guidance.

PAS 1192-3:2014 will eventually be replaced by BS EN ISO 19650-3 *Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling (BIM) — Information Management using Building Information Modelling: Operational Phase of the Asset.*

Figure 1: BIM standards prior to and from January 2019 © The British Standards Institution

Prior to January 2019

BS 1192

PAS 1192-2

PAS 1192-3

PAS 1192-4

PAS 1192-5

PAS 1192-6

From January 2019

BS EN ISO 19650-1 + UK National Foreword

BS EN ISO 19650-2 + UK National Foreword

PAS 1192-3

PAS 1192-4

PAS 1192-5

PAS 1192-6

1.3 Transition of UK BIM to international standards

The International Organization for Standardization (ISO) international standards have been developed based on the UK's standards for information management using BIM however, there have been a number of terminology changes to suit the international standard. For those who have a prior understanding of BIM and the UK terminology, these changes are summarised in Figure 2.

Figure 2:
BIM terminology changes between PAS 1192 and ISO 19650 standards

PAS 1192 term	ISO 19650 term
[New]	Risk register
BIM execution plan	Information delivery plan (in BS EN ISO 19650-1) BIM execution plan(in BS EN ISO 19650-2)
Capital / delivery phase	Delivery phase
<CDE> area / section	<CDE> state
CDE gate	Transition
Container / file / document	Information container
Contract	Appointment
Employer	Appointing party / lead appointed party / appointed party
Employer's information requirements (EIR)	Exchange information requirements (EIR)
Graphical / non-graphical	Geometrical / non-geometrical
Level of model definition / level of detail (LOD) / Level of information (LOI)	Level of information need (no acronym)
Model / information model	Information model
Plain language questions (PLQ)	Project information requirements (PIR)
Project delivery team	Delivery team
Responsibility matrix	Responsibility matrix / Assignment matrix
Roles	Function
Standard method and procedure (SMP)	Combination of information standard and information production method and procedure
Suitability	Status
Supplier	Lead appointed party (tier 1) / appointed party (tier 2 and below)
Task team	Task team
Volume strategy	Federation strategy

To avoid confusion, the rest of this guidance will use the new ISO terminology.

1.4 BIM as an information management tool

At its core BIM is about information management, providing frameworks and processes for the collaborative production, management and delivery of information in relation to a building's lifecycle. BIM **information requirements**, and the **information delivery cycle**, are key to the successful implementation of BIM as an information management tool. In parallel, conservation practice is based on fully informed decision making and judgement and, at the heart of this, there should be robust frameworks for the management of historic building information and conservation philosophies. It is therefore suggested that BIM workflows can offer huge benefits to CRM activities and asset management within the built historic environment.

Within a 'traditional' (previously referred to as Capex) BIM workflow, information is produced and collated throughout the process of design and construction as a project information model (PIM). This is passed to the building owner upon project completion to be transferred into an asset information model (AIM) and used for the on-going management of the asset. As stated in BS EN IS0 19650-1:2018 (BSI 2019a), the PIM and AIM are the structured repositories of information needed for making decisions during the whole lifecycle of a built environment asset.

A Historic BIM workflow begins at the point of production and maintenance of information during asset management in the information delivery cycle (previously referred to as Opex). This means starting with an AIM, from which information can be drawn for heritage asset management and to inform CRM activities, such as maintenance or repair projects (minor or major) or restoration or redevelopment projects (Figure 3).

Note: The terms heritage BIM, Historic Building Information Modelling, HBIM, BIM for heritage and BIM for historic buildings have been used almost interchangeably. For the sake of consistency, the term Historic BIM will be used throughout this publication when referring to any use of BIM for heritage and archaeology, including applications for documentation, research, conservation and asset management.

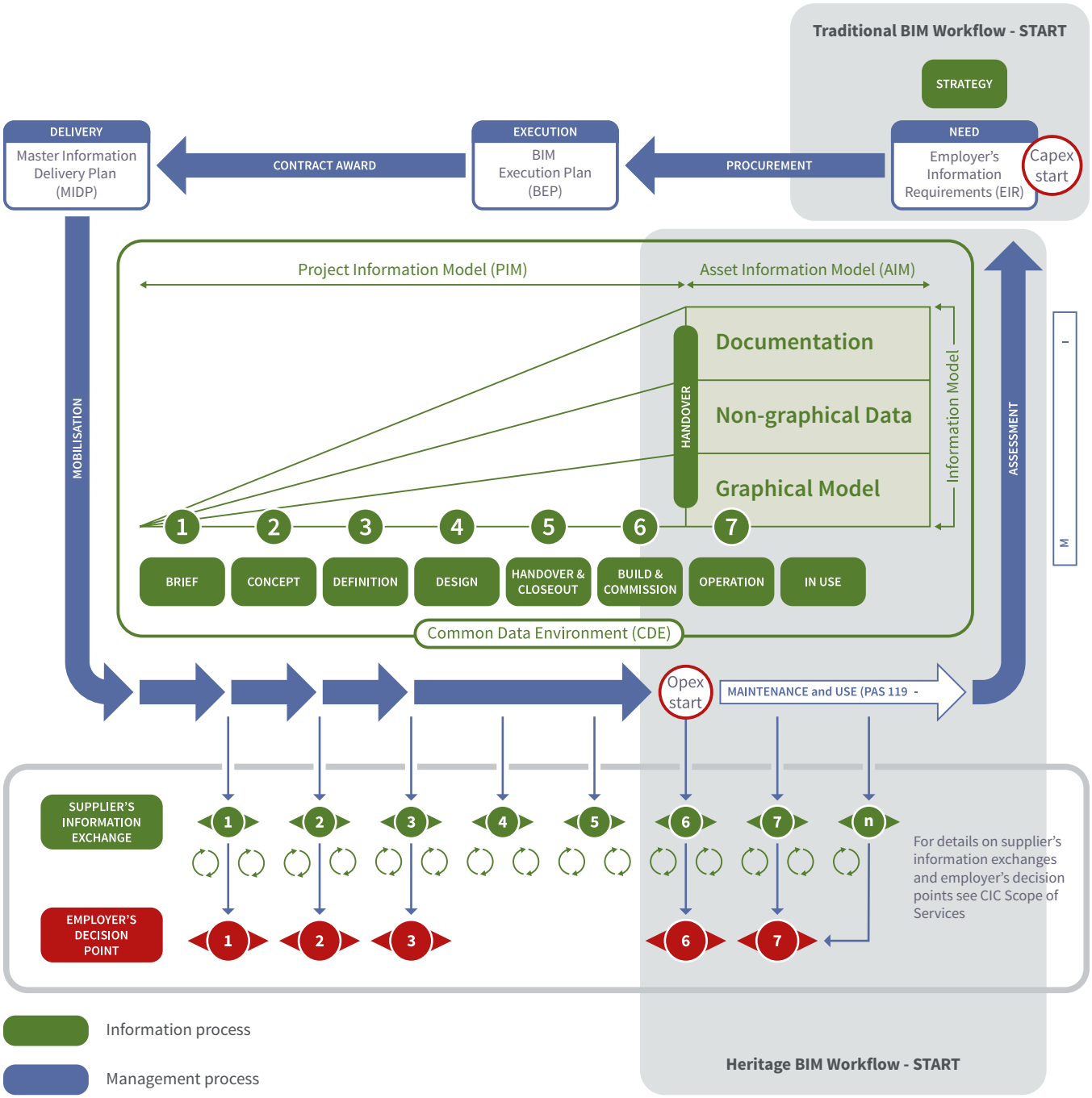


Figure 3:
Historic BIM workflow
© The British Standards Institution

With this in mind, the first task for a heritage organisation wanting to manage assets using BIM is to develop an AIM.

While this requires a certain level of resources, as a basis for heritage asset management and to provide a single source of data to be used to inform CRM activities, an AIM can be hugely beneficial and is a justifiable business case. PAS 1192-3:2014 (BSI 2014) provides clear and concise guidance on the creation of an AIM and the information requirements to do so however, it does not give specific consideration to application in a heritage context. Each heritage asset or project will be unique and, as such, frameworks for the sector to work with must be provided if BIM for heritage is to develop cohesively and become common practice.

In developing an AIM within a BIM workflow, information requirements, including organisational information requirements (OIR) and asset information requirements (AIR), should be established. Exchange information requirements (EIR) should then be developed using these defined requirements prior to undertaking any conservation project.

While template documents are available to assist this process, none is heritage specific. It is noted in *BIM for Heritage: Developing a Building Information Model* (Historic England 2017, p 30) that consideration of how PAS guidance might be applied in a heritage context was outside the scope of that publication (Figure 4).

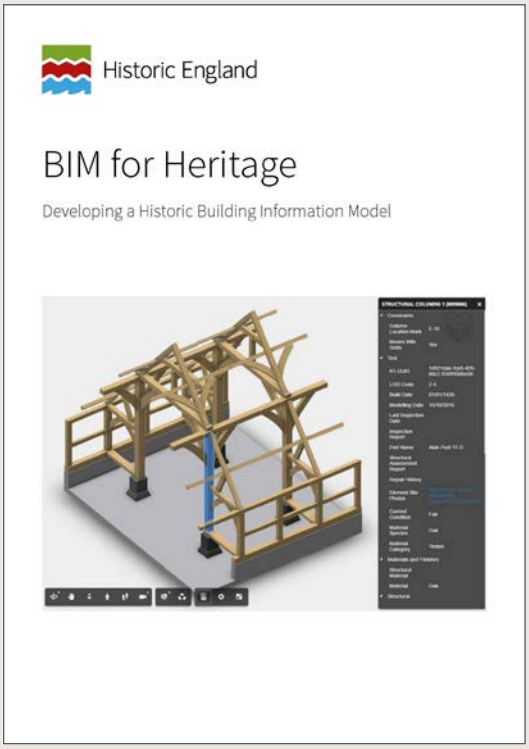


Figure 4:
Historic England guidance - BIM for Heritage, Developing a Historic Building Information Model

This guidance therefore aims to provide advice on information requirements for heritage conservation activities, applying PAS and ISO guidance to heritage asset management, and advice in developing the suite of documents required, to assist those wishing to adopt BIM workflows in a heritage context.

The Historic England HBIM Information Requirements (HIRs) template documents illustrated here (Figures 5–7) are available to download from the Historic England website.

Figure 5 (top left): Organisational Information Requirements (OIR) template

Figure 6 (top right): Asset Information Requirements (AIR) template

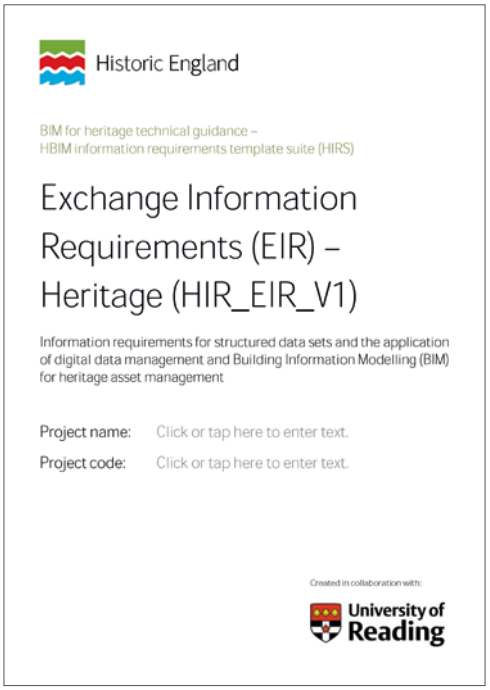


Figure 7 (bottom left): Exchange Information Requirements (EIR) template

2 Heritage asset management and CRM activities

2.1 Why asset management?

The social, environmental and economic value of cultural heritage cannot be denied. Not only does it allow us to connect with the past, providing a sense of identity and belonging, it is also an important source of employment and income.

The report *Heritage Counts* (Historic England 2017) highlighted various headline figures (Figure 8).

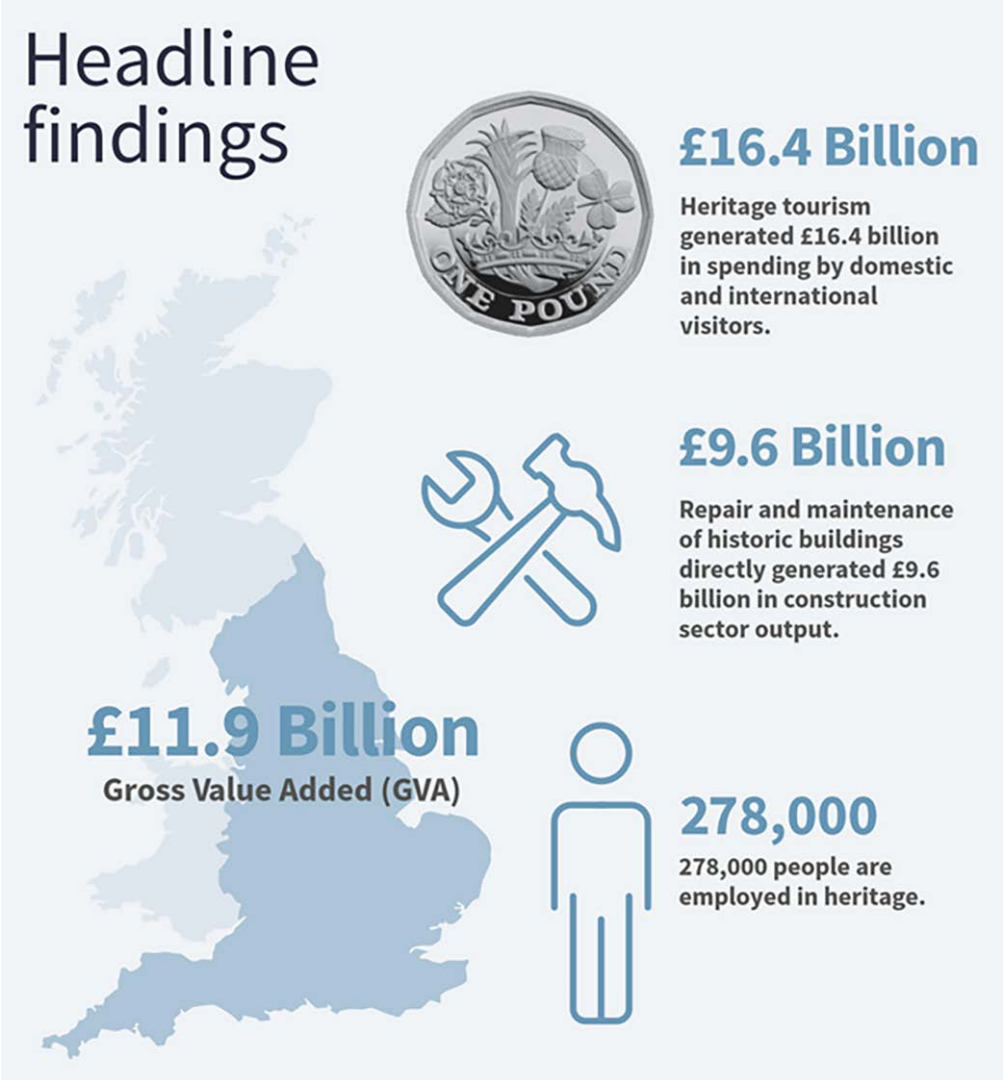


Figure 8:
Headline findings on the value of cultural heritage

It is acknowledged that England's historic environment, at both a national and a local level, is a unique asset. While attracting millions of domestic and international visitors each year, the critical role that local heritage assets can play in successful regeneration projects is also recognised. Heritage assets are important for current commercial activity, providing premises for businesses, and make up a fifth (approximately 4.9 million) of the country's residential dwellings.

The conservation repair and maintenance (CRM) of the nation's heritage is therefore vital for the preservation of such valuable assets. This, however, comes at a huge cost. English Heritage noted in its *2016/17 Annual Report* (English Heritage 2017) that its annual expenditure on conservation projects (diligent maintenance only) was £9.8 million. The National Trust, which is involved in environmental and heritage conservation across England, Wales and Northern Ireland, has reported that its 2016–17 annual conservation expenditure on property projects, conservation repairs and conservation of contents was £139 million. Both organisations note that investments are primarily directed at conservation, backlog repairs and presentation. In 2015, English Heritage valued **urgent** conservation defects across the national heritage collection (400+ sites) at £52 million.

With such large costs and often scarce financial resources, heritage asset management plays a key role in facilitating rational asset decision-making (Figure 9).

English Heritage cares for over 400 historic buildings, monuments and sites – from world-famous prehistoric sites to grand medieval castles, from Roman forts on the edges of the empire to a Cold War bunker. Set up as a registered charity in 2015, the English Heritage Trust is responsible for conserving and maintaining some of the most nationally and internationally significant historic buildings, monuments and landscapes in England.

The conservation of the historic estate is the largest area of expenditure for the charity. In 2015 English Heritage, through its Asset Management Plan, valued urgent conservation defects across the national heritage collection at £52 million. With government funding secured for these works, the charity is now working to reverse the decline in the condition of the collection and investing in new projects.

Figure 9:
Assessing the conservation, repair and maintenance (CRM) requirements for Witley Court Fountain

2.2 What is asset management?

Asset management refers to systematic procedures and processes that help monitor and maintain things of value, including tangible assets, such as buildings, and intangible assets, such as intellectual property – data and information. 'It involves the balancing of costs, opportunities and risks against the desired performance of assets to achieve an organisation's objectives' (The Institute of Asset Management).

The discipline of asset management and an integrated approach to the management of information allows organisations to apply analytical approaches towards the management of assets.

PAS 55-1:2008 *Asset Management Part 1: Specification for the Optimized Management of Physical Assets* (BSI 2008) states that organisations should develop an asset management policy, or organisational strategic plan, as an overall, long-term plan for the organisation. It should be derived from and embody the organisation's:

- vision
- mission
- values
- business policies
- stakeholder requirements
- objectives
- management of risks.

2.3 Heritage asset management

Heritage asset management differs from traditional asset management in its approach. Where traditional asset management is driven by definitive lifecycle costs from creation or acquisition to disposal, the management of heritage assets is based on the conservation principles of minimal intervention and on-going conservation maintenance for preservation.

In 2016, Historic England published a case study report, *Inclusion of Heritage in Asset Management Plans* (Historic England and NPS Group 2015), aimed at providing guidance to local authorities when developing asset management plans, and how to incorporate heritage asset strategies. The report acknowledged that heritage assets require their own management strategy with specific objectives where the emphasis is placed upon 'stewardship' and 'curation'.

The overall purpose of heritage asset management strategies might include:

- conserving cultural heritage on behalf of the nation
- promoting access to cultural heritage and enhancing the visitor experience
- informing and educating the public about cultural heritage and its significance
- establishing and promoting national standards for the management of heritage assets.

As noted by English Heritage and Historic Environment Scotland in their own asset management plans, heritage asset management should be underpinned by supporting principles such as:

- knowledge-based decision making based on comprehensive and current data
- systematic and embedded processes
- explicit leadership and responsibilities for asset management
- risk-based approaches to managing safety and protecting cultural significance
- performance measurement
- conservation best practice and technical standards.

2.4 How do we do asset management?

The discipline of asset management relies on the following.

Asset management information: 'meaningful data relating to assets and asset management' (PAS 55-1:2008; BSI 2008). Examples of asset management information include asset registers, drawings, contracts, licences, legal, regulatory and statutory documents, policies, standards, guidance notes, technical instructions, procedures, operating criteria, asset performance and condition data, or all asset management records.

An asset management information system: *'system for the storing, processing and transmission of asset management information'* (PAS 55-1:2008; BSI 2008). Organisations should establish what their asset management information requirements are, and design, implement and maintain a system for managing this information.

BIM: BIM concepts based around the collaborative production, management and delivery of building information across a building's lifecycle, provide an effective solution for meeting asset management requirements.

PAS 1192-3:2014: *Specification for Information Management for the Operational Phase of Assets using Building Information Modelling* (BSI 2014) is a critical document for BIM in a heritage context as it relates to the discipline of asset management. It states that where there is a suitable business case, an existing asset (such as heritage assets) may enter a BIM Information Management Process (IMP) with the development of an Asset Information Model (AIM).

Although it is acknowledged that BIM IMP can be a huge benefit for asset management, until now there has been no guidance on how to apply these concepts to heritage asset management.

This guidance provides you with the information you need to enable your organisation to think about how BIM concepts can be applied to your own heritage asset management requirements.

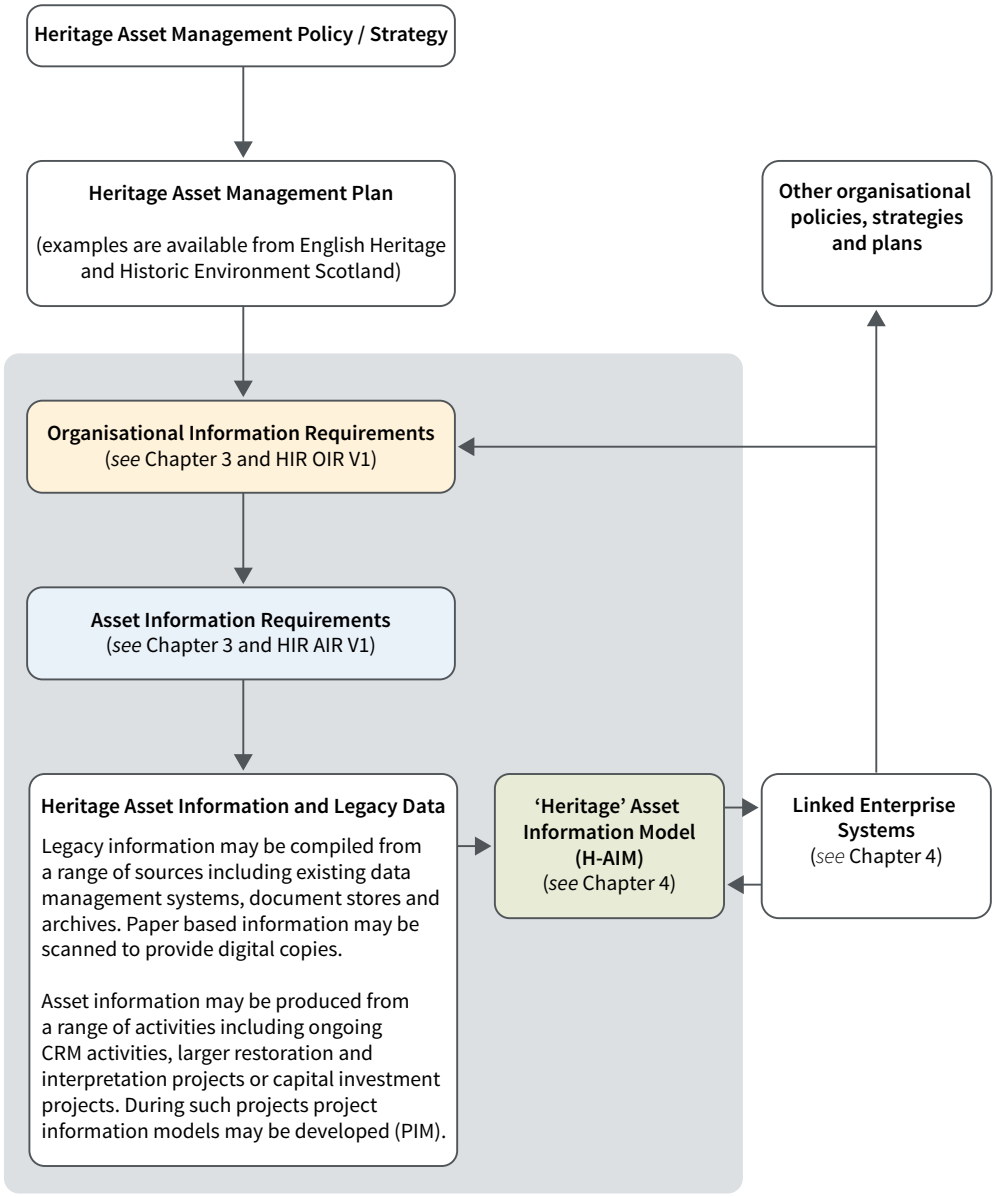
2.5 Developing a heritage asset IMP using BIM concepts

The process of managing heritage assets using BIM concepts begins with the development and implementation of an asset information management process (IMP). For the purposes of heritage asset management, the IMP should be used to manage the on-going maintenance, preservation, interpretation and future restoration of heritage assets.

PAS 1192-3:2014 (BSI 2014) illustrates the high-level IMP with a flowchart. In Figure 10, this has been amended to suit the requirements of heritage asset management.

Chapters 3–6 break down the IMP into a series of steps, beginning with the development of OIR and AIR, and leading on to the development and maintenance of an AIM or Heritage Asset Information Model (H-AIM).

Figure 10:
The asset Information Management Process (IMP) workflow



3 Establishing information requirements

BIM concepts are, at their core, about frameworks and processes for the collaborative production, management and delivery of information in relation to a building's lifecycle. One of the key tasks when adopting a BIM approach for the management of information about an asset or estate (whether new or existing) is to establish exactly what information is required by the organisation, across all departments, in order to carry out the organisational functions.

As discussed in Chapters 1 and 2, in a heritage context we are dealing with existing assets and therefore begin with information management for the operational phase, otherwise referred to as asset management or heritage asset management.

In adopting a BIM approach for heritage asset management, the overall goal is to develop a digital AIM that offers a single source of validated data to support asset management activities. The data and information that go into an AIM should be informed by OIR and AIR.

BS EN ISO 19650-1:2018 (BSI 2019a) provides the following definitions:

- OIR: 'information requirements in relation to organisational objective.'
- AIR: 'information requirements in relation to the operation of an asset'

Figure 11 provides guidance on the information requirements and the resulting information models.

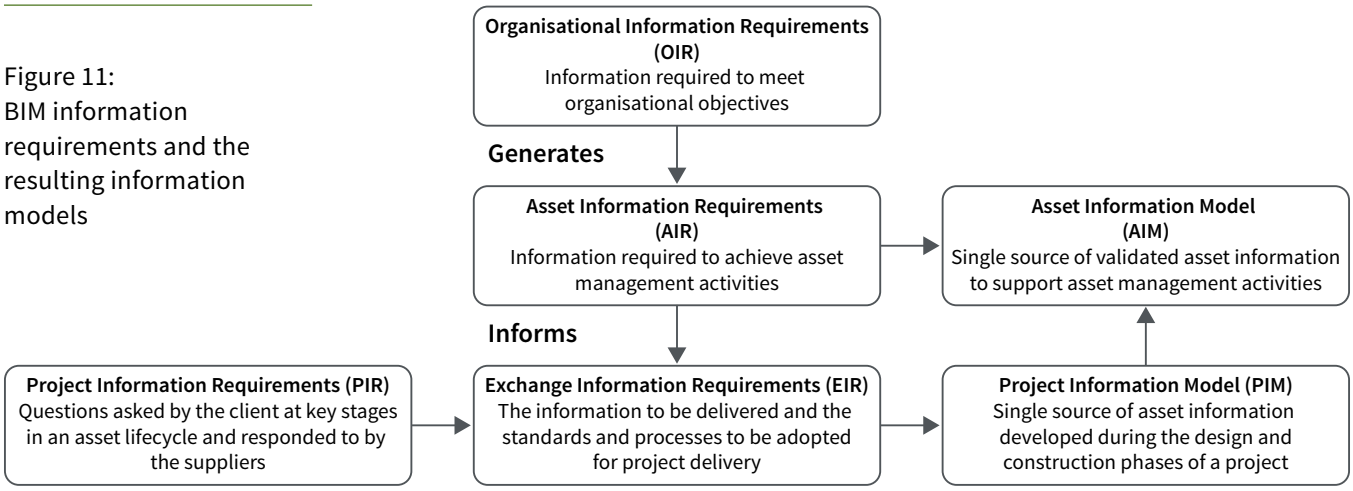


Figure 11:
BIM information requirements and the resulting information models

3.1 OIR

An organisation should begin by developing an overarching organisation information requirements (OIR) document that defines the information required to meet the needs of the asset management system and other organisational functions. The OIR is a high-level, organisation-wide, document that helps the organisation and project team focus on the overall information requirements rather than the finer details of how this information is to be managed, such as data format, function and responsibilities and delivery programmes. This level of detail is defined in the AIR and EIR.

Where organisations have an asset management strategy/policy and asset management plan in place, these should be used to help inform the development of the OIR.

Each organisation may have different information requirements, so it is important to begin this process early and communicate with all the departments or stakeholders who have a responsibility for strategic decision making concerning the asset or estate. BIM processes promote collaborative working practices. The development of an OIR provides an opportunity to collaborate and is intended to integrate information requirements at an organisation-wide level.

3.1.1 Who should be involved?

The people involved in establishing the OIR will vary according to individual projects and organisations. In order to establish who should be involved, it is important to understand what the asset management activities are and who is involved in the decision-making processes. Early discussions should take place to bring a project team together. While high-level discussions might take place between directors and departmental leads, it is also important to undertake detailed discussions with all information users.

Figure 12:
Geospatial surveyors undertaking survey work at a heritage site

It can be difficult to think of all the data and information that are used day to day to perform tasks and complete activities, therefore it is important to work closely with information users to gain a full understanding of the requirements. In the case of heritage organisations, the following people may all contribute to the development of OIR:

- directors
- heads of departments
- property steering groups/project boards
- project lead/senior responsible officer (SRO)
- project and facilities managers
- estate, historic building surveyors and geospatial surveyors (Figure 12)
- conservation architects
- architectural technologists
- property curators
- survey coordinators
- data managers/asset data managers
- site/building managers and users
- consultants
- user panels
- champions
- 'friends of' groups.

3.1.2 What should be included?

While PAS 1192-3:2014 (BSI 2014) provides guidance in the development of OIR, it does not define the content of an OIR. Typical content headings that might be found within an OIR are provided in PAS 1192-3:2014 Annex A.2, but these are aimed at new build assets and do not take heritage-specific information requirements into consideration.

Asset information may be used within your organisation by a range of different departments. The following questions may help you to consider some of the activities that you undertake and the information that you require.

Before I can carry out conservation intervention, what information will I need?

- What is the historical significance of this space, or this building fabric, and how does this affect what I do?
- To put together consent applications for conservation intervention, what information will I need?
- What information do I need to understand and manage planned and preventative maintenance tasks?
- What equipment and plant do we have, and what information do we need to maintain it?
- What are the presentation requirements of this space?

Examples from large heritage organisations are provided below to help you consider the content headings for your own OIR.

Estates departments at a strategic management level will require information regarding the condition of the assets, anticipated future needs and the value of defect liabilities, to enable budget planning and programming of CRM activities. In addition, information regarding significance, heritage values and risk to significance is required to facilitate the prioritisation of CRM activities.

Conservation maintenance and facilities management teams will also require information regarding the condition of assets, but this information might be more specific to particular defects, historic building material specifications, historic building components or equipment, and life expectancy, inspection and certification details.

Curatorial or interpretation teams might require information relating to space planning with regard to space categories and use, space size and access routes.

Health and safety teams will require information regarding the inspection of historic sites and related risks and mitigation measures, in order to meet statutory and regulatory obligations.

This is not a complete list, and there might be many more information requirements within your organisation, but these suggestions will help you think about the range of activities that take place, and therefore the range of information that is required. However, it is always worth considering the following.

- Why am I collecting this information, what use is it and is it required?
- What else can this information be used for, who else will it assist?

A list of suggested content headings to meet heritage information requirements is provided in the OIR template document HIR_OIR_V1 (Historic England 2019a): this document should be used to develop specific OIR for individual organisations.

3.1.3 Summary

The OIR should be produced collaboratively as a high-level, organisation-wide document that outlines the information required to meet the needs of the asset management system and other organisational functions.

The development of an OIR should be an on-going process. Continued discussions with departments and stakeholders should assess whether the data being collected is suitable and how this can be improved. It provides a reference document against which to compare the data that is collected with defined information requirements, therefore providing quality assurance for your IMP.

The defined OIR should be used to develop more specific AIR.

3.2 AIR

BIM for Heritage: Developing a Historic Building Information Model (Historic England 2017) discusses asset information requirements (AIR) in Chapter 4: Commissioning BIM. Having identified that heritage asset management and CRM projects could greatly benefit from the development of an AIM, this guidance has been produced to help with the procurement or inhouse development of an AIM. The development of a detailed AIR document is a key step in this process, and therefore in the successful implementation of BIM in a heritage context.

AIR define the data and information that are required in an AIM to support asset management activities. They should be informed by the defined OIR.

Development of AIR is a considerable task that requires time and effort to complete. Taking sufficient time to develop robust AIR will significantly improve the process of developing an AIM for a historic asset, and initially will require significant input of information and legacy data.

Collaboration between organisational departments and information users in the form of workshops will help to establish the asset data and information required in response to the OIR, thus further improving the process.

PAS 1192-3:2014 (BSI 2014) notes that, while the AIR may begin as descriptive text, possibly as a series of notes taken from AIR development workshops, this should be developed into a digital plan of deliverables. AIR will be specified as part of a contract or, more likely in relation to heritage asset management, as an instruction to inhouse teams.

3.2.1 What should be included?

PAS 1192-3:2014 (BSI 2014) Annex A.3 summarises specific AIR under the following headings.

- Legal
- Commercial
- Financial
- Technical
- Managerial

In collaboration with industry professionals, and in line with heritage asset management processes, CRM activities and heritage consent procedures, the following information requirements have been prepared to provide guidance for individuals or organisations that are developing their own AIR for heritage assets. While these are still generic in nature, they may be defined further by individual organisations.

3.2.2 Legal information

- Details of ownership, guardianship/stewardship, leases
- Asset-related contractual information
- Maintenance responsibilities and extents
- Legal obligations/statutory and regulatory information, such as health and safety, environmental, scheduling
- Works instructions, orders, contracts

3.2.3 Commercial information

- Asset description, which in a heritage context might include asset type or monument category, such as roofed, unroofed, ruins, etc
- Asset function, such as visitor attraction, museum, office, ancillary (Figure 13)
- Statements of significance, such as historical significance, commercial significance
- Asset condition and intensity of use, such as monument condition indicators

Figure 13:
Harmondsworth Barn – the "Cathedral of Middlesex"

- Condition standards, minimum standards of repair
- Key performance indicators

3.2.4 Financial information

- Cost of planned and preventative maintenance tasks
- Downtime impact/loss of revenue if monuments are closed for conservation works
- Value of defect liabilities

3.2.5 Technical information

Engineering and design parameters, which in a heritage context might include:

- structural survey records
- material specifications
- stone analysis and sourcing reports
- mortar specification and mortar analysis records
- environmental monitoring data and limits
- existing technical and geospatial survey drawings (Figure 14).

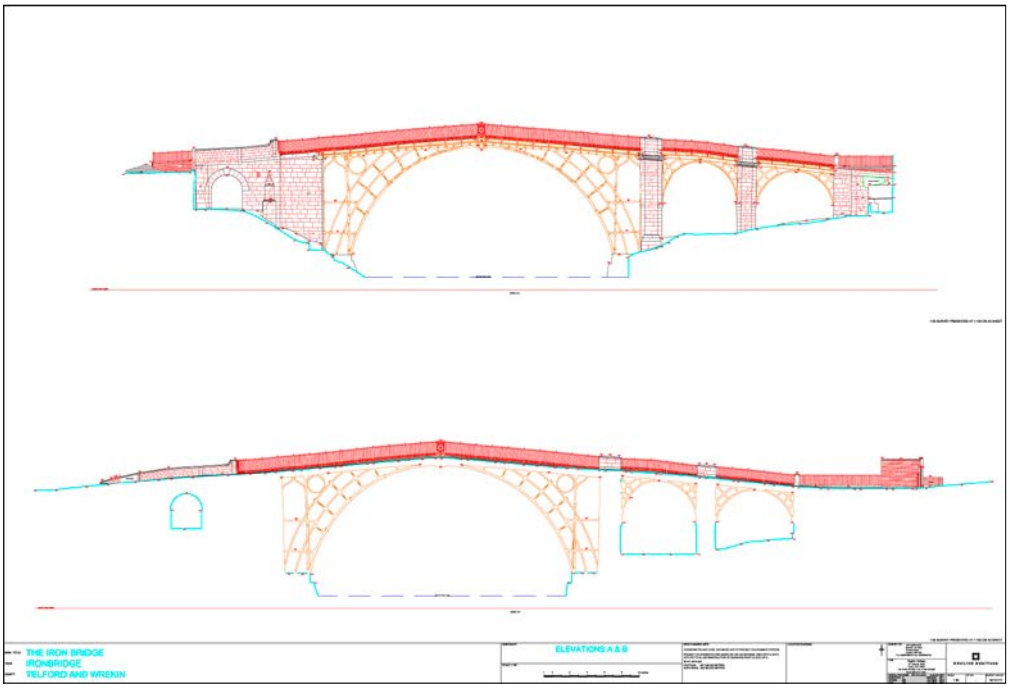


Figure 14:
CAD drawing for The Ironbridge, Shropshire

3.2.6 Managerial information

- Unique asset identification numbers
- Asset locations, possibly using spatial data or geographic information systems (GIS)
- Spatial data, such as space type, use, size, accessibility, availability, presentation standards
- Conservation management plans, such as risks and opportunities, conservation repair philosophy
- Cyclical/maintenance schedules and records
- Survey records, including condition, ecology, structural, high level, asbestos (Figure 15)
- Asbestos register and management plan
- Specialist inspections
- Health and safety inspections and records, including inspection certificates, due dates
- Consent details, such as standing consent, historic consent applications
- Curatorial and interpretation details
- Collections details, records, catalogues (Figure 16)
- Archaeological records
- Emergency plans

Figure 15:
Undertaking a condition survey on site
© Joanna Hull

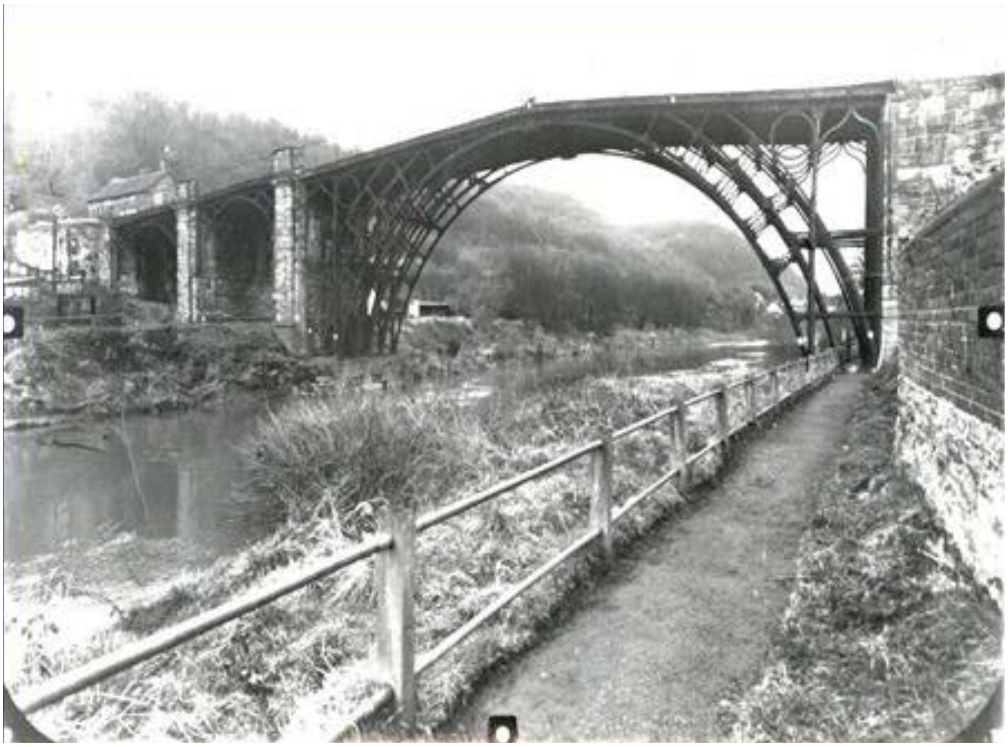


Figure 16:
Archive photograph of the Ironbridge captured during photogrammetric survey work from 1972

3.2.7 Summary

The AIR define the data and information required in an AIM to support asset management activities.

The AIR should be produced collaboratively, including workshops with information users, to understand the full range of information required to meet all asset management activities. A template has been produced to assist you in developing your own AIR: HIR_AIR_V1 (Historic England 2019b).

The defined AIR should be used to inform the development of EIR.

4 The AIM and CDE

4.1 What is an AIM?

There is some confusion surrounding BIM, not least in the heritage sector, that, alongside concern over the time and cost elements of 3D modelling, may act as a barrier to the uptake of BIM for heritage. However, BIM is not solely about 3D models. While a 3D model might be a requirement on some projects and could offer benefits to heritage asset management, CRM and interpretational activities (*see* Chapter 7), it is not a necessity, particularly in the early stages of developing an asset information model (AIM) for a heritage asset (Figure 17).

So, what is an AIM?

- An information model relating to the operational phase of an asset
- A set of structured and unstructured information containers

- BIM is a digital data 'model' or 'repository': a digital version of traditional (paper-based) building and project files and archives.
- It could be thought of as a document management system or file storage system that contains validated data and information relating to an asset or portfolio of assets.
- It should be collated from a range of sources to include information about the history of the building, building components and materials and the information required to support decision-making and asset management activities.
- It will comprise geometrical (3D models, 2D drawings, photographs) and non-geometrical components (structured building data, databases) and documentation (operation and maintenance manuals, reports, surveys, contracts).
- It will be managed within a CDE, i.e. a digital workspace.

- It should be a unified system as far as users are concerned, but may comprise multiple databases, file stores or bi-directional links to other enterprise systems.
- The contents of the AIM should be approved and validated using a defined IMP, thereby offering a single source of truth.
- An AIM should be intelligent and integrated, supporting interoperability (linked enterprise systems, classification/ standardisation), core information management (version and access control) and, at BIM level 2, intelligent, federated models.

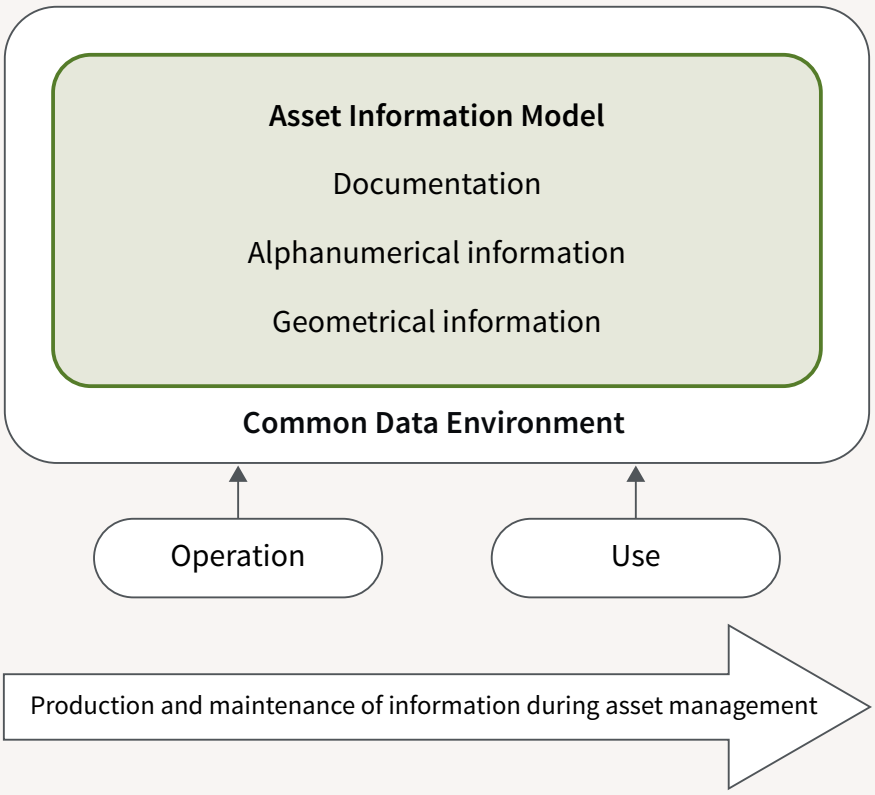


Figure 17:
The Asset Information Model (AIM). Diagram derived from the information delivery cycle that appeared in PAS 1192-2:2013 (BSI 2013b)
© Mervyn Richards

The AIM should comprise two parts:

- a file store containing 'published' files such as documents, reports, surveys, drawings and, where appropriate or at BIM Stage 2, geometric 3D federated models
- a data store comprising non-geometrical structured data, such as a relational database.

As noted in PAS 1192-3:2014 (BSI 2014), the two parts should be referentially and relationally maintained so that an object in the data store can reference a model or document in the file store. The references in the data store can also be external.

The information required in an AIM is unique to each organisation. Furthermore, the range of data and information required for the management of heritage assets is complex, requiring thought and attention. The needs of any particular organisation or asset are established through the development of OIR and AIR, as discussed in Chapter 3.

Establishing an AIM for a historic building is potentially a large, resource-heavy undertaking but, as already mentioned in section 1.4, it should be considered where there is a suitable business case. In the case of large heritage organisations that are responsible for the conservation of historic estates, such a business case will exist. Where asset management databases already exist, it may be feasible to progress to a BIM management process. PAS 1192-3:2014 (BSI 2014) states that, where data management systems already exist (such as asset management systems), these could be incorporated into, or become, the AIM.

4.2 Creating an H-AIM

Once you have decided on the information and data required to undertake your heritage asset management activities (*see* Chapter 3), you are ready to create a heritage asset information model (H-AIM). Once completed, an H-AIM should provide a single source of validated and approved information, offering huge benefits to conservation management, properly informed decision making and standardisation across the heritage sector.

In a traditional BIM workflow, information is generated during the design and construction phases to develop a PIM. Some data is added directly to the 3D model (as data parameters; *see* Chapter 7) and then produced as a populated data set, such as a construction operations building information exchange (COBie) spreadsheet, and handed over at project completion to be added to the AIM or to be integrated with other management systems, such as computer-aided facilities management (CAFM) or asset management databases. Project-related documentation, such as operation and maintenance manuals, as-built drawings and data-enriched models in industry foundation classes (IFC) format, will also be provided.

In a heritage context we need to think of the development of the AIM as the first task in a process of compiling and structuring the data required to meet the heritage-specific OIR and AIR rather than as a result of the design and construction process.

Following creation, the AIM is then used to inform project works and will undergo on-going development as a result of project work.

As noted in PAS 1192-3:2014 (BSI 2014), creation of the AIM may also be achieved by any of the following activities, all of which are relevant to heritage asset management.

- Transfer of information and data from existing organisational systems, such as existing property management systems, data management systems (sharepoints or network drives), archive systems, etc.
- Recognising or relabeling an existing data and information store as part of the AIM, such as an existing asset management database, GIS or similar.
- Collection of new or updated information and data from surveys of the physical asset, including digital survey data and structured survey data

An existing AIM should be identified, or a new AIM created, before any CRM works are undertaken. This would be referred to as a 'trigger event', such as minor conservation works, maintenance or major structural works.

Heritage conservation projects are unique in that, before any work is undertaken, the historic and cultural significance of the asset should be understood, and the impact on significance as a result of any project work should be assessed and measures taken to mitigate risk of damage. Surveys of the existing buildings should be undertaken, and proposals must be based on informed decision making. An AIM can provide a single source of validated information to be used in such decision-making processes.

Things you will need to consider when developing your AIM include the following.

- **What information is required?**
  This is defined in your OIR and AIR (*see* Chapter 3)

- **What geometrical information is required for your heritage asset?**
  BIM level 1 – are 2D drawings and photographs sufficient for the management of your asset?
  BIM level 2 – is 3D data capture required?
  Is a 3D point cloud required as a digital record of the asset?
  Is a 3D parametric model required and, if so, to what level of detail?
  (Further advice on the development of 3D building information models is provided in Historic England 2017a; and *see* Chapter 7).

- **How will information be collated?**
  What format should the data be in?
  How will you classify and structure your data (*see* Chapter 5)?

- **How will your AIM be managed?**
  What is your IMP?
  How will you ensure that information is constantly updated in response to works carried out on the asset?

Note: PAS 1192-3:2014 (BSI 2014)

All data and information related to or required for the operational phase of an asset shall be contained in or linked to the AIM. At BIM level 2, the AIM shall be a federated model consisting of a number of discrete parts. The extent and nature of these parts shall be related to the complexity, purpose and scale of the asset.

An AIM may be developed progressively over the life of a building and enhanced as a phase of prioritised and programmed activities in line with the OIR. When first developed it may be at quite a simple level, using only 2D geometrical components and some structured data in spreadsheets and simple databases. Over time an organisation may choose to make developments to the AIM, adding 3D models and transferring model data into structured databases or CAFM systems, for example. As already noted in section 4.2, an organisation may begin by identifying an existing organisational system and relabeling this as the AIM or by transferring this data into a new AIM. Phased development of an AIM might be a particularly useful approach for heritage organisations.

4.3 Maintaining the AIM IMP

An information management process (IMP) that defines the way in which data and information are collated, managed and transferred to and from the AIM should be developed and incorporated into the AIR (HIR_AIR_V1; Historic England 2019b).

As CRM works are carried out, new information will need to be added to the AIM, and out-of-date information will need to be archived. Surveys and information on the condition of a building should be updated and new findings of cultural significance should be added.

The processes for managing these tasks are defined in the IMP and should be developed by considering the following items.

- **Functions and responsibilities for information management**
  Who will manage the data?
  Has an information manager been appointed?

- **Process, procedures and activities for information management**
  What is the validation/sign-off process?
  How will version control be managed?
  How frequently should information be updated?
  What is the process for monitoring and improving the data to ensure it constantly meets organisational requirements?
  What are the processes for retrieval, distribution and availability of data?

- **Risks to information management**
  What are the quality-control procedures, how will data be checked for accuracy and validated against the AIR requirements, how will unwanted or incorrect data be archived?
  What access rights and security procedures are in place, is data confidential, do external stakeholders need access to information, and are restricted access rights required?
  What back up strategy and disaster recovery procedures are in place?

4.4 Links to existing enterprise systems

PAS 1192-3:2014 (BSI 2014) notes that the IMP shall allow the AIM to link to existing enterprise systems that support business processes, information flows, reporting and data analytics, in order to meet organisational requirements (Figure 18).

Existing enterprise systems might include:

- asset management or property management systems
- document management systems
- GIS systems
- condition monitoring and maintenance planning systems
- finance, accounting and procurement systems.

The interface between the AIM and existing enterprise systems should be bi-directional. It should push validated data and information from the AIM to the appropriate enterprise system, as determined by the organisation requirements, and pull data and information, as required by the AIR, from enterprise systems into the AIM to support contractors or in-house project and works teams.

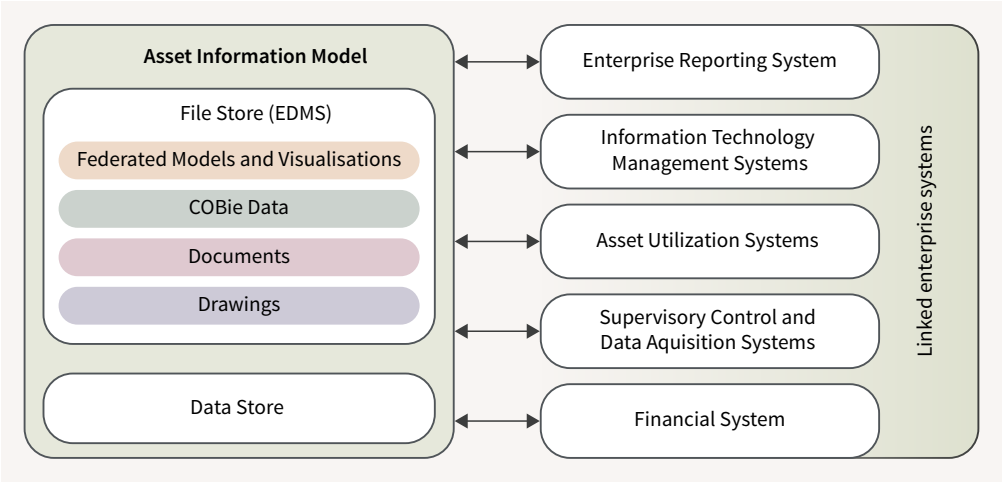


Figure 18:
Linking the AIM to existing enterprise systems.
Diagram derived from PAS1192-3:2014 © The British Standards Institution 2014

4.5 CDEs

Asset information should be managed using a common data environment (CDE) and workflow.

The CDE is an agreed source of information for any given project or asset, for collecting, managing and disseminating each information container through a managed process (BS EN ISO 19650-1:2018; BSI 2019a). It is a digital workspace that provides a central repository of information about an asset that allows for improved collaboration between project and asset stakeholders, reduces duplication and mitigates the risk of mistakes. It is a key concept at the heart of BIM implementation and forms the basis of the IMP.

The CDE may take any form as decided by your organisation or project team, but it is generally a type of file-based retrieval system or electronic

document management system. There are specific BIM CDE software systems available, but in its simplest format the CDE may be a project server or sharepoint. Establishing the CDE should be a main priority.

Examples of software that can be used for a CDE included the following, taken from the GOV.UK digital marketplace

EcoDomus is the world's leading Lifecycle BIM CDE software, allowing facility designers, builders and owners to collect and share information and visualise it in 3D/2D. The software integrates with other solutions, such as CAFM, CMMS, BAS, SCADA and GIS, to support UK's PAS 1192 requirements. http://ecodomus.com/

Bentley CDE (connected data environment) is a client-centric, PAS 1192-compatible CDE for managing information throughout the asset lifecycle in support of BIM Level 2 and BIM Level 3 (asset-centric) collaborative business processes. https://www.bentley.com/

GroupBC is the leading AIM CDE for clients wanting to digitise estates, capturing supplier-delivered project information and maintaining this throughout the asset lifecycle. Every client benefits from a dedicated CDE, deployed in a secure private UK cloud environment, helping government departments procure asset information in accordance with UK industry standards. https://www.groupbc.com/solutions

Further examples of software include the following.

Viewpoint For Projects is a cloud-based document and information management solution for sharing, controlling and collaborating on project documents used by dispersed project teams. https://viewpoint.com/en-gb/products/viewpoint-for-projects

Autodesk BIM 360 Docs is a design and construction document management software system. https://www.autodesk.com/bim-360/

Trimble Connect enables collaboration for engineering and construction projects. It is accessible via desktop, mobile, or web applications. Trimble Connect allows users to view, share and access project information from anywhere at any time. https://connect.trimble.com/

Oracle Aconex is a document management software built for construction and engineering. It provides quick access to current documents, including drawings, models, contracts, reports, schedules and bids/tenders. https://www.oracle.com/uk/industries/construction-engineering/aconex-products.html

The CDE should include the following states, thus providing a validation process for asset data.

Work in progress (WIP): this state should be used to hold information while it is being developed, i.e. work in progress, and should not be visible or accessible to any other task team. It could include information such as reports, surveys, drawings, digital survey, etc. The IMP should set out clearly functions and responsibilities, including who is responsible for managing data within the WIP state and the process for approving the information before it is transferred to the 'Shared' state of the CDE.

Shared: the shared state is used to hold information that has been approved for sharing with other members of the organisation or project team. This information is suitable for other members to use as a reference for the development of their own activities, thus enabling constructive and collaborative development of the information model. These information containers should be visible and accessible but should not be editable.

Published: the published state is used for information that has been authorised for use, eg in the construction of a new project or in the operation of an asset. The published state may require access control if some information is of a sensitive or confidential nature.

Archive: the archive state should hold inactive or superseded information and create a journal of all information containers that have been shared or published during the IMP. The archive state provides an audit trail of information updates and may be used in the event of disputes or to look back at historical changes. **In a heritage context, this does not refer to historic/archive material.**

The developed AIM should only contain information from the published or archived states. This verified information should be used to support the OIR and AIR.

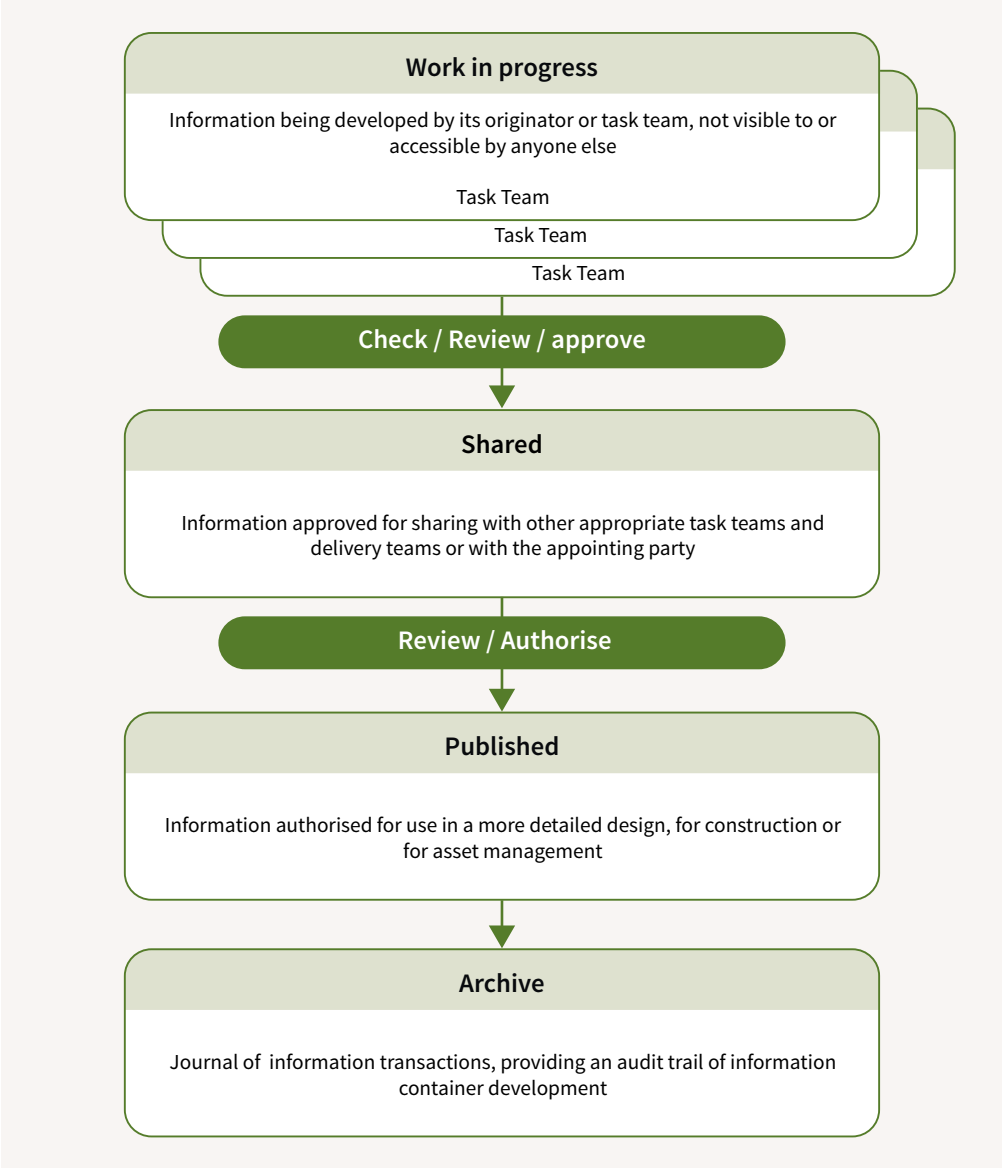
4.6 Revision and status codes

ISO 19650-1:2018 (ISO 2018a) notes that each information container managed through the CDE should have metadata, including the following (Figure 19).

- A revision code, in accordance with an agreed standard, eg IEC 82045-1:2001 Document Management – Part 1: Principles and Methods (ISO 2001)
- A status code, showing the permitted use(s) of information.

Metadata is initially indicated by its author and then amended by the approval and authorisation processes.

Figure 19:
The Common Data Environment (CDE) concept diagram. Diagram derived from PAS 1192-3:2014 (BSI 2014b) © The British Standards Institution 2014



5 Classification Systems and Data Exchange

When data and information is produced or collated in relation to a project or asset, it can build up rapidly. Traditional methods for the production of paper-based files or digital PDF documents can be difficult to manage and can get misplaced or missed by individual project stakeholders.

Furthermore, for the purposes of on-going asset management, information and documentation in this format does not facilitate efficient analysis, planning and decision making. How often do project team members spend hours reading through documents to find the right piece of information? How many times is work (such as survey, drawing and specification) duplicated because the information cannot be found, or because it is quicker to re-do rather than search archives or project files for the required information? How do you analyse, filter, interrogate and compare unstructured data?

To improve on this and provide more efficient data retrieval and analysis, potential information should be classified, structured and delivered as detailed in the AIR or, in response to project works, in the EIR (see the HIR_AIR_V1 and HIR_EIR_V1 templates; Historic England 2019b, c).

5.1 Classification systems

Classification systems are discussed briefly in *BIM for Heritage: Developing a Historic Building Information Model* (Historic England 2017, section 2.4.3). Further guidance is provided here on classification systems and how to apply them in the development of your own AIM and asset management process.

As discussed in Chapter 4, information and data to be added to an AIM must be sufficiently organised and structured to enable successful storage, retrieval and interrogation. Naming conventions should be used to organise files within the CDE, and a standardised approach improves collaboration between project stakeholders.

The data within 3D geometric models comprising BIM objects and/or, BIM data models (such as relational databases) that form part of the AIM, should also be structured. Organising data, particularly in large data sets, using classification systems provides structure and allows it to be quickly and efficiently retrieved and queried.

Data may be structured using an agreed classification system or using the structure of the file and data store software that is being used.

PAS 1192-3:2014 (BSI 2014) states that while the choice of classification system should meet industry standards where possible, it should also take account of the organisation's specific requirements.

5.2 Heritage classification

MIDAS Heritage – The UK Historic Environment Data Standard, v1.1 (English Heritage and FISH 2012) is a British cultural heritage standard for recording information on buildings, archaeological sites, shipwrecks, parks and gardens, battlefields, areas of interest and artefacts. It is available free from Historic England, https://historicengland.org.uk/images-books/publications/midas-heritage/, and provides a framework within which information systems should be developed. It provides guidance and a framework for the information that should be recorded, but it does not provide a standard for classification or naming conventions.

The Forum on Information Standards in Heritage (FISH) has developed a suite of heritage vocabularies that may be a useful resource when considering your classification system: http://www.heritage-standards.org.uk/fish-vocabularies/

While construction sector data classification standards have not been developed with the specific requirements of the heritage sector in mind, as the benefits of BIM are increasingly recognised and adoption in the heritage sector rises such classification systems, including Uniclass 2015, are being updated to incorporate heritage requirements.

5.3 Uniclass 2015

Uniclass 2015 is the UK construction sector standard for data classification that forms part of the National Building Specification (NBS) BIM toolkit: https://toolkit.thenbs.com/.

Uniclass 2015 provides the following.

- A unified classification system for the construction industry. For the first time, buildings, landscape and infrastructure can be classified under one unified scheme.
- A hierarchical suite of tables that supports classification, from a university campus or road network to a floor tile or kerb unit.

- A numbering system that is flexible enough to accommodate future classification requirements
- A system compliant with ISO 12006-2 (ISO 2015) that is mapped to *New Rules of Measurement 1* (NRM1) (RICS 2012) and supports mapping to other classification systems in the future.
- A classification system that will be maintained and updated by NBS.
- Within the BIM toolkit, a database of synonyms to make it as easy as possible to find the required classification using standard industry terminology.

Uniclass tables allow information about a project or asset to be defined from the broadest sense to a fine level of detail. The tables are categorised in Table 1 and a selection of examples that might be used in a heritage context are also provided.

Further information regarding classification and the Uniclass 2015 classification tables is available from https://www.thenbs.com/our-tools/uniclass-2015#classificationtables.

5.4 Data exchange

BIM processes require information and data about an asset to be structured and delivered using non-proprietary templates, thus improving interoperability.

COBie is the standard BIM method for exchanging information (as a subset of model information) in a structured format, and is a requirement for meeting BIM Level 2 compliance.

COBie uses standard spreadsheets (such as Microsoft® Excel) to pull together key information in one format. While COBie provides a format for exchanging asset information, it does not specify what information is to be included, when it is to be provided by, or by whom.

A COBie structure allows information to be transferred between software products, eg from BIM software such as Autodesk® Revit to organisational asset management and CAFM systems.

In a heritage context, COBie may be selected as the information exchange method by the project team. In such cases, developing COBie spreadsheets to include a defined set of conservation parameters is required.

Conservation parameters required in heritage AIMs have been developed based on the information requirements of the UK consent process, CRM best practice and heritage asset management activities. These are provided within the AIR template: HIR_AIR_V1 (Historic England 2019b).

Categories	Description	Examples
Complexes	the project in overall terms	Cultural, educational, scientific and information complexes Monument complexes Museums Mills Areas of special architectural or historical interest Historic sites Convents and monasteries
Activities	the activities that take place in the complex, entity or space. Complexes for large heritage organisations may involve a range of activities, including administrative, commercial and technical (conservation management). The activities table provides a full list that will be useful to a range of organisations, but also includes the following historic building-related activities.	Historic recreational activities Historic earthworks exploring Historic ruins exploring Historic sites exploring Historic building and site surveying Cultural, educational, scientific and information activities Conservation of art and artefacts Collection exhibiting
Spaces/ locations	spaces in which various activities take place. A full list of space types is provided that should meet all the requirements of a heritage asset or estate, including administration, ancillary and welfare spaces. When considering the use of public viewing spaces in historic monuments, the following sub-categories are the most appropriate.	Viewing spaces Recreational spaces
Elements/ functions	elements are the main components of a structure, such as floors, walls and roofs. While the elements provided in Uniclass 2015 provide a good overall framework within which to situate the components of historic buildings, additional components may be required. The requirements should be considered by each organisation in relation to its own heritage asset.	
Systems	systems are a collection of components that form an element. For a pitched roof, for example, the rafters, lining material, tiles, ceiling boards and ceiling finish comprise the collection of components (system) that form the element. In a heritage context the following system (collection of historic architectural components) might be considered in relation to the element: wall/historic elevation – parapet, cornice, stringcourse, etc. Uniclass 2015 provides a range of systems but in general does not include historic architectural components that may form an element and that require recording in the case of heritage asset management. Until Uniclass 2015 is amended to include more heritage-specific systems, heritage organisations may find it useful to develop additional component lists. These should be fully referenced throughout all documentation.	
Products	these are the individual products used to construct a system. The Uniclass table includes products such as natural dimensioned stone, lime and mortar aggregates that might be particularly useful in a heritage context.	

Table 1:
Uniclass information showing example heritage categories

Further information on the use of COBie is available from http://www.wbdg.org/resources/cobie.php.

5.5 Bespoke templates

As an alternative approach, heritage organisations may find it more appropriate to develop a bespoke spreadsheet or data template to facilitate the export/import of data from models or survey or legacy data into the AIM, CAFM or asset management database.

A data exchange template should include the following.

- Asset types/maintainable assets – a list of assets that require maintenance should be established. Asset types should be classified to provide structure. Classification might be achieved using the Uniclass 2015 system or a bespoke/organisational classification system.

- Data attributes – for each asset type, the required data attributes should be agreed. Data attributes are the specific items of data that will be required to manage or maintain the asset.

- Responsibilities – details stating who is responsible for providing each piece of information.

- Data drops/timings/exchanges – details of what information is required, when and to what level. For example, formal data exchanges should take place before the end of each project stage to allow gateway decisions to be made.

6 Exchange Information Requirements (EIR)

The exchange information requirements (EIR) document forms part of the appointment and tender documentation for project BIM and should be developed prior to undertaking any CRM, restoration or capital investment project that will be managed using BIM.

BS EN ISO 19650-1:2018 (BSI 2019a) defines the EIR as: 'Information requirements in relation to an appointment'.

They could be thought of as the pre-tender document setting out the information to be delivered, and the standards and processes to be adopted by the supplier as part of the project delivery process.

Clients need to become better educated with regard to BIM processes and information requirements if they are to get the most benefit. Simply stating in a project brief that BIM, or BIM Stage 2, is required is not enough. Clients need to take control of the process, define their requirements and state the expected deliverables, which is where the EIR document comes in. A well-developed EIR reduces the risk of confusion and ensures clients receive the information they need, therefore reducing the risk of potential project disputes.

The EIR should clearly communicate your BIM requirements. It will define the information required from both internal teams and external suppliers for both the development and delivery of projects, and the operation and management of assets.

Having already developed a BIM strategy with defined OIR and AIR puts the heritage organisation in a good position to manage major CRM works or restoration projects using BIM processes. In such a case the AIR will be used to develop the EIR that are required in the tender process.

The development of EIR may begin at a very high level, stating the information required in a broad sense. As design and project work develops, so will the EIR. In a heritage context, information regarding materials and sourcing of materials, conservation repair methodologies, and such like, will be required. At the end of a project, information that will support the on-going CRM will be required and should be provided in a format that allows the AIM to be updated to include this new information.

This chapter gives further advice on developing your own EIR to be used when managing CRM, restoration or capital investment projects using BIM processes.

6.1 What should be included?

The content of an EIR will depend on the individual project, the complexity of the project and the specific asset and organisational requirements. Project teams should establish information requirements using the defined AIR prior to engaging with suppliers. The EIR does not need to be complicated. It should clearly and concisely communicate your BIM requirements.

Once information requirements have been established, the EIR should clearly state who is responsible for providing the information and, in what format, i.e. documents, model files and structured data (COBie or other information and data exchange templates).

The EIR should also state the timings and format for data exchanges (*see* Chapter 5).

At the broadest level, the EIR should include the following.

- Standard methods and procedures – how information is created, naming conventions and exchange of data.
- Roles and responsibilities – relating to information management.
- Information delivery plan (IDP)/schedule for data drops – outlining when information is to be provided, by whom and in what format.
- Information and data exchange requirements – such as COBie or a bespoke template. These should let the supplier know what structured data is required, who it should be provided by and, when.

The requirements of an EIR (at BIM Stage 2) are categorised as follows.

Information management

- Level Of Information Need (previously the level of model definition; LOD/LOI) – see Historic England (2017) and the Glossary for more information.
- Training requirements – training may be required regarding the use of BIM software, such as CDE software/programs.
- Planning of work and data segregation – such as file naming conventions/protocols (*see* Chapter 4).
- Coordination and clash detection – what model checks are required and who is responsible?

- Collaboration process – outline processes in the BIM execution plan (BEP), CDEs, project meetings, etc.
- Compliance plan – bidders' proposals for the management of the coordination process should be provided within the BEP.
- Health and safety/CDM regulations – CDM responsibilities and specific health and safety information requirements.
- A schedule of security and integrity requirements – organisation-specific security requirements.
- A schedule of any specific information to be included or excluded from information models.
- A schedule of constraints set by the appointing party on the size of model files, the size of extranet uploads or emails, or the file formats that can define the size of a volume.
- A definition of any 3D co-ordinate origin/system – required by the appointing party to place geometrical models according to real world co-ordinates.
- A schedule of any software formats including version numbers – to be used by the organisations or individuals in the supply chain to deliver the project.

Commercial management

- Exchange of information – alignment of information exchanges, work/project stages, purpose and required formats.
- Expected purpose – details of the expected purposes for information provided in the models.
- Responsibility/assignment matrix – setting out discipline responsibilities for model or information production in line with the defined project stages.
- Standards and guidance documents – a schedule of documents used to define BIM processes and protocols to be used on the project.
- A schedule of any changes to the standard roles, responsibilities, authorities and competences set out in the contract.

Competence assessment

- Details of the competence assessment that bidders must respond to – such as BIM certification, experience, pre-contract BEPs and example models.
- Changes to associated tender documentation.
- BIM tender assessment details – detail how BIM competency will be assessed and the process recorded.

The above schedule provides an initial reference point for the items that you might include in your EIR. Some, or all, of the points may be applicable to your own project; however you should aim to make your EIR as concise as possible, and if an item in this schedule is not applicable to your own project then you do not need to include it.

6.2 Who should be involved?

The EIR should be completed as early as possible, pre-contract and prior to any appointment. It may be created inhouse or by an external consultant.

If an external consultant is appointed, time should be taken to discuss and clarify any organisational, asset and project requirements so that the consultant gains a full understanding of what you require. The consultant should have experience of developing EIRs and should have an understanding of the heritage and conservation sector and heritage asset management.

As discussed in earlier chapters, heritage organisations may have different or specific information requirements that should be understood by the consultant or individual preparing the EIR. The EIR should define what the organisation's requirements for the model are and how they will use it. In a heritage context, the model may only be used for planning, visualisation and engagement. In these situations, it may not be worth adding a huge amount of data to the model as it simply will not be used; however, a high level of geometrical detail might be important. Such cases may be referred to as BIM-ready models.

If an organisation wants to use data for on-going heritage asset management then the level of data and information added to a model, and the information and data exchange template as a deliverable of the project, will be extremely important. In this case, the level of geometrical detail of the model may be of less importance. Internal asset management teams, or consultants with experience of heritage asset management and conservation maintenance projects, will be best placed to advise on this.

6.3 Appointed party response to the EIR

Appointed parties will respond to the developed EIR within their tender submission by including a BEP. This should directly respond to the EIR, in the same layout and using reference numbers.

The appointing party may request responses to only some parts of the EIR in the pre-contract BEP. This should be made clear within the document.

The BEP (pre- and post-contract) should include the following.

- Specific response to the EIR, with cross-referencing.
- Specific response to the IDP, including confirmation of ability to deliver the information requirements, in the requested format and to the specified level of information need, or, where delivery is impractical, alternative delivery proposals.
- Project goals for collaboration and information modelling and management.
- Major project milestones consistent with the project programme and IDP.

A compliant BEP in support of a project tender will demonstrate how each section of the EIR and IDP will be met. The BEP and its response to the EIR will form part of the tender scoring process and subsequent supplier selection.

7 Understanding Parametric Modelling

So far this guidance has focused on the BIM IMP, in particular the goal of producing an AIM to be used for heritage asset management and in the planning and delivery of CRM. There has been little emphasis on the 3D modelling aspects of BIM. In adopting a BIM approach for the management of historic building data, it is suggested that 3D models might be desirable but they are not a necessity.

3D data capture through laser scanning and photogrammetry has been shown to be effective in the digital documentation of historic assets, and resultant point clouds are useful as visualisation and engagement tools and as an aide to creating a 3D model in computer-aided design/ drafting (CAD) software (*see* https://historicengland.org.uk/images-books/publications/3d-laser-scanning-heritage/ & https://historicengland.org.uk/images-books/publications/historic-building-survey-in-cad/).

Figure 20:
Laser scan point cloud for The Ironbridge captured in 2012

3D CAD models are a useful addition to heritage projects, allowing the visualisation of conservation interventions, but the key factor that makes models for BIM different to standard 3D CAD models is the parametric modelling element.

Parametric modelling uses pre-programmed rules or algorithms (known as data parameters) within the digital model. Parametric rules create relationships between different elements of the design. The same algorithm might be used throughout a **model** so that, if a particular **element** or rule is changed, it changes throughout the **model**. In effect the **model** is a representation of all the rules that the user has defined. For further information, *see* https://www.designingbuildings.co.uk/wiki/Parametric_modelling.

While this is particularly useful in the design phases of conservation intervention, the addition of bespoke conservation data parameters to the model, such as element condition, significance and urgency of repair/maintenance, can be used as a visual planning tool within the model and is particularly useful for analysing and interrogating data for CRM planning (Figure 21). Furthermore, this data can be extracted in a structured format to be added to the digital AIM, or imported into existing property management systems, offering a single source of validated data to support asset management activities.

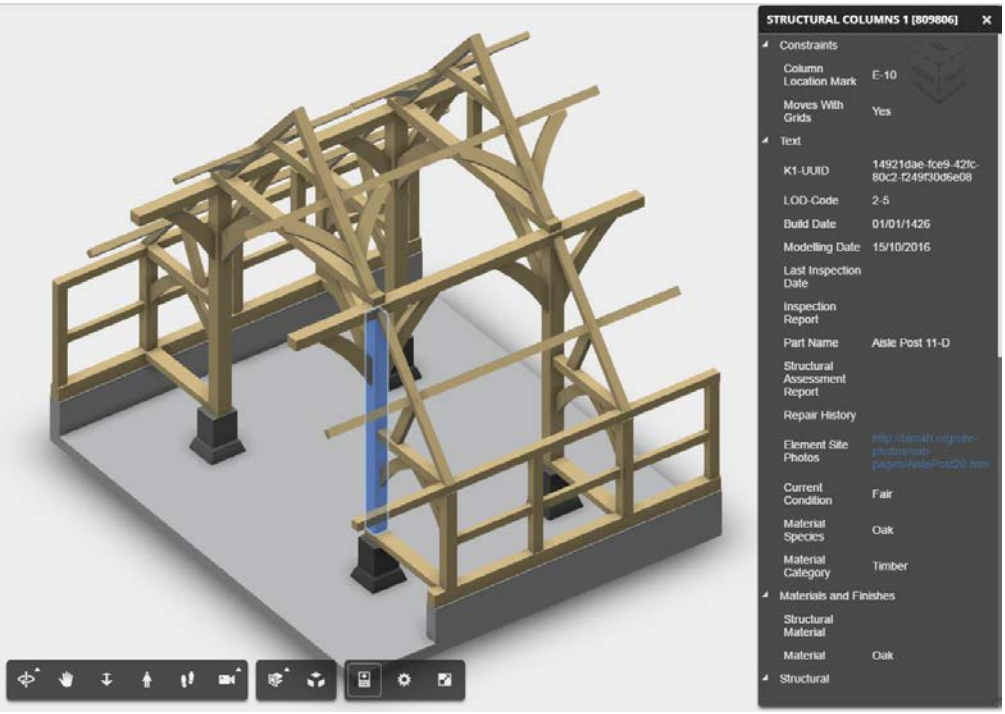


Figure 21:
BIM model for Harmondsworth Barn highlighting historic object parameters

To date there has been no guidance on establishing conservation-specific data parameters for Historic BIM. While Historic BIM research has considered parametric modelling and associated data parameters with regard to the creation of historic architectural library objects, research identifying and formalising data parameters for on-going CRM of an asset is limited. Example conservation data parameters are provided in the heritage information requirements template HIR_AIR_V1 (Historic England 2019b).

In a heritage context, while the time and cost of full 3D parametric modelling might not be justifiable, the use of conservation data parameters to structure building data within spreadsheets and databases is good practice and still aligns with a BIM IMP.

8 Where to find out more

A wealth of information on BIM, providing advice and guidance about adopting BIM in heritage projects, as well as free software and tools, can be found online and within books and journals, via organisations and special interest groups. Although not necessarily specific to heritage (other than the BIM4Heritage website, *see* section 6.2.2), a lot of the information found in the following resources can be applied to cultural heritage and conservation projects adopting BIM-enabled workflows.

8.1 Standards and guidance

8.1.1 Architectural, Engineering and Construction (AEC) Industry (UK) Initiative

The AEC (UK) Initiative offers practical guidance for the adoption of BIM standards in the form of the *AEC (UK) BIM Technology Protocol* (AEC (UK) 2015), with additional documents available for the most widely used BIM software. These are all available to download as free PDF files.
https://aecuk.wordpress.com/documents/

8.1.2 British Standards Institution (BSI) BIM Level 2

A series of British standards (BS) and publicly available specifications (PAS) has been developed to help the construction industry adopt BIM Level 2. Although not specific to Historic BIM, these documents are an essential point of reference for professionals and clients implementing BIM in the heritage sector. The webpages provide information, guidance, standards and online tools. The documents can be downloaded for free. A full glossary of BIM acronyms and terms is also available.
http://bim-level2.org/
http://bim-level2.org/en/standards/

8.1.3 Historic England (HE)

For guidance and a detailed specification on the use of recording techniques, the latest edition of Historic England's *Metric Survey Specifications for Cultural Heritage* (Andrews *et al* 2015) contains a short section on acquiring BIM-ready datasets. Also available from Historic England are technical guidance documents on a range of survey and recording techniques for cultural heritage. These documents are available

to download for free as PDFs or printed copies can be purchased.
https://historicengland.org.uk/advice/technical-advice/recording-heritage/

https://historicengland.org.uk/research/approaches/research-methods/terrestrial-remote-sensing/specialist-survey-techniques/

8.1.4 National Building Specification (NBS)

Guidance on the creation of BIM objects in the form of the NBS Object Standard is available on the NBS website. Also available are online resources providing free guidance, tools, plug-ins, standards, and more. The NBS BIM Toolkit provides step-by-step help to define, manage and verify responsibility for information development and delivery at each stage of the asset life cycle. It is a free tool developed to assist the UK construction industry achieve BIM Level 2. The NBS National BIM Library is an ever-expanding repository of BIM objects, available for download in proprietary or IFC format, all compliant with the NBS Object Standard. The website also provides information on COBie and the Uniclass 2015 classification scheme.
https://www.thenbs.com

https://www.thenbs.com/about-nbs/introducing-nbs

https://www.thenbs.com/services/our-tools/nbs-bim-object-standard

https://toolkit.thenbs.com/

https://toolkit.thenbs.com/articles/classification#classificationtables

https://www.nationalbimlibrary.com/

https://www.nationalbimlibrary.com/about-bim-objects

https://www.thenbs.com/knowledge/bim-mapping-out-the-legal-issues

8.2 Organisations and special interest groups

8.2.1 Archaeology Data Service (ADS)

The ADS promotes good practice in the use of digital data in archaeology, provides technical advice to the research community and supports the deployment of digital technologies.
http://archaeologydataservice.ac.uk/

8.2.2 BIM4Heritage

BIM4Heritage is a special interest group established within BIM4Communities to champion BIM within the historic environment. The group is formed by various specialists, for example from within the AEC industry, conservation, heritage organisations, academic departments and end-users. The vision of the BIM4Heritage group is to provide a forum for organisations and industry professionals to share knowledge and lessons learnt on BIM applied to historic structures. Its webpages provide papers on and technical standards for the application of BIM within the field

of heritage, as well as information and updates on the activities of the BIM4Heritage special interest group (operating within BIM4Communities).
http://bim4heritage.org

8.2.3 BuildingSMART

BuildingSMART is an international authority on open BIM and IFC standards.
http://buildingsmart.org/

8.2.4 Construction Industry Council (CIC)

The CIC provides a forum for organisations within the construction industry.
http://cic.org.uk/

8.2.5 Construction Project Information Committee (CPIC)

The CPIC provides a BEP template that can be downloaded.
http://www.cpic.org.uk/cpix/cpix-bim-execution-plan/

www.cpic.org.uk/cpix/

8.2.6 Council on Training in Architectural Conservation (COTAC)

COTAC works to raise standards, develop training qualifications and build networks across the UK's conservation, repair and maintenance (CRM) sector, currently estimated to represent more than 40% of all construction industry activities. Following a number of conferences on the theme, in 2014 COTAC initiated an ad-hoc BIM4Conservation group that was integrated with the BIM4Heritage group in 2016. Various online conference reports, presentations and publications on the subject of Historic BIM are available on the COTAC website.
https://cotac.global/

Past Caring? BIM and the Refurbishment of Older Buildings (2012)
https://cotac.global/conferences/conf12/

Integrating Digital Technologies in Support of Historic Building Information Modelling: BIM4Conservation (HBIM) (2014)
https://cotac.global/resources/COTAC-HBIM-Report-Final-A-21-April-2014-2-small.pdf

Fire and Flood in the Built Environment: Keeping the Threat at Bay (2015)
https://cotac.global/resources/BIM4C+Disaster-Fire-Pt1.pdf

COTAC BIM4C Integrating HBIM Framework Report Part 1: Conservation Parameters (2016)
https://cotac.global/resources/HBIM-Framework-Part-1-February-2016.pdf

COTAC BIM4C Integrating HBIM Framework Report Part 2: Conservation Influences (2016)
https://cotac.global/resources/HBIM-Framework-Part-2-February-2016.pdf

COTAC BIM4C integrating HBIM Framework Report Bibliography: Version 1 (as at 26 July 2016)
https://cotac.global/resources/HBIM-Framework-Bibliography-Ver-1-26-July-2016.pdf

BIM4Heritage: Where We Are and Where We Are Going (2017)
https://cotac.global/resources/BIM4H-Conf-Report-Final-22-March-2017.pdf

8.2.7 Historic Environment Scotland (HES)

HES is a public body that provides advice and guidance relating to heritage management.
https://www.historicenvironment.scot/

8.2.8 Royal Institute of British Architects (RIBA)

RIBA provides professional standards and support for its members.
https://www.architecture.com/

8.2.9 Royal Institute of Chartered Surveyors (RICS)

The RICS provides guidance and training schemes, including BIM manager certification.
https://www.rics.org/uk/

8.2.10 Chartered Institute of Architectural Technologists (CIAT)

CIAT is a global membership qualifying body for architectural technology and represents those practising and studying within the discipline and profession.
https://ciat.org.uk/

8.2.11 Survey4BIM

Survey4BIM is a cross-industry group open to all organisations involved in the survey, collection, management, processing and delivery of geospatial information within a BIM context. It is supported by the BIM Task Group.
https://survey4bim.wordpress.com/

8.3 Publications

8.3.1 Books

At the time of writing, only one book dedicated to the subject of Historic BIM has been published.

Arayici, Y, Counsell, J, Mahdjoubi, L, Nagy, G A, Hawas, S and Dweidar, K 2017 *Heritage Building Information Modelling*. London: Routledge

However, the following books are also relevant to the use of BIM technology in the field of cultural heritage.

Aubin, P and Milburn, A 2013 *Renaissance Revit: Creating Classical Architecture with Modern Software*. Oak Lawn, IL: G3B Press

Eastman, C 2011 *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors*, 2 edn. Hoboken, NJ: John Wiley & Sons Inc

Holzer, D 2016 *The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering and Construction*. Hoboken, NJ: John Wiley & Sons Inc

Klaschka, R 2014 *BIM in Small Practices: Illustrated Case Studies*. London: RIBA Enterprises

Klemisch, J 2011 *Maintenance of Historic Buildings: A Practical Handbook*. Shaftesbury: Donhead Publications

Mordue, S, Swaddle, P and Philp, D 2016 *Building Information Modeling for Dummies*. Chichester: John Wiley and Sons Inc

Osello, A and Rinaudo, F 2016 'Cultural heritage management tools: the role of GIS and BIM, in Stylianidis, E and Remondino, F (eds) *3D Recording, Documentation and Management in Cultural Heritage*. Dunbeath: Whittles Publishing

8.3.2 Journals and conference proceedings

Providing a complete list of peer-reviewed academic research papers on the subject of BIM, even one limited to Historic BIM, is outside the scope of this document. However the following publications contain content relevant to Historic BIM:

AEC Magazine
http://www.aecmag.com/

Automation in Construction
https://www.journals.elsevier.com/automation-in-construction/

BIM Journal
http://www.bimjournal.com/

Civil Engineering Surveyor
http://ces.pagelizard.co.uk/magazine

International Journal of 3-D Information Modeling (IJ3DIM)
http://www.irma-international.org/journal/international-journal-information-modeling/41967/

International Journal of Architectural Computing
http://www.architecturalcomputing.org/

Journal of Information Technology in Construction (ITcon)
http://www.itcon.org/

The Structural Engineer
https://www.istructe.org/thestructuralengineer/

8.4 Further online resources

8.4.1 B1M

Although not specific to heritage, B1M is an online library of videos explaining various topics around BIM.
http://www.theb1m.com/

8.4.2 BIM Dictionary

The BIM Dictionary is a free online resource providing definitions of hundreds of BIM terms and abbreviations.
http://bimdictionary.com/#

8.4.3 Digital Built Britain

Digital Built Britain provides further information on BIM Level 3.
http://www.digital-built-britain.com/

8.4.4 OpenBIM

OpenBIM provides the xBIM toolkit.
http://www.openbim.org/

9 Acronyms and Glossary

2D Two dimensional representation using coordinate values relative to the X and Y axes

3D Three dimensional representation using coordinate values relative to the X, Y and Z axes

4D Three dimensional representation using coordinate values relative to the X, Y and Z axes with the inclusion of time-related information

AEC Architecture, Engineering & Construction

AECO Architecture, Engineering, Construction & Operations (industry)

AIM Asset Information Model, refers specifically to the information model used to manage, maintain and operate an asset

AIR Asset Information Requirements, define the information required at project handover stage to enable the safe and effective operation of the asset

Asset Item of property owned by a person or company

BAS Building Automation System

BEP BIM Execution Plan defines the strategy for project delivery using BIM

BIM Building Information Modelling, a collaborative process for the production and management of structured electronic information and illustrating, in digital terms, all the elements that compose a building

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

BSI British Standards Institution, the independent national body responsible for preparing British Standards and other standards-related publications, information and services

CAD Computer-Aided Drawing/Design, used to describe graphics packages used primarily in engineering and design. As these disciplines require a high degree of precision, they are also ideal for survey applications

CAFM Computer-Aided Facility Management, the support of facility management by information technology to track, manage, report, and plan facilities operations

CAPEX Capital Expenditure, one-off expenditure that results in the acquisition, construction or enhancement of fixed assets including land, buildings and equipment

CDE Common Data Environment, the framework used to support interdisciplinary collaboration through BIM that specifies a single source of information for the project, used to collect, manage and disseminate project information through strictly controlled processes

CIC Construction Industry Council, the representative forum for the professional bodies, research organisations and specialist business associations in the construction industry

Clash detection Identification, inspection and reporting of interferences in a 3D project model

Cloud based Applications, services or resources made available on demand via the Internet from a cloud computing provider's servers

CMMS Computerised Maintenance Management System

COBie Construction Operations Building information exchange, a data-exchange format that supports the exchange of information about new and existing buildings and infrastructure throughout their life cycle

COTAC Council on Training in Architectural Conservation, a UK-registered charity that aims to improve the standard of education for all those involved in the protection, preservation, and sustainability of the historic environment

CRM Conservation, Repair & Maintenance (sector)

Data Parameters / Conservation data parameters Data parameters are the key pieces of information that are added to objects within the BIM model. These pieces of data can then be exported from the model in a structured format (using COBie or other data exchange template) and transferred into existing managements systems such as computer aided facilities management systems (CAFM) or asset management databases

Deliverables Goods or services that will be provided upon completion of a project

EIR Exchange Information Requirements, pre-tender document setting out the information requirements in relation to an appointment

Enterprise system Asset management, computer-aided facility management (CAFM), geographical information systems (GIS), databases and archives used to manage information about an asset/estate

Federated models An assembly of the discipline-specific models that contain 3D geometric and non-graphical data and associated documentation

File Store A digital folder containing documents

Gateway decision A key decision point in a design and construction project

Geometrical 3D models, 2D drawings and photographs

GIS Geographical Information System, a system comprising a spatially referenced computer database and application software for capturing, storing, checking, integrating, analysing and displaying data that are spatially referenced to Earth

H-AIM Heritage Asset Information Model

HBIM Historic Building Information Modelling

H&S Health & Safety, the laws, rules, and principles intended to keep people safe from injury or disease at work and in public places

IDP Information Delivery Process

IFC Industry Foundation Class, an object-based open standard for the exchange of BIM information between different software. Developed by 'buildingSMART', a global alliance specialising in open standards for BIM, IFC is an official standard, BS ISO 16739, and contains geometric as well as other data

IMP Information Management Process, the process developed and used to manage your information and data throughout the BIM process

Information container The term used within a BIM process and within BIM software to describe a virtual information store within which project information, models, files and documents are kept.

Intangible assets Identifiable non-monetary assets, such as heritage values and significance, that cannot be seen, touched or physically measured and are created through time and effort

Intelligent and integrated AIM Relates to the IT system. Information and data in the AIM should reference each other and multiple systems that comprise the AIM should be linked

Intellectual property Creative work which can be treated as an asset or physical property

ISO International Organisation for Standardisation

Laser scanning An active, fast and automatic acquisition technique using laser light for non-contact measurement of 3D coordinates of points on surfaces in a dense regular pattern

Legacy information Information already available on a historic asset which may exist in paper or electronic format, on-site or dispersed in several off-site locations and potentially under intellectual property or security restrictions

Lifecycle BIM BIM processes relating to the operational and maintenance phases of building's lifecycle

LOD Level Of Detail, how much geometric detail is included in BIM components and refers only to the appearance of the object geometry not the amount of associated information. Now referred to as level of information need

LOI Level Of Information, the description of non-graphical content of models at each of the stages defined for example in the CIC Scope of Services. Now referred to as level of information need

M&E Mechanical and Electrical, refers to systems that include infrastructure, plant and machinery, heating, plumbing and ventilation

Metadata Data that describes other data and facilitates the re-use and long-term preservation of 3D survey datasets

NBS National Building Specification

Non-geometrical Structured building data, databases and documentation

O&M Operation and maintenance, the daily activities and services needed to ensure an asset performs to its intended function

OIR Organisational Information Requirements establish and categorise the information requirements to meet the needs of an organisations asset management system

Operational stage/phase The final stage in an assets development when the BIM data is used to manage all the information related to the operation and maintenance of the asset

OPEX Operational Expenditure, revenue expenditure incurred as a result of the day-to-day operations of an asset

Parametric modelling The creation of a digital model based on a series of pre-programmed rules so that changes in design will automatically update the assembly and its components

Parametric objects Objects created using geometric definitions, associated data and rules that define their behaviour, how they interact with other objects or respond to changes in their parameters

PAS Publicly Available Specification

PDF Portable Document Format, a file format used to present and exchange documents reliably, independent of software, hardware or operating system

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

PIM Project Information Model developed during the design and construction phase of a project which often forms the basis of the asset information model

PIR Project Information Requirements

Point cloud A collection of XYZ coordinates in a common co-ordinate system, that may also include additional information such as an intensity or RGB value, that portrays to the viewer an understanding of the spatial distribution of the surface of a subject

Project BIM BIM processes relating to the design and construction phases of a project

Schedule Listing of information in tabular format

SCADA Supervisory Control and Data Acquisition

Tangible assets Physical attributes that are quantifiable, measurable and factual

Unified system A unified IT system should look like one system to the user but might actually comprise multiple databases with one front end

Validated data Reviewed and approved as ‘up to date’ data

WIP Work In Progress

10 References

BSI 2008 PAS 55-1:2008 Asset Management Part 1: Specification for the Optimized Management of Physical Assets. London: British Standards Institute (BSI).
https://www.britishstandard.org.uk/pub/pas-55-12008--asset-management.-specification-for-the-optimized-management-of-physical-assets--9780580509759.aspx#

BSI 2014 PAS 1192-3:2014 Specification for Information Management for the Operational Phase of Assets using Building Information Modelling (BIM). on: British Standards Institute (BSI).
http://bim-level2.org/en/standards/ https://shop.bsigroup.com/ProductDetail/?pid=000000000030311237

BSI 2019a BS EN ISO19650-1:2018 and PD19650-0:2019 Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling (BIM). Information Management using Building Information Modelling. Concepts and principles. London: British Standards Institute (BSI).
https://shop.bsigroup.com/ProductDetail?pid=000000000030389652

BSI 2019b BS EN ISO 19650-2:2018 Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling (BIM). Information Management using Building Information Modelling. Delivery Phase of the Assets. London: British Standards Institute (BSI).
https://shop.bsigroup.com/ProductDetail?pid=000000000030333757

Cabinet Office 2011 Government Construction Strategy. London: Cabinet Office.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/61152/Government-Construction-Strategy_0.pdf

COTAC 2017, BIM4Heritage Conference Report 2017. Council on Training in Architectural Conservation (COTAC)
https://cotac.global/resources/BIM4H-Conf-Report-Final-22-March-2017.pdf

English Heritage Science Strategy, English Heritage 2013
https://historicengland.org.uk/images-books/publications/ehss/ehss/

English Heritage 2017 2016/17 Annual Report
https://www.english-heritage.org.uk/siteassets/home/about-us/annual-reports/eht_annual_report_2016-17.pdf

The Institute for Asset Management 2015. What is Asset Management?
https://theiam.org/knowledge/introduction/what-is-asset-management/

English Heritage and FISH 2012 MIDAS Heritage – The UK Historic Environment Data Standard, v1.1. London: English Heritage.
https://historicengland.org.uk/images-books/publications/midas-heritage/.

Historic England 2017 BIM for Heritage: Developing a Historic Building Information Model. Swindon. Historic England.
https://historicengland.org.uk/images-books/publications/bim-for-heritage/

Historic England 2017 Heritage Counts. Swindon: Historic England.
https://historicengland.org.uk/research/heritage-counts/

Historic England and NPS Group 2015 Inclusion of Heritage in Asset Management Plans. Swindon: Historic England.
https://historicengland.org.uk/images-books/publications/inclusion-heritage-asset-management-plans/

Historic England 2019a Organisational Information Requirements (OIR) – Heritage (HIR_OIR_V1). Swindon: Historic England.

Historic England 2019b Asset Information Requirements (AIR) – Heritage (HIR_AIR_V1) . Swindon: Historic England.

Historic England 2019c Exchange Information Requirements (EIR) – Heritage (HIR_EIR_V1). Swindon: Historic England.

Historic Environment Scotland Asset Management Plan.
https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationid=bb46bde1-518e-4590-8fca-a882010e711f

ISO 2001 IEC 82045-1:2001 Document Management – Part 1: Principles and Methods. Geneva: International Organization for Standardization (ISO)
https://www.iso.org/standard/34159.html

ISO 2015 **ISO 12006-2:2015** Building Construction – Organization of Information about Construction Works –Part 2: Framework for Classification. Geneva: International Organization for Standardization (ISO)
https://www.iso.org/obp/ui/#iso:std:iso:12006:-2:ed-2:v1:en

ISO 2018a ISO 19650-1:2018 Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling – Information Management Using Building Information Modelling: Concepts and Principles. Geneva: ISO
https://www.iso.org/standard/68078.html

ISO 2018b ISO 19650-2:2018 Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling – Information Management Using Building Information Modelling: Delivery Phase of the Assets. Geneva: ISO
https://www.iso.org/standard/68080.html

National Trust Annual Report 2016-2017
https://nt.global.ssl.fastly.net/documents/annual-report-201617.pdf

RICS 2012 New Rules of Measurement NRM 1: Order of Cost Estimating and Cost Planning for Capital Building Works, 2nd edition. Coventry: Royal Institution of Chartered Surveyors (RICS).
https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/sector-standards/construction/nrm-1-order-of-cost-estimating-and-cost-planning-2nd-edition-rics.pdf

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