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COTAC BIM4C
Integrating HBIM
Framework
Report Part 1:
Conservation
Parameters

COTAC Study 3
Edited by Ingval Maxwell OBE



COTAC BIM4C Integrating HBIM Framework Report

Part 1: Conservation Parameters

The 'Council on Training in Architectural Conservation'

Established in 1959 as the 'Conference on Training in Architectural Conservation' COTAC's founding principle was its recognition of the need for specialists to properly specify and oversee work involved in repairing and conserving historic buildings and churches. At the time, this ground-breaking approach occurred when industry and professional training and education in modernism, concrete and brutalism prevailed, and the knowledge of traditional building technologies was fast disappearing. Over the years COTAC has successfully, persistently and influentially worked to lift standards, develop training qualifications and build networks across the conservation, repair and maintenance (CRM) sector, estimated (in 2014) at 42% of all construction industry activities. This has involved national agencies, professional and standard setting bodies, educational establishments and training interests.

In its new guise, the 'Council on Training in Architectural Conservation' was re-established as a Charitable Incorporated Organisation in July 2015, where COTAC's 21st century role is no less critical than that of its past. New technologies, including aspirations to low carbon retrofit, demanded energy efficiencies and emerging digital innovations, can too easily obscure the need for a core understanding of traditional materials and how to approach historic structures with a finely honed set of skills. This report aims to address an imbalance in the understanding of these essential areas within the emergence of Building Information Modelling (BIM). In doing so, COTAC enabled a *BIM4Conservation* (BIM4C) Group in 2015 with the remit of raising awareness and understanding of BIM within the conservation and heritage sector of the built environment, and to link with other BIM4 Communities in advancing knowledge and influencing understanding of conservation needs within the broader context of the BIM industry sector.

This Report, presented in two parts with a supporting selective bibliography, offers some considerations that might be taken into account as the awareness of the particular needs of BIM4C gain ground. Through that development it is hoped that an appreciation of the differences in approach required by Historic Building Information Modelling will emerge. Whilst every care has been taken on the preparation of this publication COTAC and its Editor specifically excludes any liability for errors, omissions or otherwise arising from its contents. Readers must satisfy themselves as to the described principles and practices.

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COTAC BIM4C Integrating HBIM Framework Report

Part 1: Conservation Parameters

Abstract

It is generally recognised that the built heritage is under threat from a variety of influences - including a lack of knowledge by the professions, and from a lack of understanding by the 'main-stream' construction industry. But what is 'main-stream' when the entire sector virtually operates in two equal halves? In the *Farrell Review* (April 2014: p71) it is remarked that:

Today, most architecture is subject to the design of components by others The trusses, cladding systems, windows and doors and the kitchens, wardrobes and bathroom elements all the way down to the door handles have already been "pre-designed", so what is it that the architect does? As Farrell Review Expert Panel member Sunand Prasad has said, the role of the architect today is increasingly about selecting, synthesising and integrating, and they are well placed to do this.

Whilst this may well be true in the de-rigueur of building anew from catalogued sources, it is far from the case in dealing with the existing built heritage - and especially so with that which was traditionally constructed prior to 1919 - where all the selecting, synthesising and integrating has already been pre-determined from a portfolio of parts and elements that are generally no longer available. The requirement here requires a different professional expertise and understanding. Resolving that matter will be at the heart of any successful HBIM developments as they might be applied to the existing built heritage. To do so will require a considerable effort given the scale, promotion and new-build bias of BIM developments that have already taken place. This Part 1 Report aims to integrate the standard understanding of BIM developments in the new-build industry with key aspects, guidance and principles that are common-place within the conservation, repair and maintenance sector of the construction industry, yet tend to go totally unrecognised in the new-build sector.



London DSC00395a: The Modern Urban Grain is complex, often subverting its historic pedigree. © Ingval Maxwell

COTAC BIM4C Integrating HBIM Framework Report

Part 1: Conservation Parameters

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COTAC BIM4C Integrating HBIM Framework Report: Part 1: Conservation Parameters

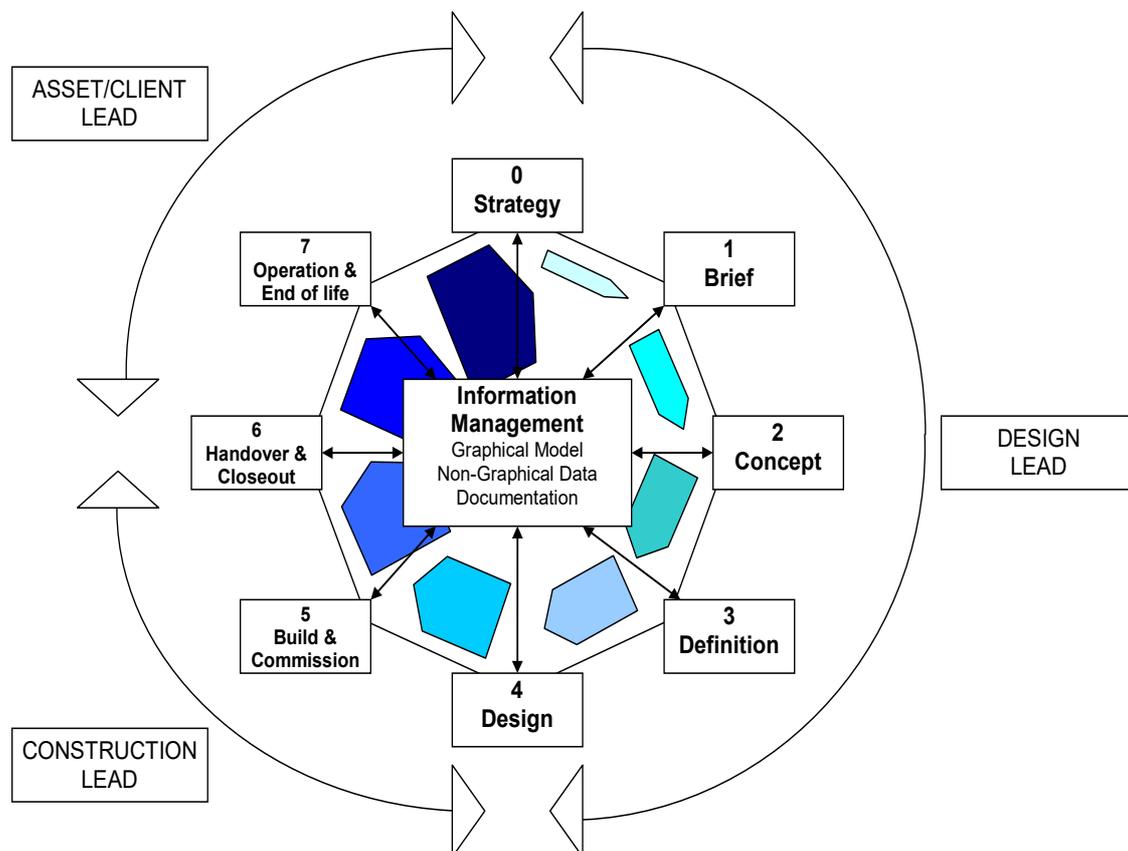
Proposed BIM4C HBIM Framework

Background

Following the COTAC *Digital Future for Traditional Buildings* Conference in November 2013, the now renamed *Council on Training in Architectural Conservation* (COTAC) produced a report entitled: *Integrating Digital Technologies in Support of Historic Building Information Modelling: BIM4Conservation (HBIM)* in April 2014 (Available to download from www.cotac.global as Study 1). This report concluded that there had been no serious work initiated to date in determining how BIM might be applied to the diverse conservation, repair and maintenance (CRM) work activities in the Conservation Sector of the UK's construction industry.

CIC BIM Cyclical Diagram

As the CRM Sector occasioned some 42% of all the UK's construction activities (in 2014), it seems likely that pressure will predictably continue to grow to address this discrepancy in the application of BIM. But BIM, in its current guise, and as outlined in the CIC BIM Cyclical Diagram below, does not readily fit with the needs of the CRM Sector, and a more specific adaptation, in the form of HBIM, will be necessary.



On the basis of analysing the COTAC Report-related 'Survey Monkey' questionnaire results (of March 2013), it was considered that standard BIM seemed less appropriate if a more specific version of HBIM emerged that better fitted the Conservation Sector requirements.



London + DSC00518b: Scale differentials and approach between the old and new can be overpowering. © Ingval Maxwell

The conflicting needs of new and old are readily apparent when comparing the visual impact of modern and traditional architecture. Whilst the former is more at ease with digital technologies in their making, the broad diversity of traditional building techniques in the later are less readily accommodated. Compounded by an established awareness in heritage sectors as to their value and significance, the added considerations of legislative concerns, historical importance and uniqueness causes the current impetus being given to Building Information Modelling in the new build arena to be questioned as to its relevance, without challenge or change in approach.

That said, it is clear that, under Government driven targets, increasingly greater degrees of pressure will mount in pursuing and promoting the BIM initiative into the heritage sector, and the emergence of Historic Building Information Modelling (HBIM) is all but inevitable.

COTAC HBIM Cyclical Diagram

The *Integrating Digital Technologies in Support of Historic Building Information Modelling: BIM4Conservation (HBIM)* report made an initial attempt at identifying what these more specific HBIM themes might be. Overlapping the CIC diagrammatic framework, the Report's Figure 5 determined that under Philosophical/Specialist/Conservator; Conservation Contractor and Specialist Support; and Asset/Client Leads, clustered around and feeding into

the core 'Information Management Graphical Model Non-Graphical Data Documentation' the eight steps might be sequenced as:

- 0 Identification of Asset Strategy
- 1 Research Legislation Preliminary Survey
- 2 Determining Options
- 3 Define Detailed Survey
- 4 Determining Intervention
- 5 Physical Intervention
- 6 Handover
- 7 Operation and Future

Maintaining a read across to the CIC BIM Diagram, during the Second COTAC BIM4C Meeting on 5 May 2015, these initial considerations were taken a stage further, as illustrated in the emerging HBIM Framework Diagram below:



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Integrating HBIM within the CIC Framework

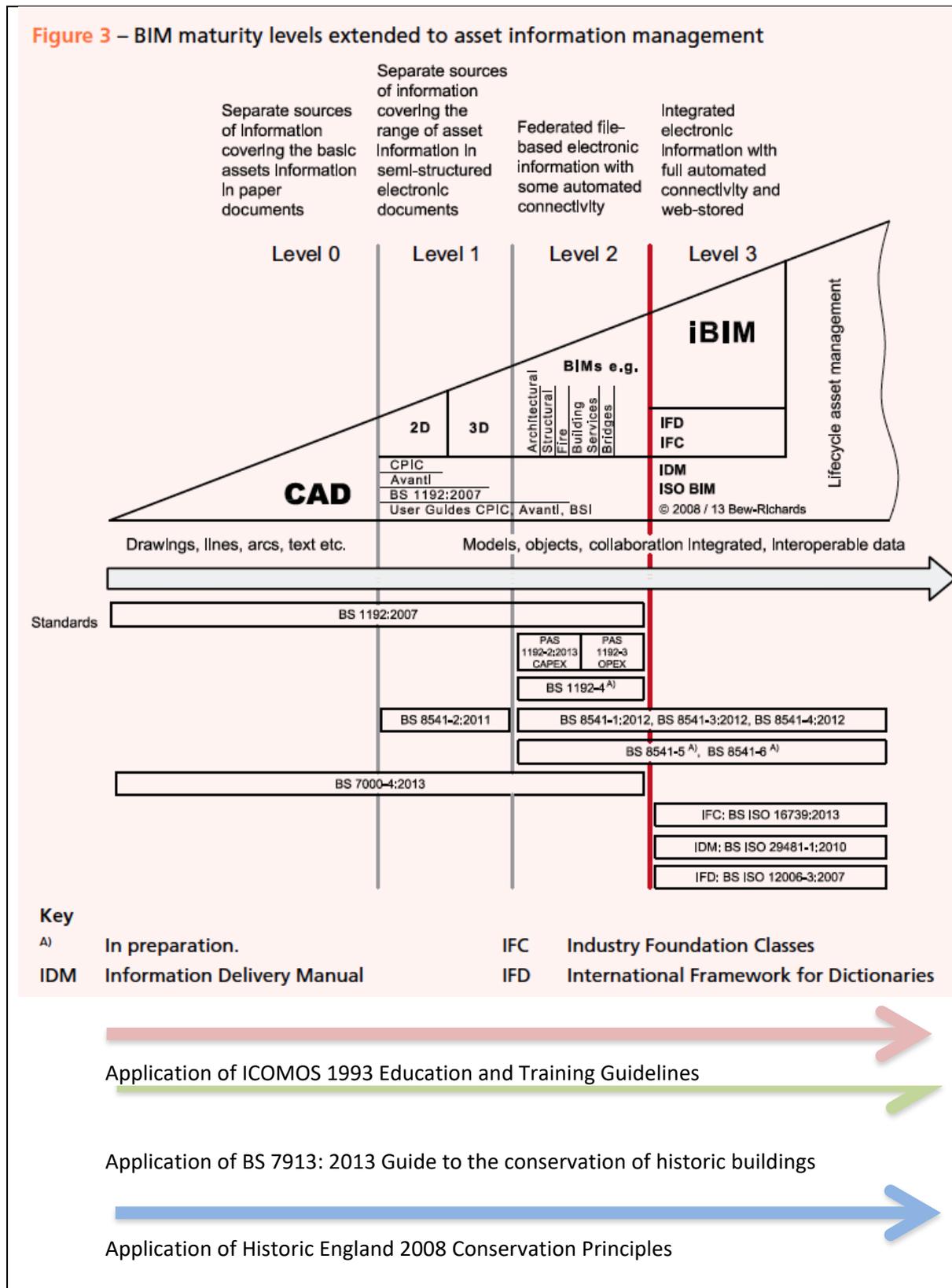
With a diverging change of emphasis, away from the BIM 'Design Lead' in the New-build sector, to that of understanding 'Conservation Philosophy' as the principle factor that underpins the relevant approaches to deal with existing historic and traditionally constructed buildings, a new set of values emerge in HBIM considerations. It is appreciated that there is also a need to relate to established central BIM considerations and that this can be achieved by refocusing the initial inner steps from 'Strategy, Brief, Concept, Definition and Design' to 'Asset Management Strategy, Researching Significance and Value, Determining Options, and Identifying Survey Needs (of what already exists), to Determining Interventions'.



Glasgow: DSCO1811 Requiring relevant technical and philosophical guidance, determining the appropriate degree and level of intervention can be challenging. © Ingal Maxwell

To render the BIM approach appropriate to the conservation sector, a close relationship with established criteria and operational activities is also essential. Two fundamental criteria emerge to assist in achieving this integration in the form of the internationally recognised 'ICOMOS Education and Training Guidelines' and 'BS7913: 2013 Guide to the conservation of historic buildings', as indicated in the overlapping directional arrows set in parallel with the Bews-Richards Wedge Diagram, as below.

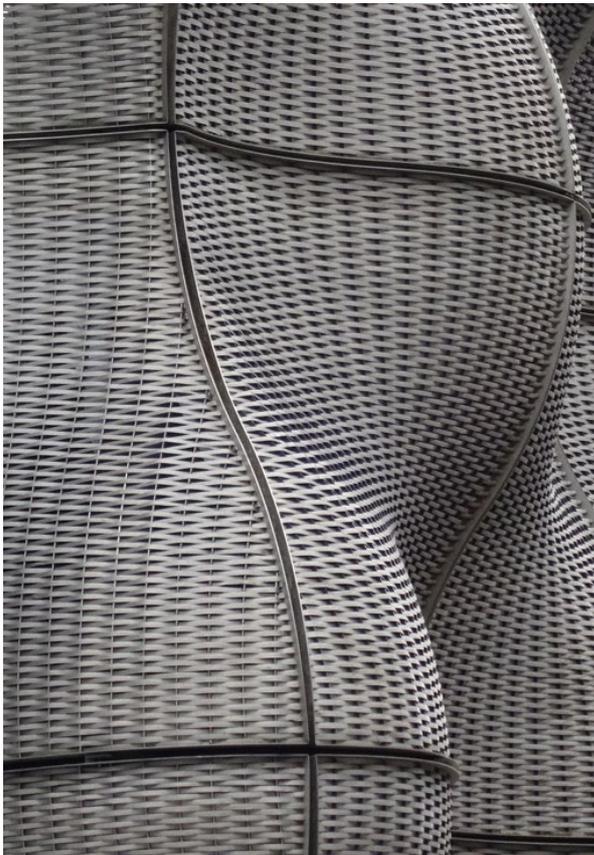
Bew-Richards BIM Maturity Levels with Added Key Conservation Influences



PAS 1192-3:2014 BIM Maturity Levels and their common New Build related Standards, with the outline additional application of the key ICOMOS Conservation Guidelines, BS7913: 2013, and Historic England Principles.

Extending such an approach, it should be possible to align current HBIM Conservation Case Study experiences. But, given the fundamental difference between dealing with an existing structure as opposed to building anew, it is anticipated that significant additions and adjustments will be required to be made to the guidance framework suggested by the BIM Maturity Levels Figure 3 of PAS 1192-3:2014 (Copied from: *PAS 1192-3:2014 Incorporating Corrigendum No. 1 Specification for information management for the operational phase of assets using building information modelling*)

Whilst a plethora of underpinning Standards are suggested as being relevant to bolster the Bew-Richards 2008 Maturity Levels Wedge Diagram, these tend to bias the new build perspective. From the conservation and CRM perspective many of these Standards do not have such a comfortable fit, as BS7913, and the illustrations below, ably reveal.



London and Avoncroft: Modern building textures often follow historic precedents where catalogued re-supply replacements never existed.
© Ingvál Maxwell

Consequently, there is a need to acknowledge the applicability of the relevance of the *ICOMOS Education and Training Guidelines*, the *BS 7913: 2013 Guide to the conservation of historic buildings*, and the *Historic England Conservation Principles* as equally germane standards and documentation to provide an offsetting balance that incorporates a better understanding of conservation philosophy, ethics and influences. In addition (but not dealt with here) the advice, guidance and direction offered by numerous international conservation charters and conventions might also be referred to and integrated.

Integration of the ICOMOS Education and Training Guidelines

The 1993 ICOMOS Guidelines (See Annex A) form the backbone of all post-graduate architectural conservation courses in the UK: all seven of the professional body Accreditation in Architectural Conservation Schemes (run by the RIBA [with the RSAW and RSUA], the RIAS, AABC, RIAI, RICS, CARE and CIAT; the www.understandingconservation.org on-line COTAC self learning course, and the annual RSUA Conservation Course delivered in Ulster. They are also recognised by the four Home Countries' official Heritage bodies.

As the supporting texts of the 14 listed Guidelines a) to n) indicate, such a multi-disciplinary read-across allows the integration of a wide variety of HBIM considerations into '*historic buildings, historic areas and towns, archaeological sites, and the contents therein, as well as historic and cultural landscapes*'. In addition, they also effect a related link to sustainable management issues, disaster preparedness, and education and training requirements, having stood the test of time in a positive and effective way. That said, it is recognised that the concepts and needs of caring for the built heritage have evolved since 1993, and are still evolving. With these developments has come the requirement for 'Capacity Building' in the CRM sector.



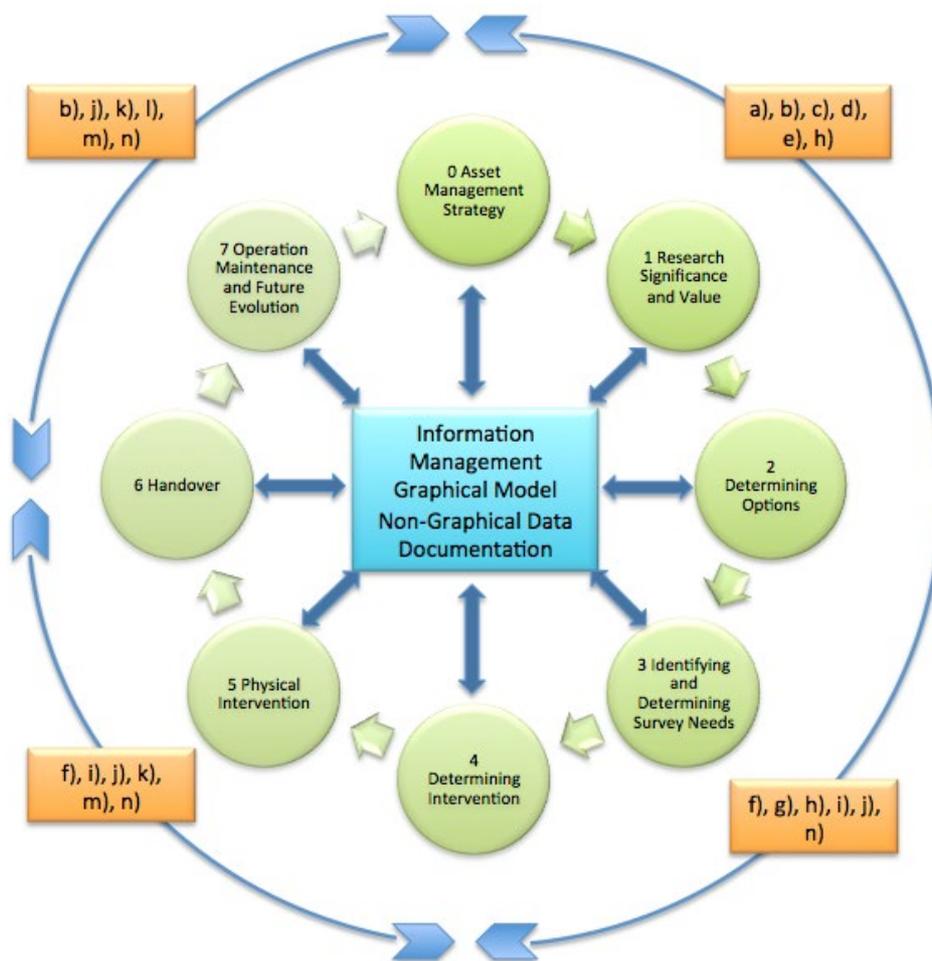
Leeds: DCSO6958 Adaptive reuse enhanced through the creation of an enclosed Atrium. © Ingal Maxwell

The ICOMOS International Training Committee (CIF) has been at the forefront of thinking here, and have recently drafted their '*Principles for Capacity Building through Education and*

Training in Safeguarding and Integrated Conservation of Cultural Heritage'. In doing so, the CIF document states:

The present (Aug 2013) document should be seen as a framework document providing overall guidance for the principles of Capacity-Building in the safeguarding and conservation of the cultural heritage. Additional documents could be attached providing a more in-depth guidance for specific types of heritage and target audiences, as well as for different types of Capacity-Building activities, or safeguarding and conservation actions. These principles extend but do not replace the ICOMOS-CIF 1993 Guidelines.

Consequently, the integrated of the 1993 ICOMOS Guidelines within the COTAC HBIM Cyclical Diagram enables a further effective BIM4C read-across and alignment with the initial CIC BIM Diagram.



Application of the ICOMOS Education and Training Guidelines

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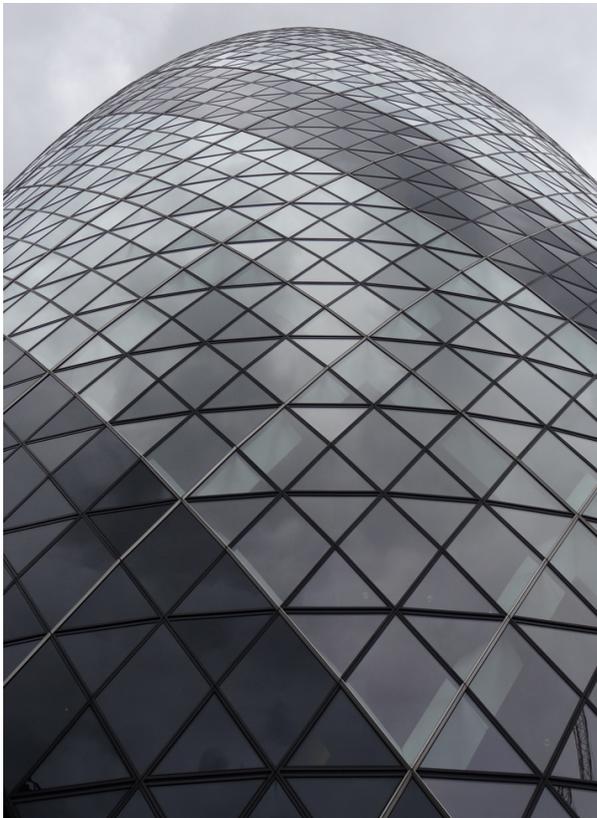
As illustrated by their groupings on the outer circle in the common HBIM Diagram above, the 14 ICOMOS Paragraph 5 requirements [a) through to n)] readily sit within the overall concept

and enhance its application to conservation activities. Recognition of this is a key aspect in future HBIM deliberations. Consequently, given their already widespread recognition and adoption, an easier integration of relevant HBIM thinking and developments within the architectural conservation sector of the professions and industry might be more productive than first thought.

Application of BS7913: 2013 *Guide to the conservation of historic buildings*

The Introduction to *BS7913: 2013* states:

The immediate objective of building conservation is to secure the protection of built heritage, in the long-term interest of society. Issues relating to building conservation are often complex and interwoven. The conservation of historic buildings requires judgement based on an understanding of principles informed by experience and knowledge to be exercised when decisions are made.



London and Durham: The required professional and industry competence and understanding in each case can be significantly different. © Ingal Maxwell

Importantly, it goes on to indicate that:

British Standards that are applicable to newer buildings might be inappropriate. The decision to conserve historic buildings can be justified on social, cultural, economic and/or environmental grounds, and usually a combination of these. Conflicting pressures often need to be balanced to assist good decision-making. Good conservation depends on a sound research evidence base and the use of competent advisors and contractors.

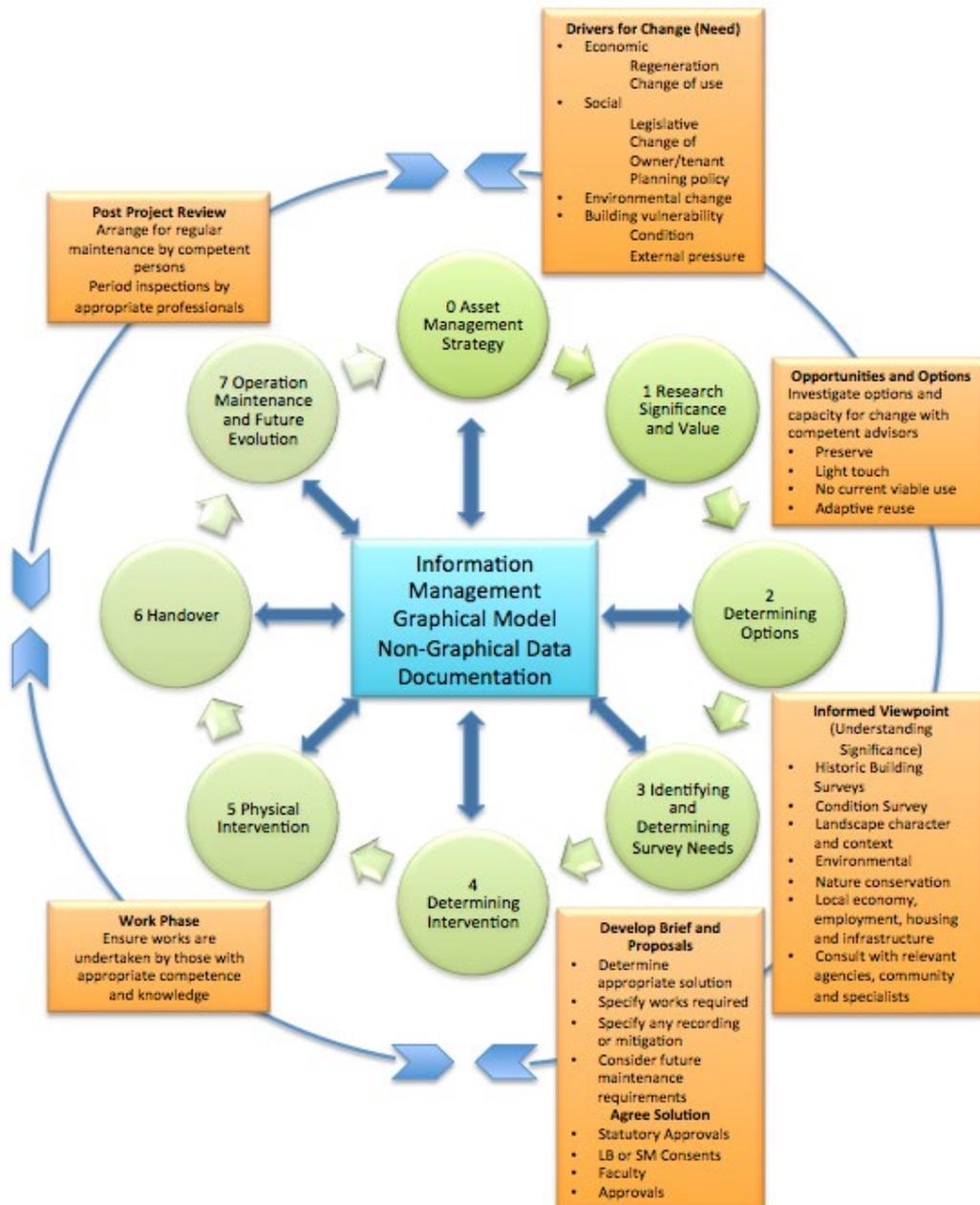
In describing best practice in management and treatment, the Standard is applicable to historic buildings with and without statutory protection. It also has an intended wide user audience as it:

... is intended for those who own, use, occupy and manage historic buildings, the professional team's contractors and others employed to work on their behalf, and can be used by decision makers and funders. It is intended to provide building owners, managers, archaeologists, architects, engineers, surveyors, contractors, conservators, planners, conservation officers and local authority building control officers with general background information on the principles of the conservation of historic buildings and sites, when setting conservation policy, management strategy and procedures.



London DSC00326 and Norwich IMG_2522: Insertion of services can be readily pre-planned in advance on a new-build, whilst a high degree of careful fabric disassembly will inevitably be required before service routes can even be established. © Ingvál Maxwell

With such a potentially broad based application, the Standard clearly could have a significant impact on the adoption of an appropriately determined HBIM approach. By way of example, and as the above illustrations reveal, planning the insertion of services within a new building that is in the course of construction can be readily accommodated in advance through the BIM initiative. But, a considerable degree of pre-investigation, intervention and careful consideration will be necessary before any services can be sensitively installed in a traditionally constructed building.



Application of BS7913: 2013 Conservation Process Flowchart

© Ingal Maxwell

To assist in the decision-making process, *BS7913: 2013* offers a cyclical procedural Flow Chart to illustrate the Conservation Process. As above, this is presented under the headings:

- Drivers for Change
- Informed Viewpoint
- Opportunities and Options
- Develop brief and Proposals
- Agree Solution
- Works Phases
- Post project review
- Arrange for Regular maintenance

Placing these headings within the context of the HBIM Cyclical Diagram below, an additional read-across emerges that, in part, expands upon the previously identified alignment of the 14 ICOMOS Education and Training Guidelines a) – n). Inevitably, a much greater degree of emphasis is put on initial four steps of the cycle to pre-determine the influences on, and establish the condition of the structure, and its details, before determining the level of intervention

Application of Historic England Conservation Principles Policies and Guidance: April 2008

English Heritage (now Historic England) set out its document in 2008 to provide a logical approach to decision-making and guidance about all aspects of the historic environment in England. The aim was to help ensure a consistency in approach whilst undertaking their role as the Government’s statutory advisor on the historic environment.



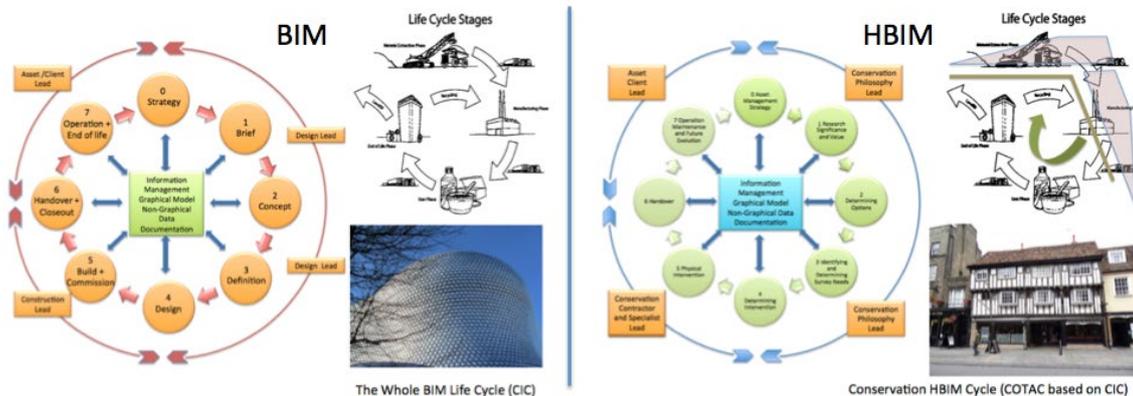
Application of Historic England Conservation Principles

© Ingval Maxwell

Although primarily developed to guide their staff activities, the organisation commended the adoption and application of the same Principles, Policies and Guidance to all involved with, and in making future decisions about, the historic environment. In the process Historic England adopted the term *'place'* for any part of the historic environment that can be acknowledged as having a distinct identity. As can be noted by the chart above, the Principles sit comfortably within the suggested approach of the HBIM Cyclical Diagram.

COTAC Annual Conferences and Reports

In taking an active approach in strategic terms to better integrate the conservation sector with the newbuild BIM approach through HBIM, since 2013 COTAC has aimed to ensure that its annual conference programme addressed relevant supportive topics.



The COTAC conferences also set out to help address the the fundamental differences between the existing BIM approach in new build projects, and the emerging HBIM approach in the conservation, repair and maintenance sector. Being fundamentally different, the key variation lies in looking at the life cycle stages of each approach. With new build, contemporary material extraction, transportation and manufacturing is inevitably essential to the construction process, whilst with existing structures the majority of these needs have already been addressed by dint of the buildings' remaining existence.

In this comparison, the philosophy behind carrying out effective true conservation work generally demands that little new material is involved in the process – the generally accepted remit being to sensitively retain what remains. Inevitably, the demand for replacement materials slightly increases when carrying out restoration, renovation and rehabilitation work approaches, but the overall requirement is much less than that demanded when building in

a green field location. As a result a broad range of other considerations need to be addressed and incorporated. In that process, accepted conservation guidelines and principles, such as those addressed above, provide essential reference points.

COTAC Annual Conference Report 2013 (Published 2014)

COTAC's 2013 Conference '*A Digital Future for Traditional Buildings: Practical Applications for Survey and Management*' was conceived to offer an integrated approach in accordance with the ICOMOS Education and Training Guidelines c), d), g), and l). These specific Guidelines call for an understanding of the setting of a historic asset, its contents and surroundings in relation to other buildings, gardens or landscapes; together with the need to find and absorb all available sources of information relevant to what is being studied; coupled with the ability to inspect and make reports intelligible to lay readers with appropriate illustrations, whilst also documenting and archiving the information.

Surveying is at the heart of fully understanding the setting, construction and detailing of the traditionally constructed built environment. In doing so a variety of technique could be called upon to help achieve the desired degree of knowledge and understanding. A COTAC *Select www Based Survey Information Bibliography*, published in conjunction with this Report, offers a selection of on-line informative links that could assist in the process.

With regard to documentation and archiving, an emphasis is also put on how these specific ICOMOS aspects might relate more closely to the challenges of adopting a tailored HBIM system for existing structures and traditionally constructed buildings. In tabulated and related cyclical diagrammatic form, a read-across of the wider 2013 COTAC Conference information-gathering findings, might be promulgated as follows:

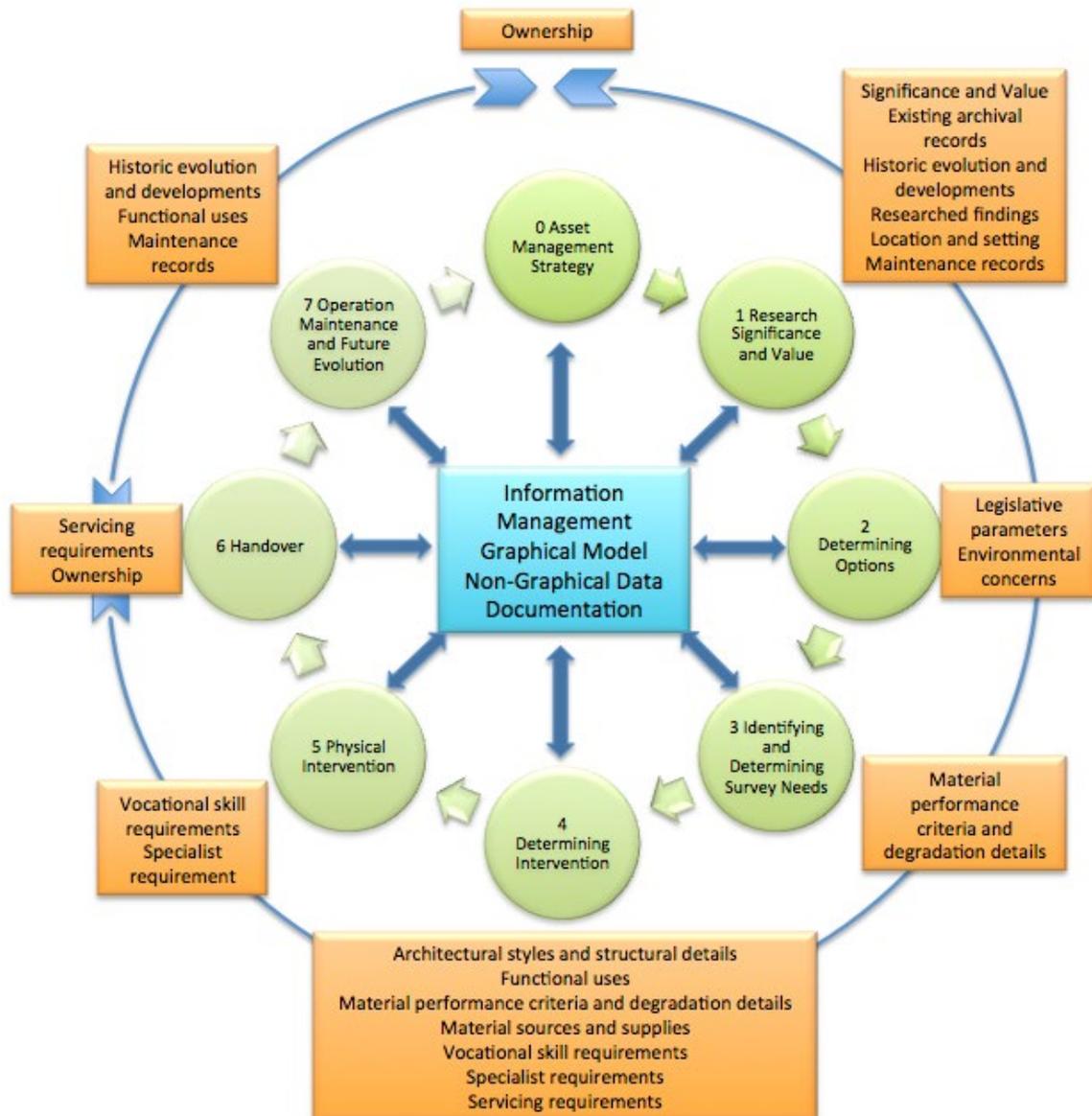
Integrating Digital Technologies in Support of Historic Building Information Modelling: <i>BIM4Conservation (HBIM) April 2014 Report</i>			
Integrating HBIM Conservation topics and elements with the CIC framework			
Step	CIC New Build Emphasis Headings	COTAC Conservation Emphasis Headings	COTAC 2014 BIM4C Report Conclusions: HBIM Headline topics and elements (Numbers and bullet points refer to the COTAC Report Conclusion [Section 15] which should be read in conjunction with this interpretation)
0	Strategy	Asset Management Strategy	16. Ownership <ul style="list-style-type: none"> • Monitoring sites at risk • Post-disaster recording

			<ul style="list-style-type: none"> • Application to master planning in context for planners • Disaster preparedness • Strategic policy
1	Brief	Research Significance and Value	<ol style="list-style-type: none"> 1. Significance and Value 3. Existing archival records 4. Historic evolution and developments 5. Researched findings 7. Location and setting 14. Maintenance records
2	Concept	Determining Options	<ol style="list-style-type: none"> 2. Legislative parameters 8. Environmental concerns <ul style="list-style-type: none"> • Application to master planning in context for planners • Energy efficiency • Improving accessibility, fire prevention and security • Sustainability demands
3	Definition	Identifying + Determining Survey Needs	<ol style="list-style-type: none"> 10. Material performance criteria and degradation details <ul style="list-style-type: none"> • Deviation mapping • Integration with 3D microwave moisture meter and thermography to plot: <ul style="list-style-type: none"> ○ Condensation and risk of mould growth ○ Damp, leaks and water penetration ○ Defective insulation ○ Electrical and mechanical malfunctions ○ Fractures and air leakages ○ Heat loss ○ Thermal bridging ○ Voids and surface disruption • Understand construction phases • Link with ground penetrating radar to reveal: <ul style="list-style-type: none"> ○ Archaeology ○ Underground services • 2D drawings • 3D drawings • 3D modelling and printing • As built records • Cutaway drawings

			<ul style="list-style-type: none"> • Isometric/axonometric drawings • Gigapixel imaging • Point cloud information
4	Design	Determining Intervention	6. Architectural styles and structural details 9. Functional uses 10. Material performance criteria and degradation details 11. Material sources and supplies 12. Vocational skill requirements 13. Specialist requirements 15. Servicing requirements <ul style="list-style-type: none"> • Condition monitoring • Energy efficiency
5	Build + Commission	Physical Intervention	12. Vocational skill requirements; 13. Specialist requirements <ul style="list-style-type: none"> • Deviation mapping • Physical replication • Testing colour renditions • Replication 3D milling
6	Handover + Closeout	Handover	15. Servicing requirements; 16. Ownership <ul style="list-style-type: none"> • Facilities Management • Quinquennial/routine inspections
7	Operation + End of life	Operation, Maintenance and Future Evolution	4. Historic evolution and developments 9. Functional uses 14. Maintenance records <ul style="list-style-type: none"> • Condition monitoring • Physical replication • Post-disaster recording • Replication 3D milling • Disaster preparedness • Energy efficiency • Facilities Management • Improving accessibility, fire prevention and security • Preventative maintenance • Quinquennial/routine inspections

Put in an alternative diagrammatic format around the cyclical framework, a summary of the application of the 'HBIM Headline topics and elements' (listed in the above right-hand

column) from the 2013 Conference Report Conclusions (published in April 2014) could be allocated as follows:



Application of the COTAC 2014 Conference Report Findings

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COTAC Annual Conference Report 2014 (Published 2015)

By dint of their being, existing structures (unlike new build) have already gone through their fundamental material extraction, manufacture and transporting phases, but are potentially more vulnerable to the imposed effects of fire and flood. Remedial consideration therefore need to look more widely to the potential of damaging events occurring through a better informed HBIM process through a broader risk assessment process. In both circumstances this calls for a detailed building analysis, compounded in the potential threat of flooding by addressing regional geophysical and metrological implications, as the conference report findings aim to consider.

With reference to the 2014 COTAC *'Fire and Flood in the Built Environment: Keeping the Threat at Bay'* Conference Report Conclusions, these noted that, in addition to holding relevant surveyed materials and knowledge, data management systems for historic and traditionally built structures might also include additional relevant information on a variety of related matters. The 3-part Conference Report, published in 2015, aims to build on the HBIM process in a manner that fits within the overall predetermined Approach of Key HBIM Elements suggested in the 2013 Conference Report. In doing so, and building upon the *UNESCO: Disaster Risk Management Cycle* report, it takes the theme of disaster preparedness as being a critical element of HBIM further. In this approach, the knowledge of associated available data is essential.

Coupled with associated research investigations, a number of key HBIM considerations can be highlighted. As summarised below, they should better inform BIM4C on the 'preparedness' aspect of conservation requirements, if so integrated:

Fire - Building Specific Data

Requiring the combination of fuel, oxygen and an ignition source, an awareness of the risk of a fire propagating should be considered within an HBIM context.

Material performance criteria and degradation

Material sources and supplies

Specialist requirements:

- Materials and source identification
- Function vulnerability assessment
- Determine risks and potential threats
- Retrofitting services
- Management preparedness
- Post-incident mitigation support

Flood - Contextual Geospatial Data

Within an HBIM context water might be considered as the primary vehicle involved in creating varying degrees of damage to a historic or traditionally constructed building.

Location and Setting:

- Environmental Concerns
- Aggregated hazard identification
- Vulnerability assessment
- Determine risk levels and potential/frequency of threats
- Historic incident data
- Preparedness

Flood - Building Specific Data

- Immediate mitigation
- Response and recovery

To ensure a consistency in approach, and a more effective integration, as many as possible of these data sets should be GIS related. Not only will this assist in better decision-making, cost savings and greater efficiencies, improved communications through having the data managed

geo-spatially will greatly increase the ability to understand the needs more fully when prescribing appropriate actions, particularly in flood situations.

UNESCO Disaster Risk Management Cycle Resource Manual

Touching on a wider international front, UNESCO’s Resource Manuals are intended to provide focused guidance on the implementation of the WH Convention to States Parties, heritage protection authorities, local governments, site managers and local communities linked to World Heritage sites, and other stakeholders in the identification and preservation process. By way of example, and in relating to the intentions of the COTAC 2014 conference and its report, the UNESCO Resource Manual on Disaster Risk emphasizes the concerns, and remedial activities.



Application of UNESCO Disaster Risk Management Cycle

Managing Disaster Risks for World Heritage Resource Manual activity-630-1

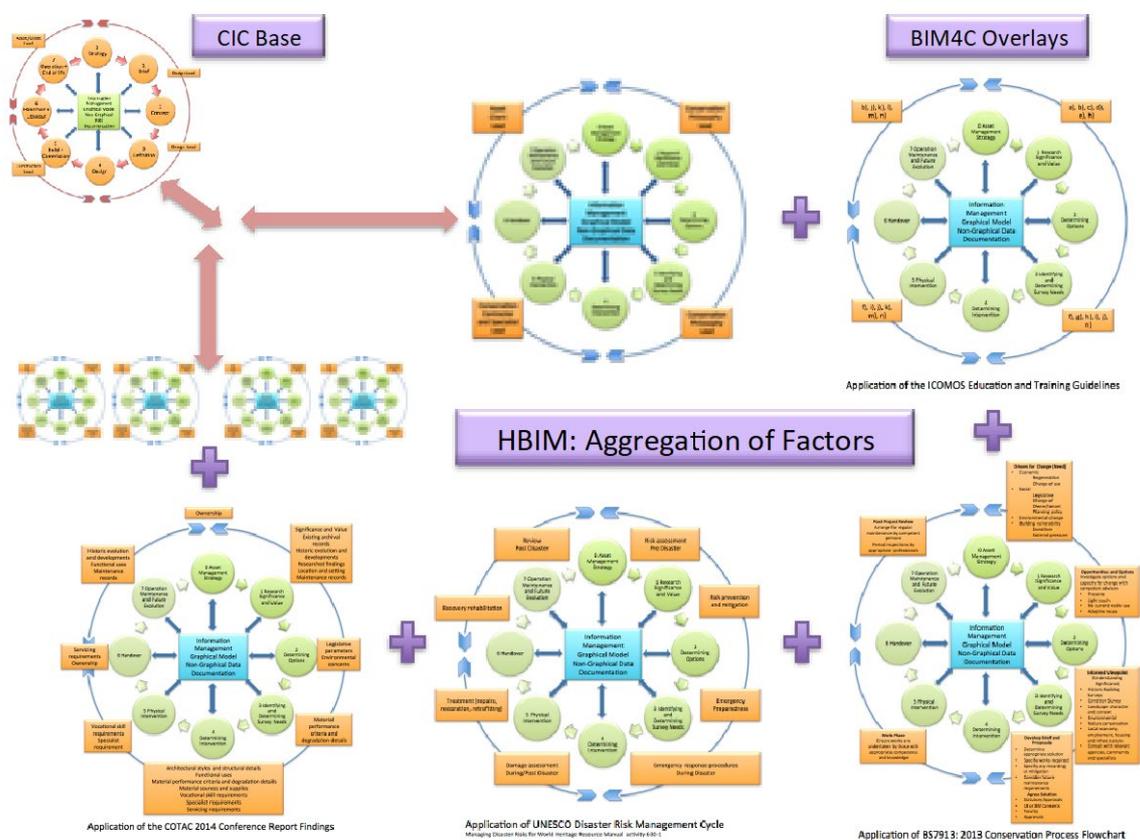
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The Disaster Risk Management Manual is primarily aimed at site managers, management teams and the agencies and organizations that have a direct stake in the management of a heritage property. Consequently, the summary and cyclical preparedness activities (UNESCO

Figure 1: Disaster Risk Management cycle) can be readily incorporated as a further veneer in the HBIM Cyclical Diagram's overlay of the diagrammatic CIC Cyclical approach, as illustrated above.

Integrating the Many Conservation Influences through HBIM

Although only a few related influences have been addressed so far in this Part 1 Report, as a next step, overlaying all the included cyclical diagrams can effect a compiled read-through of the overlapping side notes, to start illustrating how complex appropriate conservation considerations in HBIM data gathering might be. Through this approach a start can be made to expand upon each of the 8-stepped BIM criteria to create a clearer interpretation of related HBIM needs, as illustrated below.



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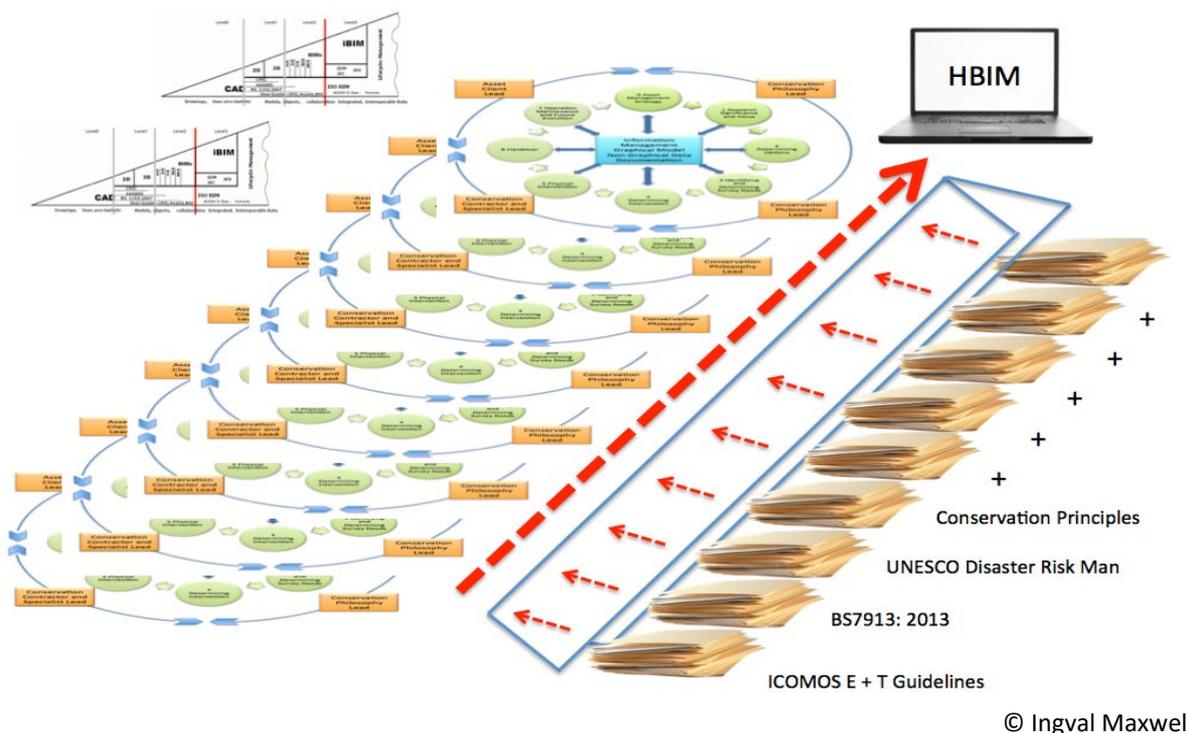
With further consideration of relevant influences, a variety of additional overlaps could also be assimilated to create a more in-depth process of what, collectively, needs to be and should be incorporated. As historical and traditional buildings already exist a full understanding of their needs must be fundamentally informed by a detailed survey and analysis of what is currently there, together with an awareness of their significance and value, and the risks they face.

Incorporating the above five detailed cyclical overlays, the diagram below set out to illustrate how integrating successive veneers of information could be overlaid on the cyclical base. In addition a variety of aggregated factors need to be incorporated in the eventual decision-

making process. This is liable to occur at various points throughout the lifespan of the building, as it is liable to also have a variety of different uses, each imposing associated changes and influences on what previously existed.

Diagrammatically, rather than consider each of the overlaying individual HBIM factors as being neatly stacked one on top of the other, they should be considered in the form of the repeating spiral. Sequentially, each turn of the spiral would relate to the 8 consecutive sectors of the cyclical approach as every new use for the building emerged.

As change takes place a variety of additional factors will need to be taken into account. Consequently, by considering a wedge shaped extraction of data from each of the central segments, a fuller appreciation of the various influencing factors can emerge.



By way of example of how such information developments might grow (in using the findings of the April 2013/2014 COTAC *Integrating Digital Technologies in Support of Historic Building Information Modelling: BIM4Conservation (HBIM)* report) the CIC BIM Cyclical diagram sector '1 Brief', as transferred into an HBIM context of '1 Research Significance and Value,' could be expanded from the simplified aggregated headings as follows:

CIC '1 Brief'	Design Lead
COTAC HBIM '1 Research Significance and Value'	Conservation Philosophy Lead
Application of the COTAC 2014	<ul style="list-style-type: none"> ● Significance and Value ● Existing archival records

Conference Report Findings	<ul style="list-style-type: none"> • Historic evolution and developments • Researched findings Location and setting • Maintenance records
Application of the ICOMOS Education and Training Guidelines	<p>a), b), c), d), e), h)</p> <p><i>a) Read a monument, ensemble or site and identify its emotional, cultural and use significance;</i></p> <p><i>b) Understand the history and technology of monuments, ensembles or sites in order to define their identity, plan for their conservation, and interpret the results of this research;</i></p> <p><i>c) Understand the setting of a monument, ensemble or site, their contents and] surroundings, in relation to other buildings, gardens or landscapes;</i></p> <p><i>d) Find and absorb all available sources of information relevant to the monument, ensemble or site being studied;</i></p> <p><i>e) Understand and analyze the behavior of monuments, ensembles and sites as complex systems;</i></p> <p><i>h) Know, understand and apply UNESCO conventions and recommendations, and ICOMOS and other recognized Charters, regulations and guidelines;</i></p>
Application of BS7913: 2013 Conservation Process Flowchart	<p>Opportunities and Options</p> <p>Investigate options and capacity for change with competent advisors</p> <ul style="list-style-type: none"> • Preserve • Light touch • No current viable use • Adaptive reuse
Application of Historic England Conservation Principles	<p>Principle 1: The historic environment is a shared resource</p> <p>Principle 2: Everyone should be able to participate in sustaining the historic environment</p> <p>Principle 3: Understanding the significance of places is vital</p>
Application of UNESCO Disaster Risk Management Cycle	<p>Risk prevention and mitigation</p>

As pursued in the related Part 2 to this report, such an approach could be devised and repeated in sequenced steps around the cyclical diagram to create a fuller understanding of all the issues that need to be considered and taken into account. In addition, further apparently peripheral influences emanating from the broad range of accepted International Conservation Charters could be similarly analysed and incorporated.

Relating PAS 1192-3:2014 and BS 1192-4:2014 documentation.

As a further step in the evolution, development and integration of HBIM, an analysis is required to align the direction and guidance of the PAS documents with the COTAC HBIM Cyclical Diagram. However, the intentions of BS 1192-4:2014 *Collaborative production of information Part 4: Fulfilling employer's information exchange requirements using COBie – Code of practice* could be more challenging to follow in respect of the existing built heritage. In its Introduction it is stated that:

This standard defines expectations for the exchange of information throughout the lifecycle of a Facility. The use of COBie ensures that information can be prepared and used without the need for knowledge of the sending and receiving applications or databases. It ensures that the information exchange can be reviewed and validated for compliance, continuity and completeness.



Glasgow DSC01742: Following a disaster in an existing building, the essential exchange of information can only be initiated once the full extent of what has been lost can be established and understood. This can be a significant hurdle if no detailed previous records exist. © Ingval Maxwell

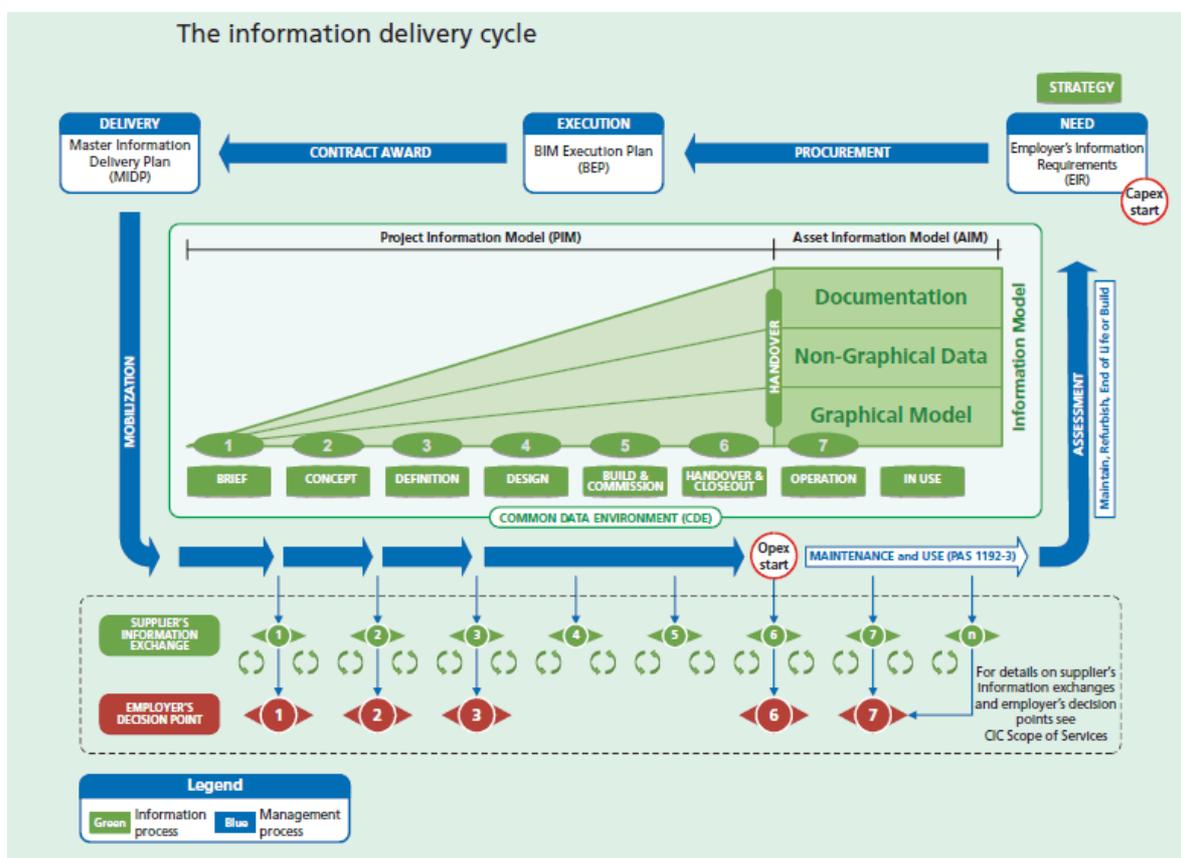
With a building or structure that has already been in existence for a couple of centuries already, and could equally have a future life expectancy of two or three more, such an aspiration of BS 1192-4:2014 might not be so readily achieved without taking other factors into account. The potential scale and scope of these are addressed in Part 2 of this Report.

BIMTalk Website

BIMTalk is a valuable online BIM information portal centered on building design, construction, manufacturing and facilities management. In addition to providing details on the Standards, the website content provides a Glossary; a list of useful Sites; Case Studies; a Virtual Library; details on BIM Courses and Events; Processes; and Legal Matters.

Members of the CIBSE BIM Steering Group, a voluntary association of individuals pooling their knowledge of BIM with others and aiming to fill a gap in general BIM information, have established the site. It lists the main UK 'standards' that relate to BIM and briefly describes them. But it perhaps comes as no surprise that BS7913: 2013 *Guide to the conservation of historic buildings* is not listed.

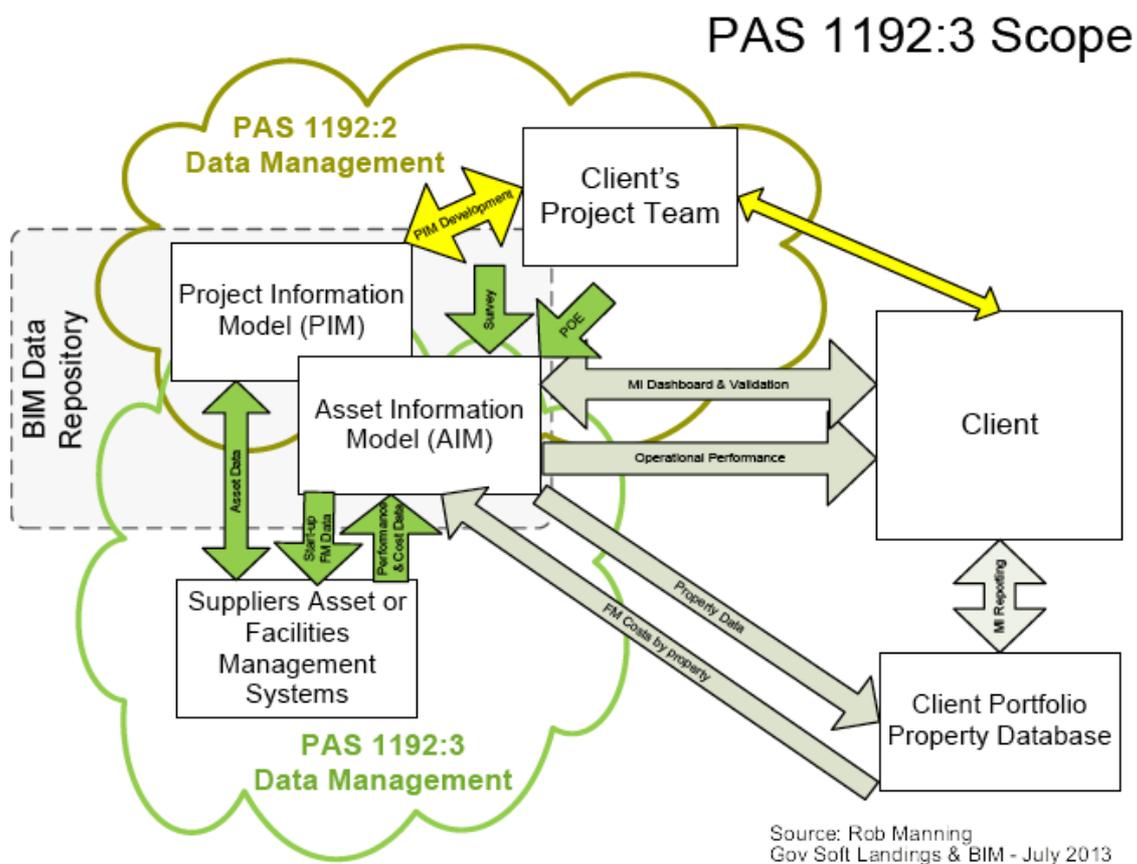
However, two of the site diagrams (as copied below) are of assistance in considering where the needs of conservation activities might be correlated. Particularly, the sites '*Information delivery cycle*' (copied below) could be better informed by the incorporation of the intentions of the various COTAC HBIM Cyclical diagrams previously considered in this Report.



http://bimtalk.co.uk/media/bim_info_delivery_cycle_pas1192-2.gif

Conservation interests might also be integrated with the *PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information modeling* document in its intention to provide information on the management of data produced within a BIM project environment, and supplements the processes and procedures contained in *BS 1192:2007*.

PAS 1192-3 Specification for information management for the operational phase of assets using building information modeling is a partner document to PAS 1192-2 that focuses on the operational phase of assets for both new and old buildings. Like PAS 1192-2, it applies to both building and infrastructure assets, the scope of which is diagrammatically outlined below:



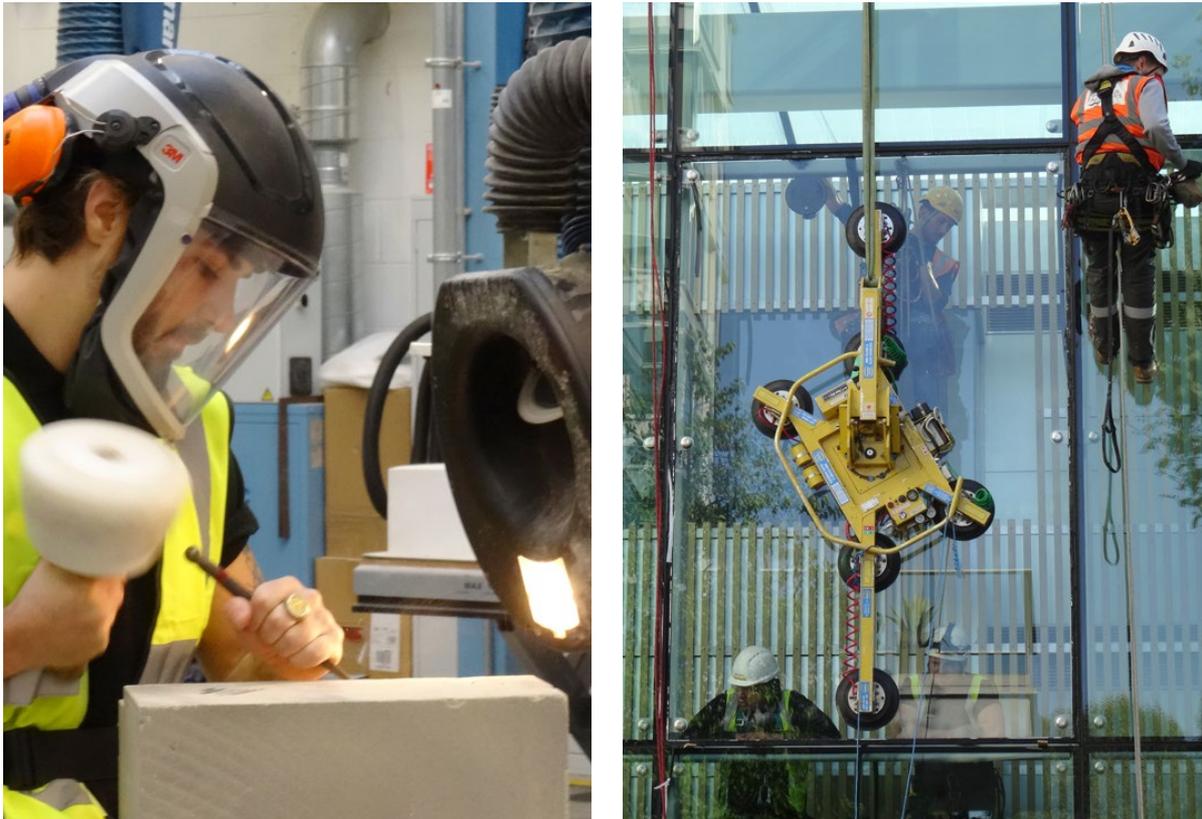
http://bimtalk.co.uk/media/bim_glossary:gslanbim-201307.gif

Whilst *PAS 1192-3* suggests it has a relevance to 'old buildings', it is currently unclear as to what this means if the variously devised COTAC HBIM Cyclical diagrams, and the 'Integrating HBIM Conservation topics' table previously addressed in this Report, are taken into account with equal validity.

It is anticipated that Part 2 of this Report, in offering a more detailed HBIM Evaluation Framework for consideration, will start to create a greater understanding of this complexity.

Summary Conclusion

In the emerging development of HBIM, it is clear that a very different approach needs to be holistically considered and integrated with the more commonly adopted BIM in the new-build construction sector. A greater acceptance of the need to understand the complex characteristics of the built heritage will become increasingly necessary if a related understanding of what should be included in the process can be achieved. This needs to emerge from accepting, and incorporating, a variety of influential sources when devising an appreciation, generation and management of the digital representations of physical and functional characteristics of existing places, how they were created, and how they need to be responded to.



Stirling DSC03248 and London DSC01620: The variations in the necessary training, education, skills base, materials used, and constructional techniques between the New-build and Conservation sectors of the construction industry can be considerable. © Ingval Maxwell

The BIM4C (BIM for Conservation) connotation, encompassing as it does a broad diversity of remaining structures and buildings across the country, might equally be considered as having a more accurate BIM4EB (BIM for Existing Buildings) or BIM4ES (BIM for Existing Structures) description, these terms perhaps being more encompassing. However, there already exists a strong identity and added strength, based on the evolving BIM4C terminology, and the recognised conservation perspective it has. In its use, BIM4C's primary aim is to work towards restating a more effective awareness of how the construction industry actually operates in the two (almost) equal halves of the 'New-build' and the 'Conservation, Repair and Maintenance' sectors.

Annex A



GUIDELINES ON EDUCATION AND TRAINING IN THE CONSERVATION OF MONUMENTS, ENSEMBLES AND SITES (1993)

The General Assembly of the International Council on Monuments and Sites, ICOMOS, meeting in Colombo, Sri Lanka, at its tenth session from July 30 to August 7, 1993;Adopts the following guidelines, and Recommends that they be diffused for the information of appropriate institutions, organizations and authorities.

Aim of the Guidelines

1. The aim of this document is to promote the establishment of standards and guidelines for education and training in the conservation of monuments, groups of buildings ("ensembles") and sites defined as cultural heritage by the World Heritage Convention of 1972. They include historic buildings, historic areas and towns, archaeological sites, and the contents therein, as well as historic and cultural landscapes. Their conservation is now, and will continue to be a matter of urgency.

Conservation

2. Conservation of cultural heritage is now recognized as resting within the general field of environmental and cultural development. Sustainable management strategies for change which respect cultural heritage require the integration of conservation attitudes with contemporary economic and social goals including tourism.

3. The object of conservation is to prolong the life of cultural heritage and, if possible, to clarify the artistic and historical messages therein without the loss of authenticity and meaning. Conservation is a cultural, artistic, technical and craft activity based on humanistic and scientific studies and systematic research. Conservation must respect the cultural context.

Educational and Training Programs and Courses

4. There is a need to develop a holistic approach to our heritage on the basis of cultural pluralism and diversity, respected by professionals, craftspersons and administrators.

Conservation requires the ability to observe, analyze and synthesize. The conservationist should have a flexible yet pragmatic approach based on cultural consciousness which should penetrate all practical work, proper education and training, sound judgment and a sense of proportion with an understanding of the community's needs. Many professional and craft skills are involved in this interdisciplinary activity.

5. Conservation works should only be entrusted to persons competent in these specialist activities. Education and training for conservation should produce from a range of professionals, conservationists who are able to:

a) Read a monument, ensemble or site and identify its emotional, cultural and use significance;

b) Understand the history and technology of monuments, ensembles or sites in order to define their identity, plan for their conservation, and interpret the results of this research;

c) Understand the setting of a monument, ensemble or site, their contents and] surroundings, in relation to other buildings, gardens or landscapes;

d) Find and absorb all available sources of information relevant to the monument, ensemble or site being studied;

e) Understand and analyze the behavior of monuments, ensembles and sites as complex systems;

f) Diagnose intrinsic and extrinsic causes of decay as a basis for appropriate action;

g) Inspect and make reports intelligible to non-specialist readers of monuments, ensembles or sites, illustrated by graphic means such as sketches and photographs;

h) Know, understand and apply UNESCO conventions and recommendations, and ICOMOS and other recognized Charters, regulations and guidelines;

i) Make balanced judgments based on shared ethical principles, and accept responsibility for the long-term welfare of cultural heritage;

j) Recognize when advice must be sought and define the areas of need of study by different specialists, e.g. wall paintings, sculpture and objects of artistic and historical value, and/or studies of materials and systems;

k) Give expert advice on maintenance strategies, management policies and the policy framework for environmental protection and preservation of monuments and their contents, and sites;

l) Document works executed and make same accessible.

m) Work in multi-disciplinary groups using sound methods;

n) Be able to work with inhabitants, administrators and planners to resolve conflicts and to develop conservation strategies appropriate to local needs, abilities and resources;

Aims of Courses

6. There is a need to impart knowledge of conservation attitudes and approaches to all those who may have a direct or indirect impact on cultural property.

7. The practice of conservation is interdisciplinary; it therefore follows that courses should also be multidisciplinary. Professionals, including academics and specialized craftspersons, who have already received their normal qualification will need further training in order to become conservationists; equally those who seek to act competently in historic environment.

8. Conservationists should ensure that all artisans and staff working on a monument, ensemble or site respect its significance.

9. Training in disaster preparedness and in methods of mitigating damage to cultural property, by strengthening and improving fire prevention and other security measures, should be included in courses.

10. Traditional crafts are a valuable cultural resource. Craftspersons, already with high-level manual skills, should be further trained for conservation work with instruction in the history of their craft, historic details and practices, and the theory of conservation with the need for documentation. Many historic skills will have to be recorded and revived.

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