

Building Information Modelling (BIM), Collaborative and Integrated Team Working



Practice Note – Building Information Modelling (BIM), Collaborative and Integrated Team Working

This Practice Note is designed to assist in providing an understanding of BIM to those who may be new to or unfamiliar with the concept. It is not intended to be a definitive guide.

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Building Information Modelling (BIM), Collaborative and Integrated Team Working

Introduction

- 1 This Practice Note considers BIM in the construction industry and how BIM's methodologies and principles are applied. The use of BIM as part of Collaborative and Integrated Team Working is also considered. This Practice Note is designed to assist in providing an understanding of BIM to those who may be new to or unfamiliar with the concept. It is not intended to be a definitive guide – there are many sources of information available and reference is made throughout this Practice Note to independent industry-standard guidance from organisations such as the Government's BIM Task Group and the National Building Specification (NBS), both of whom are central to the promotion, dissemination of guidance and encouragement of BIM in the UK. A short bibliography is provided at the end of this Practice Note giving details of any documents referred to and for use by those wishing to obtain more detailed information.
- 2 BIM can mean different things to different people and organisations. This Practice Note provides an introduction to BIM and looks at the role BIM plays in the promotion of Collaborative and Integrated Team Working and BIM's relationship with a typical project's contractual arrangements.

What is Building Information Modelling and why is it valuable?

- 3 The Government Construction Strategy was published in May 2011. The strategy followed on from the Latham Report (Constructing the Team, 1994) and the Egan Report (Rethinking Construction, 1998) and set out a wide range of proposals including the phased roll-out of Building Information Modelling. The Government's BIM Task Group website defines BIM as:

"... value creating collaboration through the entire life-cycle of an asset, underpinned by the creation, collation and exchange of shared 3D models and intelligent, structured data attached to them."

The NBS defines BIM as below:

"BIM brings together all of the information about every component of a building, in one place. It makes it possible for anyone to access that information for any purpose, e.g. to integrate different aspects of the design more effectively. In this way, the risk of mistakes or discrepancies is reduced, and abortive costs minimized."

The Government's report Digital Built Britain: Level 3 BIM - Strategic Plan published in February 2015 by the BIS includes the following general definitions of BIM:

"Building Information Modelling (BIM) is a collaborative way of working, underpinned by the digital technologies which unlock more efficient methods of designing, delivering and maintaining physical built assets. BIM embeds key product and asset data in a 3D computer model that can be used for effective management of information throughout an assets lifecycle – from earliest concept through to operation."

"BIM uses advanced computer systems to build 3D models of infrastructure and hold large amounts of information about its design, operation and current condition. At the planning stage it enables designers, owners and users to work together to produce the best possible designs and to test them in the computer before they are built. In construction it enables engineers, contractors and suppliers to integrate complex components cutting out waste and reducing the risk of errors. In operation it provides customers with real-time information about available services and maintainers with accurate assessments of the condition of assets."

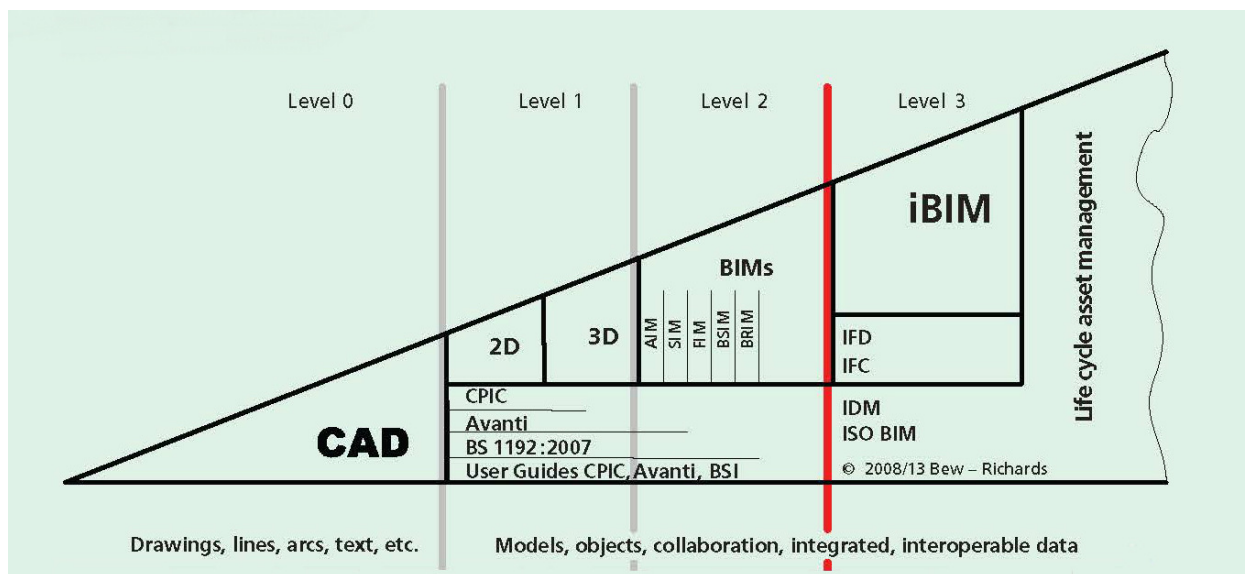
- 4 The use of BIM is steadily gaining momentum within design, manufacturing, construction and facilities management organisations. At its heart, BIM is a way of working that demands collaboration and integrated team working by all contributors to the design, manufacture, construction and operation of an asset. The UK Government is so convinced of its benefits it has given a mandate for the use of BIM on all centrally funded public sector projects regardless of scale by 2016 (Government Construction Strategy of May 2011). BIM is also a key driver in the Government's pursuit of efficiency savings in the management of its own estate (in the form of lower capital cost, faster delivery and lower emissions). This take-up is not limited to the public sector in the UK but is also driven by the private sector and is occurring internationally where the benefits of BIM are being felt.
- 5 It is important to appreciate that BIM is not just a piece of software, such as 3D CAD but a technology-enabled process that utilises interoperable software and methodologies. It is a way of creating digital information about an

asset. In essence, it is a digital model of a building that is data enriched; it defines spaces, systems, products and materials (together with their properties), addresses how those components inter-relate physically and technically and looks ahead to future maintenance needs.

BIM Maturity Levels

6 BIM has been defined by reference to ‘maturity levels’ which range from Level 0 to 3, as shown in Bew and Richards Maturity Diagram set out below. These levels can be summarised as follows:

- **Level 0:** the provision of the more traditional ‘unintelligent’ CAD, word and spreadsheet information.
- **Level 1:** the provision of a higher level of 2D and/or 3D CAD and other information that has been produced in a more collaborative manner.
- **Level 2:** the provision of 3D modelling and data produced by professionals and contractors individually and then produced and coordinated into a federated model made subject to BIM protocols (see further definitions below).
- **Level 3:** this is regarded as the most sophisticated level of BIM. It is viewed as a vision for the future, but has yet to be fully defined. It calls for creation of data and modelling which is truly interoperable, data rich and FM (facilities management) ready.



Bew and Richards Maturity Diagram

Level 2 BIM

7 BIM Level 2 has become regarded as the current benchmark for establishing the criteria required in order to be deemed to be BIM compliant. This Practice Note focuses on the concept of BIM at ‘Level 2 Maturity’, which is defined by the BIM Task Group as:

“... a series of domain specific models (e.g. architectural, structural, services etc) with the provision of a single environment to store shared data and information...”

How this single environment functions in practice will be explored further in this Practice Note.

8 The NBS defines ‘Level 2 BIM’ as follows:

“This is distinguished by collaborative working – all parties use their own 3D CAD models, but not necessarily working on a single, shared model. The collaboration comes in the form of how the information is exchanged between different parties – and is the crucial aspect of this level. Design information is shared through a common file format, which enables any organisation to be able to combine that data with their own in order to make a federated BIM model, and to carry out interrogative checks on it. Hence any CAD software that each party used must be capable of exporting to one of the common file formats such as IFC (Industry Foundation Class) or COBie (Construction Operations Building Information Exchange).”

9 At Level 2 BIM it is anticipated that the participants will each produce their contribution to BIM in the form of a model. This model is progressively enriched with data relevant to their discipline, scope of work and project stage, then combined with information from other participants before being ‘federated’ into a combined model. A key feature of Level 2 BIM is therefore that BIM principles and practices are adopted by all parties in the project, whether they be clients, consultants, main contractors, subcontractors, specialists or product suppliers, etc. in order

for the 'federated BIM model' to be produced and for that to represent a comprehensive digital representation of all aspects of the asset.

Level 3 BIM

- 10 NBS defines 'Level 3 BIM', as distinct from Level 2 BIM, as follows:

"... this represents full collaboration between all disciplines by means of using a single, shared project model which is held in a centralized repository. All parties can access and modify that same model, and the benefit is that it removes the final layer of risk for conflicting information. This is known as 'Open BIM'..."

Level 3 BIM calls for a higher degree of collaboration in that it requires the use of a single, shared project model. Level 3 BIM is not considered in any detail in this Practice Note but the JCT and other industry bodies have the shared ambition to develop the capabilities required (through use of the right technologies, processes, collaborative working and contractual arrangements) to enable greater take up of Level 3 BIM and this is very much a part of JCT's future thinking.

Digital Dimensions

- 11 Within BIM there are also subsets designed to meet different types of analysis scenarios, as follows:

- 3D BIM: modelling with 3 dimensional data - the basic BIM
- 4D BIM: the addition of construction sequencing within the modelling to support programming analysis.
- 5D BIM: the addition of 'cost' data to aid cost modelling.
- 6D BIM: the inclusion of facilities management specific data.

BIM has the capacity to provide, manage and record all of the above.

Mechanisms and Industry Standards

- 12 The concept of BIM is not new, however until recently it lacked the rigour that common mechanisms and standards can bring. In the UK much has been done to define how BIM activity is to be structured and managed both within individual projects and across the construction industry, and this has been done in particular under the guidance of the Government's BIM Task Group.

- 13 Underlying the BIM process is a selection of British Standards and Publicly Available Specifications (PAS's) that have been developed in recent years. It is recognised that poorly put together and coordinated construction documentation and information is a significant cause of delay and additional cost and BS 1192 was issued to set out a method for managing the creation, dissemination and quality of construction information, the latest edition of which is BS 1192:2007 *Collaborative production of architectural, engineering and construction information. Code of practice*. The BIM Task Group, with the sponsorship of the Construction Industry Council (CIC), has taken much of BS 1192:2007 and made the aspects of that standard specific to BIM freely available in the form of a series of Publicly Available Specifications (known as PAS1192) to support the adoption of BIM within the construction industry. The documents underlying the BIM process are summarised below:

- PAS 1192-2:2013: Specification for information management for the capital/delivery phase of construction projects using building information modelling.
- PAS 1192-3:2014: Specification for information management for the operational phase of assets using building information modelling.
- BS 1192-4: Collaborative production of information. Part 4: Fulfilling employer's information exchange requirements using COBie – Code of practice.
- PAS 1192-5: Specification for security-minded building information management, digital built environments and smart asset management.
- Building Information Modelling Protocol.
- BSRIA Soft Landings.
- Government Soft Landings (GSL).
- NBS BIM Toolkit.
- Classification Standards – Uniclass 2015.
- CIC Outline Scope of Services for the role of Information Management.
- CIC Best Practice Guide for Professional Indemnity Insurance when using BIM.

- 14 The first item in the above (PAS1192-2) is perhaps the most critical component of a BIM enabled project. PAS 1192-2 sets out in considerable detail many of the mechanisms that underpin the adoption of BIM (a detailed review of which is beyond the scope of this Practice Note), but it also introduces a number of concepts and associated acronyms specific to BIM, which are summarised below:

Employers Information Requirements (EIR): a 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. This may define the Asset Information Requirements (AIR), the maintained information model used to manage, maintain and operate the asset.

BIM Execution Plan (BEP): a plan prepared in response to the EIR to explain how the information modelling aspects of a project will be carried out.

Master Information Delivery Plan (MIDP): a primary plan for when project information is to be prepared, who will prepare it and using what protocols and procedures, incorporating relevant task information delivery plans.

Project Information Model (PIM): an information model developed during the design and construction phase of a project. The PIM is developed firstly as a design intent model, showing the architectural and engineering intentions of those responsible for design. The PIM is developed into a virtual construction model containing all the objects to be manufactured, installed or constructed. These are federated to allow design, manufacture and construction.

Industry Foundation Class (IFC): IFC is an object-based format, to enable exchange of information between different software and collaborators. IFC is an official standard (BS ISO 16739) and contains geometric as well as other data.

Common Data Environment (CDE): a single digital source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multi-disciplinary teams in a managed process.

Asset Information Model (AIM): a maintained information model used to manage, maintain and operate the asset. This is generated from the PIM.

COBie (from Construction into Operation of Building information exchange): a structured facility information for the commissioning, operation and maintenance of a project, often in the format of a neutral spreadsheet that will be used to supply data to the employer or operator to populate decision-making tools, facilities management and asset management systems.

Level of Definition (LoD): the minimum level of graphical and non-graphical information detail required at each stage of the project together with the responsibility for its incorporation into the BIM.

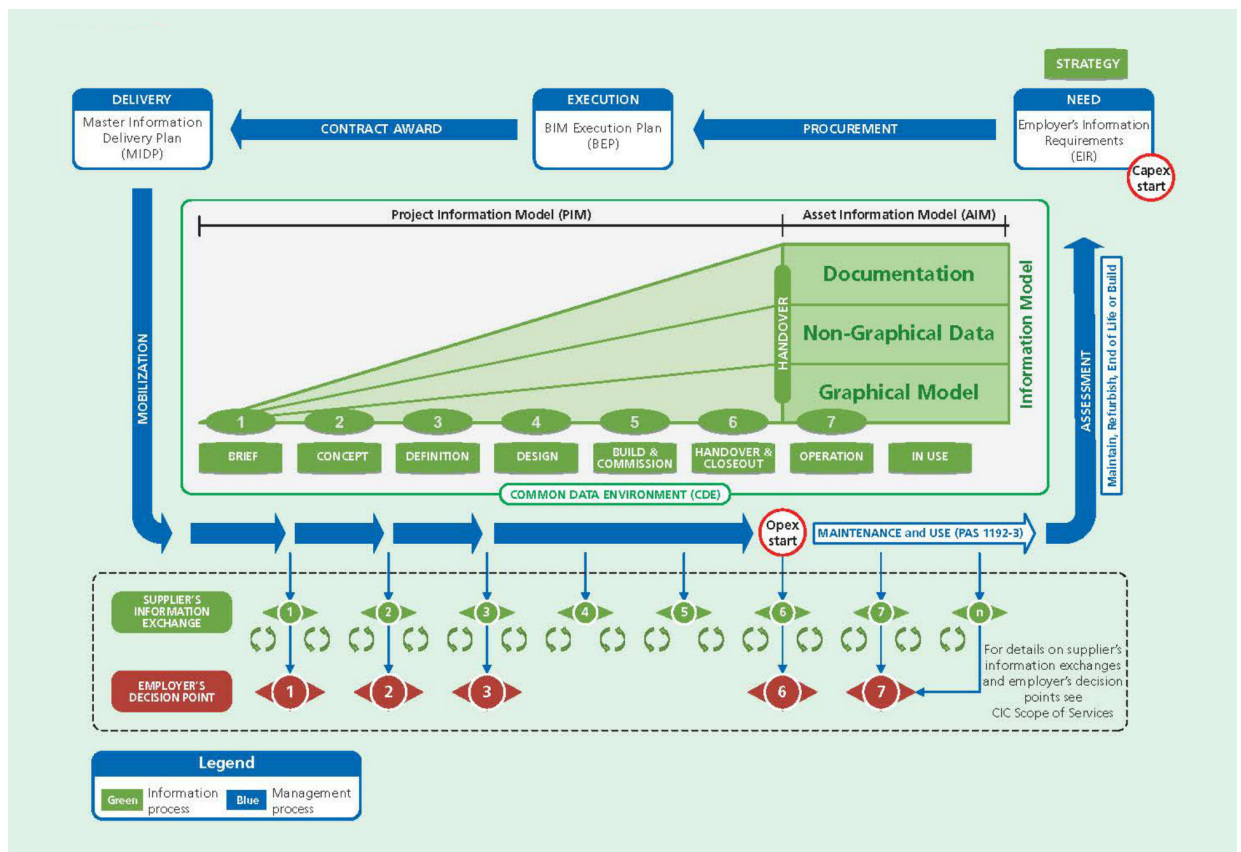
BIM Protocol: The BIM Task Group describes a BIM Protocol as:

“The BIM Protocol creates the obligation for suppliers to provide specified BIM at defined levels of detail... The Protocol also provides necessary additional protections for the producers of information through the inclusion of BIM-specific licences. The Protocol also makes a major contribution to encouraging effective collaborative working by mandating the role of Information Manager and by including provisions which will make the use of Information Management standards such as PAS 1192:2 an explicit contractual requirement.”

Government Soft Landings (GSL)/Soft Landings: GSL is a UK government-initiated project handover protocol. The phrase ‘soft landing’ has been used to describe the need for a smooth transfer from the design/construction stage to the operational stage of a newly built asset. GSL has been developed to help drive better outcomes for assets undergoing design and construction. Whilst GSL is not a prerequisite of BIM it is a key feature of the Government’s aim to derive maximum benefit from the use of BIM. Soft landings as defined by BSRIA may be more applicable outside the public sector.

Classification: A consistent approach to data classification is necessary, which can be shared across the professional disciplines, the manufacturing and construction industries and by operators (as well as internationally). PAS 1192-2 elects to use Uniclass 2015.

The above concepts are shown in the following diagram from PAS 1192-2.



It is to be noted PAS1192-2 and BS1192:2007 are in the process of being revised by the BSI, following a period of consultation which closed at end August 2015.

BIM Protocols and contractual arrangements

- 15 It is generally acknowledged that the use of a protocol is a most effective way of ensuring the activities of all project participants are controlled so that BIM mechanisms and standards are applied from commencement through to the delivery of the project and are of enduring value to the asset operator in the facility management stage (or indeed during the future modification or disposal of the asset).
- 16 Where BIM is to be used it is now recognised as important for contracts to clarify the parties' rights and obligations as they relate to BIM, which can be done through the use of a protocol and the incorporation of that protocol into the contract. The parties may wish to develop their own bespoke protocol. There are standard forms available, with the most frequently referred to being the CIC BIM Protocol, which was issued by the CIC in responding to the Government's BIM strategy. The CIC Protocol has been designed for use with BIM Level 2 only.
- 17 The BIM Protocol document will commonly sit as an appendix to the appointment documentation for professional consultants and to the main contract for the contractor with a requirement for the protocol where applicable to be stepped down to the contractor's supply chain. To be of most value therefore to the complete life cycle of the asset, BIM requirements (and the relevant protocol requirements) should be defined at the outset and led by the Employer. The BIM Task Group describes this process as follows:

"The employer has a key role in setting up a BIM Project for success. By ensuring that all consultants and the contractor are appointed on a common basis, are working to deliver a common set of Building Information Models and are contractually required to adopt common ways of working, the employer will make a great contribution to effective project working. Because the CIC BIM Protocol gives model originators additional protection – project participants will be incentivised to agree to the Protocol. Similarly, the content of the Appendices has to be included in the Employer's Information Requirements prior to appointment."

- 18 In considering the common features of a BIM Protocol it is instructive to refer to the CIC Protocol. This includes obligations on the members of the project team to produce models at certain stages, which must be produced and delivered in accordance with "the Information Requirements". A BIM Protocol should set out who will be responsible for 'Information Management'. The person allocated will most likely be an existing member of the project team, albeit the responsibility may pass to different members of this team over the life of the project. For example, the Information Manager may be a member of the design team to begin with and this responsibility may then pass to the contractor if the contractor is to be responsible for the completion of the design as well as for construction.

- 19 The Protocol provides the means for ensuring models are produced as required throughout the project's design development and construction phase.
- 20 The CIC Protocol is intended to be specifically incorporated into the contract and there is an enabling clause for that purpose set out in the CIC's protocol guidance note. The CIC's drafting is based on the principle the protocol is a contractual document and this is intended to take precedence over other documents for all provisions that relate to BIM.
- 21 The specific amendments required to any contract for the incorporation of a chosen BIM Protocol should be considered on an individual basis. Care should be taken to ensure that there is no conflict between the relevant contract provisions and the chosen BIM Protocol. JCT considers that in the event of any conflict between the contract provisions and the chosen BIM Protocol it is the contract provisions that should prevail.

Collaborative and Integrated Team Working

- 22 There has been in recent years a greater interest shown by the construction industry in the benefits of partnering and integrated and collaborative working. This was brought into focus by the Latham and Egan reports which emphasised the need for these approaches to be formalised. Progress has been made and there have been various contractual responses. Improved collaborative working is addressed in JCT Contracts and covered principally by the Pre-Construction Services Agreements, Framework Agreement, JCT - Constructing Excellence Contract documentation and the preliminary phase of the Management Contract. Collaborative working has also for some time been covered with the inclusion of a supplemental provision for collaborative working in JCT Contracts.
- 23 JCT - Constructing Excellence Contract documentation and Pre-Construction Services Agreements provide opportunities to explore non-traditional approaches to procurement, and offer those who seek to collaborate the scope to work together in achieving the common objective of a successful project outcome. The effectiveness of the BIM process relies heavily on project participants working in an integrated and collaborative manner, and on their willingness to do so, irrespective of how this is addressed contractually. JCT is committed to continuing to place emphasis on integrated team and collaborative working and recognises this goes hand in hand with the objective of seeing the further development of BIM and the formalising of its use in contracts.
- 24 JCT has already published amendments for facilitating use of BIM on public sector projects which are contained in the 2011 Public Sector Supplement. These provisions may also be considered for use in relation to private sector projects.

Bibliography

Good sources of further information:

Best Practice Guide for Professional Indemnity Insurance when using BIM: <http://cic.org.uk/publications>

BIM Task Group: www.bimtaskgroup.org

BSRIA Soft Landings: <https://www.bsria.co.uk/services/design/soft-landings/free-guidance>

CIC BIM Protocol 2013: <http://cic.org.uk/publications>

Digital Built Britain: Level 3 Building Information Modelling – Strategic Plan:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/410096/bis-15-155-digital-built-britain-level-3-strategy.pdf

Glossary of BIM Acronyms: bimblog.bondbryan.com/wp-content/uploads/2015/01/30001-BIM-acronyms1.pdf

Government Construction Strategy of May 2011:
www.gov.uk/government/uploads/system/uploads/attachment_data/file/61152/Government-Construction-Strategy_0.pdf

Government Soft Landings: <http://www.bimtaskgroup.org/gsl-department-guidance-documents>

NBS: www.thenbs.com/BIM
www.nationalbimlibrary.com
<https://toolkit.thenbs.com>

Outline Scope of Services for the role of Information Management: <http://cic.org.uk/publications>

Publicly Available Specifications available from BSI:

- PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using Building Information Modelling. <http://shop.bsigroup.com/en/forms/PASs/PAS-1192-2>
- PAS 1192-3:2014 - Specification for information management for the operational phase of assets using building information modelling. http://shop.bsigroup.com/upload/Construction_downloads/PAS1192-3%20final%20bookmarked.pdf
- BS 1192-4: Collaborative production of information. Part 4: Fulfilling employer's information exchange requirements using COBie – Code of practice. http://shop.bsigroup.com/upload/Construction_downloads/BS1192-4_Collaborative_production_of_information_Part_4.pdf
- PAS 1192-5: Specification for security-minded building information management, digital built environments and smart asset management. <http://shop.bsigroup.com/forms/PASs/PAS-1192-5>

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