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CPD

Procurement Guidance Note

PGN 03/15

(as amended)

Building Information Modelling (BIM)

Reissued: 10 June 2016

PROCUREMENT GUIDANCE NOTES

Northern Ireland Public Procurement Policy (NIPPP) was approved by the Northern Ireland Executive in 2002. In approving the policy, the Executive took the decision that legislation was not necessary to ensure that Departments, their Agencies, Non-Departmental Public Bodies and Public Corporations complied with the policy. Instead, it considered that compliance could be achieved by means of administrative direction.

Procurement Guidance Notes (PGNs) are the administrative means by which Departments are advised of procurement policy and best practice developments. They apply to those bodies subject to NIPPP and also provide useful guidance for other public sector bodies.

PGNs are developed by the Central Procurement Directorate (CPD), in consultation with the Centres of Procurement Expertise (CoPEs), and are subject to the approval of the Procurement Board.

Once endorsed by the Procurement Board, they are issued to the Departments for implementation and copied to CoPEs to develop, if necessary, underpinning procedures supporting the implementation of this guidance in their particular sector. PGNs are also published on the Department of Finance (DoF) website.

The following PGN was endorsed by the Procurement Board with effect from 18 November 2015 for use by those bodies subject to NIPPP.

Revision History	
First issued as a Procurement Guidance Note PGN 03/15	18 November 2015
Reissued to reflect the restructuring of the Northern Ireland Government departments. Also, updating references to BIM Regions groups.	10 June 2016

CONTENTS

Definition of Terminology

In the preparation of this guide, the term **contractor/supplier** has been used to denote an organisation that contracts directly with a Department, whether it is a supplier, a service provider or a construction contractor.

The term **Department** has been used to refer to those bodies subject to Northern Ireland Public Procurement Policy including Departments, Non-Departmental Public Bodies and Public Corporations. A full list of such bodies is available in Annex A of the Northern Ireland Public Procurement Policy (NIPPP).

1 INTRODUCTION

1.1 Building Information Modelling (BIM) is the process of constructing an intelligent, data rich, three dimensional (3D) model of a building or an infrastructure project. It can be applied to both new build and refurbishment projects, including projects in the roads and utilities sectors. The digital information in the model can be used to inform the decision making and management processes throughout the lifecycle of the asset. Through a collaborative approach, BIM reduces opportunity for error and waste which in turn leads to cost savings and carbon reduction in Government's building and infrastructure projects.

1.2 Through the use of 3D digital models and linked electronic data, BIM tests the asset, in virtual form, during the design and construction phases. The BIM delivery process is informed by the assessment of operational needs at the outset of the project and ensuring those requirements are addressed during key stage design and construction assessments. Through concise briefing, BIM aims to enhance coordination in the design, construction and operational phases leading to reduced cost across all phases.

1.3 The adoption of BIM will enable intelligent decisions about construction methodology, safer working arrangements, greater energy efficiency and a critical focus on the whole life performance of facilities (or assets). Equally important are the benefits for the economy that will accrue from better buildings and infrastructure delivered by Government. The UK Government has estimated savings to the UK construction industry and its clients of £2 billion per annum through the widespread adoption of BIM[1]. BIM is, therefore, a significant tool for Government in the delivery of savings in its infrastructure projects.

[1] HM Government, Industrial Strategy: Government and Industry in Partnership, Building Information Modelling, p6.

2 PURPOSE OF THIS GUIDANCE

2.1 The purpose of this guidance is to introduce BIM to Departments and to explain why Government is adopting it in the delivery of appropriate infrastructure projects. In addition, the guidance seeks to inform the construction Centres of Procurement Expertise (CoPEs) and construction suppliers as to how BIM should be applied during the procurement, delivery and operation of these projects.

2.2 Consequently, the guidance has been divided into two parts. Part A provides an overview of BIM including its benefits; Northern Ireland policy; and key aspects for Departments to consider in advance of implementation.

2.3 Part B provides operational guidance on how BIM should be applied in the procurement, delivery and operation of construction projects. It is focused at construction CoPEs and construction suppliers, however, Departments may also wish to refer to it when applying BIM in their infrastructure projects.

PART A: WHY BIM? – GUIDANCE FOR DEPARTMENTS

3 THE EVOLUTION OF BUILDING INFORMATION MODELLING

3.1 Traditional design methods

3.1.1 Construction projects have traditionally been designed in a two dimensional (2D) medium, generating paper based drawings and written specifications. 3D models have historically been used to communicate design intent through visual and tactile interaction but they could not embed or generate information about the design, its specifications or performance.

3.1.2 With the evolution of computer technology, Computer Aided Design (CAD) software emerged. CAD enabled designers to produce accurately dimensioned drawings largely in a 2D medium. The outputs were again in the form of paper based visual representations, drawings and specifications. While CAD brought benefits to designers, the process of cross referencing individual drawings to coordinate design information remained unchanged from traditional practices.

3.1.3 However, this process is exposed to the risk of error as information is passed from one discipline to another and, eventually, to the construction site where errors may become manifest. It is also wasteful in terms of time taken to review and restructure the design information to suit individual organisation's information management systems and protocols.

3.2 The emergence of BIM

3.2.1 With increasing computing power, CAD and computer aided manufacture (CADCAM) software emerged to enable 3D computer aided modelling of digital objects. The objects could now carry embedded information, known as parametric data, which informs the user of the object's properties. The interaction of the parametric data allows the user to test the performance of the design characteristics of the digital objects in a virtual environment before proceeding to the manufacturing process. Large

manufacturing industries quickly adopted CADCAM into their business models which, when applied within the appropriate management processes, enabled mass production with maximum efficiency.

3.2.2 Modelling software for the construction industry evolved at this time. Adoption of the software within the industry took time to develop until design methodologies, standard processes and protocols such as BS1192:2007 (see Section 6.3) were agreed. However, BIM pilot projects in the United States, Scandinavia, Netherlands and the United Kingdom, where BIM standards were established, have demonstrated multiple benefits to clients, designers and contractors from the adoption of BIM.

3.3 BIM benefits

BIM can offer significant benefits to Departments in the design, construction and operational phases of their construction projects. These benefits include:

- potential cost savings;
- visualisation of the virtual project enabling enhanced stakeholder understanding and engagement;
- greater transparency of cost and programme control;
- automated co-ordination of multi discipline design;
- facilitating alignment of the Department's sustainable construction requirements (for example, carbon reduction, environmental assessment and site waste management);
- the creation of safer working arrangements;
- structured and unified information management; and
- alignment of information in the model with asset management strategies.

3.4 BIM Maturity Levels

3.4.1 BIM Maturity recognises the varying work practices and level of BIM knowledge within the UK construction industry. The BIM Maturity Model (Figure 1) indicates, in graphical form, the adoption of standards and increasing BIM knowledge as time progresses. The rising incline on the graph is divided by vertical lines to create segments of maturity, starting at Level 0 and rising to Level 3, and beyond. Each 'Level' is defined by a progressive set of practices, protocols and standards relating to the use of information technology and information management in design, construction and operational processes.

3.4.2 The BIM Maturity Levels are explained in further detail in Table 1 below:

BIM Maturity	Definition
Level 0	Unmanaged 2D CAD, with data exchanged in paper or electronic paper form.
Level 1	Managed CAD in 2D or 3D format using BS1192:2007[2], with data shared via a collaborative tool such as a web based Common Data Environment (CDE) with a standardised approach to data structure and format. No integration of commercial data, finance or cost management packages.
Level 2 (BIM Level 2 required by April 2016)	Managed 3D environment where each discipline creates its own models and all project information is shared electronically in a CDE. Commercial data managed by Enterprise Resource Planning (ERP) software and integrated into the BIM by a proprietary interface or bespoke software. May use 4D construction sequencing and/or 5D cost information.
Level 3 (BIM Level 3 by TBC)	Fully integrated, collaborative process with models shared between the project team on a web-enabled BIM hub, compliant with the Industry Foundation Classes (IFC) open data standard. Will use 4D construction sequencing, 5D cost, and 6D project lifecycle management information.[3]

Table 1: BIM Maturity

[2] See Chapter 6 for BIM standard documentation

[3] Further information on BIM Level 3 is available at https://www.gov.uk/government. A date for its introduction to public sector procurement in Northern Ireland is to be confirmed.

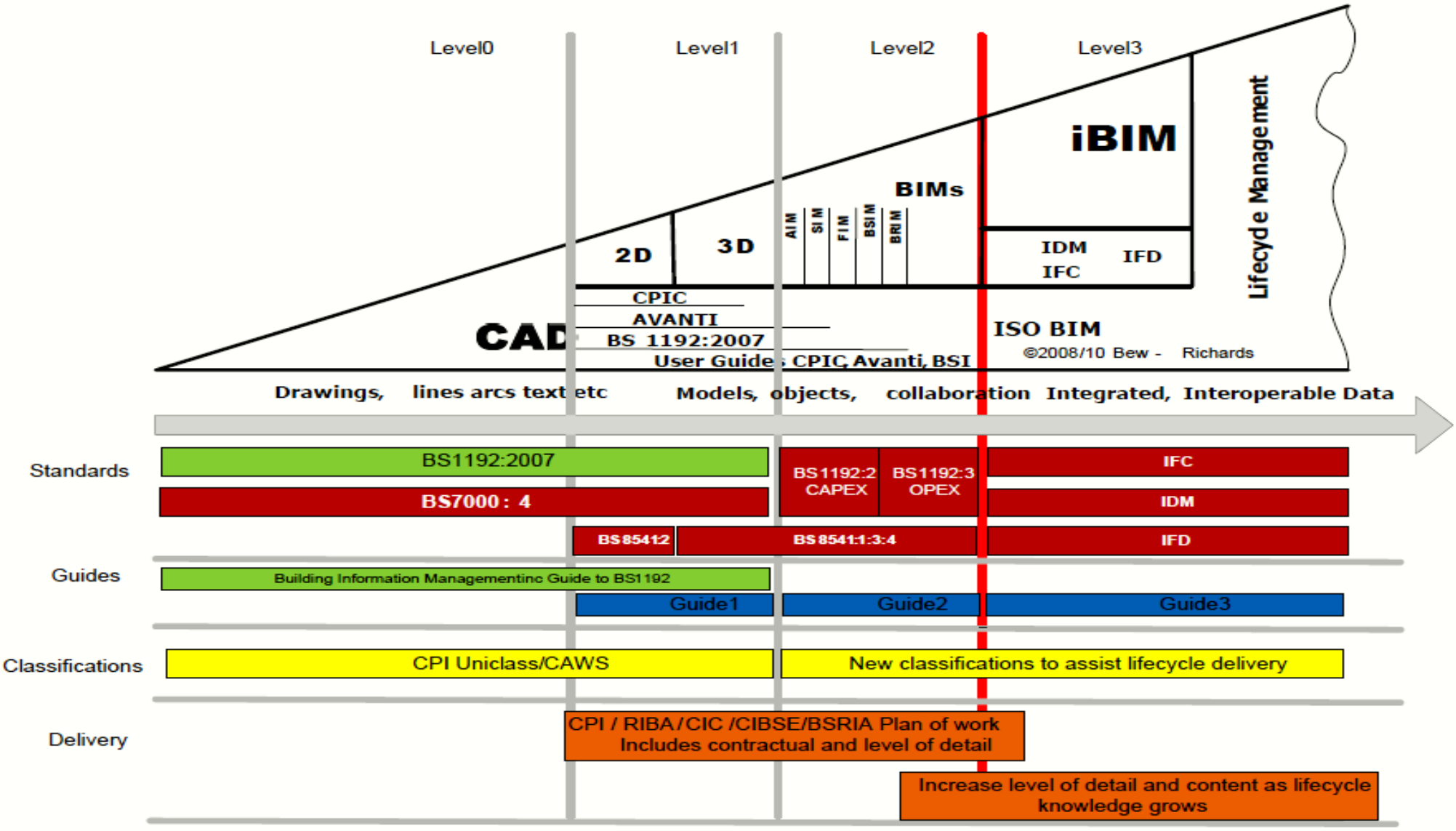

Figure 1: BIM Maturity Model © 2008/10 Bew-Richards

3.5 BIM Dimensions

BIM Dimensions are used to explain the capabilities of the BIM model. Additional dimensions are expected to evolve as BIM adoption and integration becomes widespread. Further detail on BIM Dimensions is provided in Table 2 below:

BIM Dimension	Application	Explanation
3D	**Model**	Denotes a model formed in three dimensions (width, length, height) enabling visualisation, walk through views, clash detection and off site pre fabrication.
4D	**Time**	Denotes construction planning, logistics planning and visual monitoring of programme phasing.
5D	**Cost**	Denotes cost analysis, quantity take-offs and real time costs estimating.
6D	**Facilities Management**	Denotes lifecycle management, monitoring energy efficiency, life cycle costs and optimising cost throughout the operational and maintenance phase.

Table 2: BIM Dimensions

3.6 Northern Ireland BIM policy

3.6.1 The Northern Ireland BIM policy is that from 1 April 2016, all Government centrally procured construction projects with a value greater than the EU procurement threshold for construction works (currently ~£4.1 million) shall, where there is potential for efficiency savings, be delivered to BIM Maturity Level 2.

3.6.2 The Northern Ireland BIM policy broadly aligns with Cabinet Office's policy to implement BIM Maturity Level 2 in all centrally procured construction projects by 2016. This approach seeks to ensure that regarding BIM,

Northern Ireland's construction suppliers are not placed at a commercial disadvantage compared to their GB counterparts when bidding for work outside Northern Ireland.

4 IMPLEMENTING BIM WITHIN DEPARTMENTS

4.1 The stages in BIM Enabled Projects

To assist Departments, a summary of the various stages in BIM enabled projects (including their requirements) is provided in Table 3 below. It is recognised that a Department's input may vary with the referred procurement route and stage management, but advice should be taken from the relevant CoPE regarding the degree of involvement required. Further detail on the requirements at each stage is provided in Part B.

Delivery Stage	BIM Requirements
Commissioning (RIBA Stage 0)	Completion of BIM Efficiency Test
Procurement (RIBA Stages 0-3)	Develop Employer's Information Requirements. Assessment of Consultants' and Contractors' BIM Execution Plans.
Delivery (RIBA Stages 1-5)	Develop the Project Information Model (PIM). Implement collaborative working in a Common Data Environment.
Handover (RIBA Stage 6)	As built PIM translated to Asset Information Model (AIM). Taking possession of the AIM.
Operation – In Use (RIBA Stage 7)	Post Project Evaluation Maintenance and upkeep of the AIM

Table 3: Stages in a BIM Enabled Project

4.2 Commissioning stage

4.2.1 At the commissioning stage, and as part of the business case process, the Senior Responsible Owner (SRO) for the project in conjunction with the CoPE, should undertake a BIM Efficiency Test. This is to determine if the project should be delivered through the use of BIM.

4.2.2 A sample generic template is included within Annex B to assist Departments when conducting a BIM Efficiency Test. The template is broadly based on the qualitative assessment of the Construction Project Information Committee (CPIx) 12 Areas of BIM and their potential benefits to the project. Departments and their CoPEs may wish to tailor the test to align with their standard procurement process, relevant construction sector and chosen procurement strategy. Knowledge and experience gained through the application of BIM on previous projects and the benefits it has realised can be used to inform future BIM Efficiency Tests.

4.2.3 Up until supplier selection stage, as the project proceeds, the test can be reapplied as further information becomes available. This approach is consistent with the need to clearly define the scope of BIM requirements which are to be included in procurement documentation for the procurement of the associated professional services and construction works contracts.

4.3 Procurement, delivery and handover stages

During the procurement, delivery and handover stages, the CoPE will advise the Department regarding BIM requirements. The CoPE is required to appoint an Information Manager (see Section 8.3). The CoPE, in consultation with the Department, will develop Employer's Information Requirements (EIR) to inform the procurement of consultants and contractors. The consultants and contractors will develop the design via a Project Information Model (PIM) from

which the project is built. The CoPE will normally[4] manage the consultants and contractors in the development of the model, the release of information from it and the construction and handover of the asset. Procedures, roles and responsibilities are defined within BS1192:2007 and PAS1192:2

4.4 Operation – In Use stage

Upon completion of the project, the Department (normally via its estate management function) will take ownership of the 'as-built' PIM. This is known as the Asset Information Model (AIM). It is important that the Department, through its estates management function, retains and updates the AIM with any changes to the asset. Access and reference to the AIM will be important for operation, servicing, maintenance and potentially demolition of the asset at a future time.

4.5 Investment and training in BIM

4.5.1 Adoption of BIM work practices within any organisation may require investment in hardware, software and training for staff. Departments and construction CoPEs may therefore wish to review the capabilities of their existing hardware and software and its ability to generate and receive BIM project information. However, this will be informed by the level and nature of involvement that the Department has in relation to infrastructure projects incorporating BIM.

4.5.2 For example, a Department that is not normally involved in the delivery of infrastructure projects may decide that it does not need to invest in BIM hardware or software. Should the Department become involved in the delivery of an infrastructure project incorporating BIM it may decide that investment in

[4] In some grant funded capital construction projects, the CoPE may not be involved in managing the project. In addition, some CoPEs require that the Integrated Consultant Team manages the construction contract once awarded.

read only software which enables it to view the PIM or AIM is sufficient. Read only BIM software is normally available free of charge.

4.5.3 Similarly, a CoPE that undertakes the design of all or part of an infrastructure project, incorporating BIM, may need to invest in BIM hardware, software and training for staff in the administration and operation of BIM. However, when the design is outsourced to the private sector, the CoPE may decide that investment in read only BIM software will suffice.

4.5.4 Departments and CoPEs with asset and facilities management teams may wish to review the capability of their existing Computer Aided Facilities Management (CAFM) and/or Computer Aided Maintenance Management Systems (CAMMS) software to integrate with BIM models and the training of personnel to maintain the AIM.

4.5.5 Departments and construction CoPEs that are delivering BIM projects should review staff training needs. BIM training is available within Northern Ireland through the local universities and colleges of further and higher education.

4.5.6 Departments and construction CoPEs delivering BIM projects may operate an in-house Common Data Environment (CDE) and may permit authorised Integrated Consultant Team (ICT) or Integrated Supply Team (IST) members to access it. Where no CDE exists, Departments/CoPEs may wish to notify ICT/IST in tender documentation of their requirement to provide a CDE and to permit access to it by Department/CoPE personnel.

4.6 Factors for SROs to consider when implementing BIM

To assist SROs when implementing BIM, the following factors should be considered in consultation with the CoPE:

- Is the value of the construction project greater than the value of the EU Threshold for construction works?
- If not, does the Department wish to pilot BIM on a lower value project?
- Will BIM deliver efficiency savings for the project? To determine this, a BIM Efficiency Test should be completed at the commissioning stage.
- If BIM is to be implemented, does the Department need to invest in BIM hardware, software and training for staff?
- Has the Department's estate management function been consulted from the earliest stages of the project?
- What are the EIRs and key deliverables for the BIM model at each stage of design and delivery?
- How will the Department access the BIM model during design, delivery and handover, and how will a secure CDE be created?
- How will the AIM be stored and accessed by the Department, following handover?
- Lessons learned from the implementation of BIM on the project should be captured during the Post Project Evaluation.

PART B: HOW TO APPLY BIM – GUIDANCE FOR COPES AND SUPPLIERS

5 APPLYING BIM TO GOVERNMENT'S CONSTRUCTION PROJECTS

5.1 Process management

5.1.1 Prior to implementing BIM, CoPEs should recognise that BIM requires a fundamental shift in the normal process management for construction projects. Traditional design processes typically generate most of the project information during the detailed design and tender preparation stages. Changes in design information during these stages can cause maximum impact to the cost of change in the project.

5.1.2 Integrated Project Delivery (IPD) is considered the optimal delivery mechanism as it aims to reduce waste and inefficiency by requiring all participants in a project to work collaboratively to resolve design and construction challenges during the earlier design stages. BIM enhances the outcomes of all procurement paths.

5.1.3 The MacLeamy Curve (Figure 2 below) indicates how, through the use of IPD, BIM aims to maximise production information at an earlier stage in the design process thus reducing the impact of change on cost. IPD principles are consistent with a number of procurement routes.

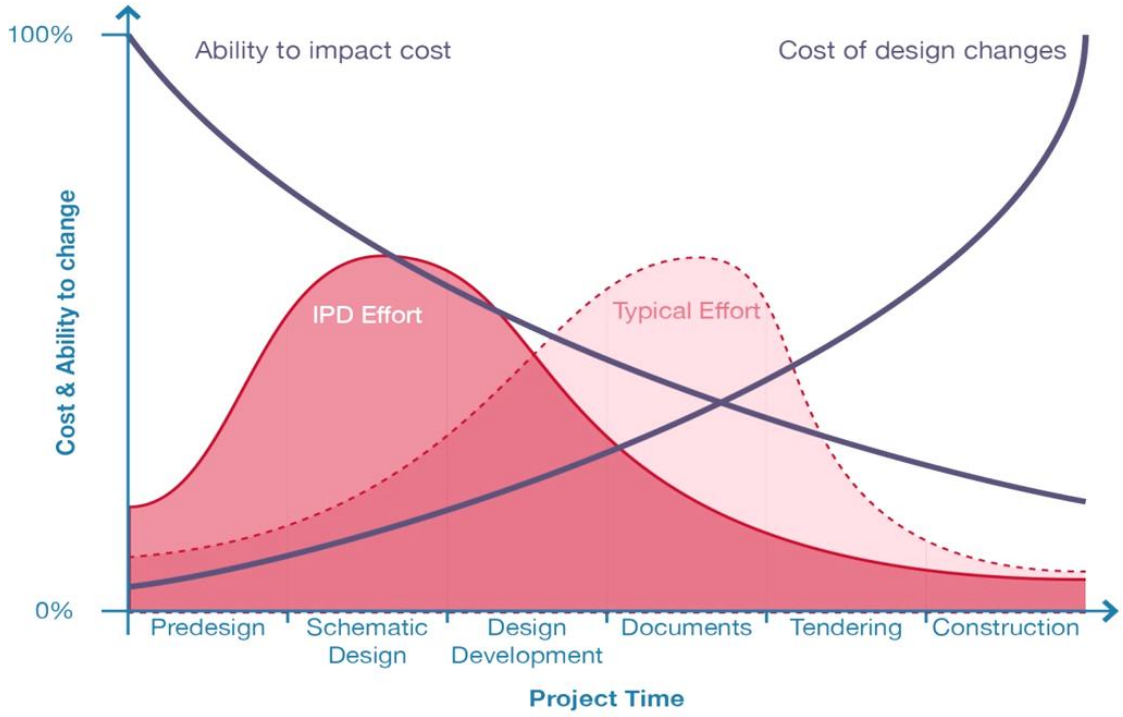

Figure 2: MacLeamy Curve © Patrick MacLeamy/HOK/Building SMART

5.2 The BIM Task Group and Northern Ireland BIM Hub

5.2.1 The UK Government established the BIM Task Group to help deliver the objectives of its Construction Strategy and to strengthen the public sector's capability in BIM implementation. The BIM Task Group seeks to promote BIM's role in achieving improvements in cost, value and carbon performance through the use of open shareable asset information. Further information is available at: www.bimtaskgroup.org.

5.2.2 The BIM Task Group brings together expertise from across the UK construction industry. Regional BIM leadership and advice throughout the UK is promoted through Construction Industry Council (CIC) BIM Regions groups which are aligned with the BIM Task Group. In Northern Ireland, the BIM Regions NI Steering Group is comprised of Northern Ireland construction industry representatives and Government Clients. Further information is available at: http://bimregni.co.uk/.

5.3 Digital Plan of Work

5.3.1 Recognising a shift in traditional work practices presented by BIM, the BIM Task Group produced the Digital Plan of Work for use on BIM projects. The Construction Industry Council's (CIC) Scope of Services Works Stages 2012 and the Royal Institute of British Architects (RIBA) Plan of Work 2013 have subsequently been aligned with the Digital Plan of Work.

5.3.2 The new plans of work unify and standardise work stages and discipline roles across project types and procurement routes. A graphical alignment of these process plans is included in Annex C. Prior to implementing BIM, construction CoPEs should familiarise themselves with the CIC's Digital Plan of Work.

6 BIM STANDARD DOCUMENTATION

6.1 BIM standard documentation

The BIM Task Group, through consultation with the UK construction industry, has developed a series of standards that facilitate the implementation of BIM in infrastructure projects. These are recognised industry standards which have been adopted in the UK[5] and are being increasingly adopted across the world. The implementation of BIM in public sector infrastructure projects in Northern Ireland is intended to align with these standards, specifications and protocols. Details of each of these standards are provided below, along with an overview of their requirements. In the following sections of this guidance, construction CoPEs should familiarise themselves with the content of these standards prior to implementing BIM in their infrastructure projects.

6.2 List of BIM standard documentation

- BS 1192:2007+A2:2016 - Collaborative production of architectural, engineering and construction information. Code of practice.
- PAS1192-2:2013 - Specification for information management for the capital/delivery phase of construction projects using building information modelling
- PAS1192-3:2014 - Specification for information management for the operational phase of assets using building information modelling
- BS1192-4:2014 - Specification for information management for the operational phase of assets using building information modelling
- PAS1192-5:2015 - Specification for security-minded building information modelling, digital built environments and smart asset management

[5] With the exception of BS1192:2007, BIM standard documentation is generally available free of charge.

- Government Soft Landings Policy (GSL)
- Construction Industry Council (CIC) BIM Protocol
- CIC Outline Scope of Services for the Role of Information Management
- CIC Best Practice Guide for Professional Indemnity Insurance when using BIM models

6.3 BS1192:2007 - BIM collaborative working and structured information

6.3.1 Collaborative working within construction projects is recognised as a more efficient method of achieving higher quality and standards. It leads to clear routes of communication and avoids unnecessary waste in the transfer of information from one party to another.

6.3.2 A widely adopted model for collaborative working and sharing of electronic information between parties is the Common Data Environment (CDE). The CDE is an online repository for the storage, transfer and recording of information between all involved in the construction project.

6.3.3 The CDE was formally recognised with the publication of BS1192:2007 which promotes its use and provides a structure for the management of the data. This is explained in graphical format in Figure 3 below. BS1192:2007 is a key requirement for achieving BIM Maturity Level 2 and above.

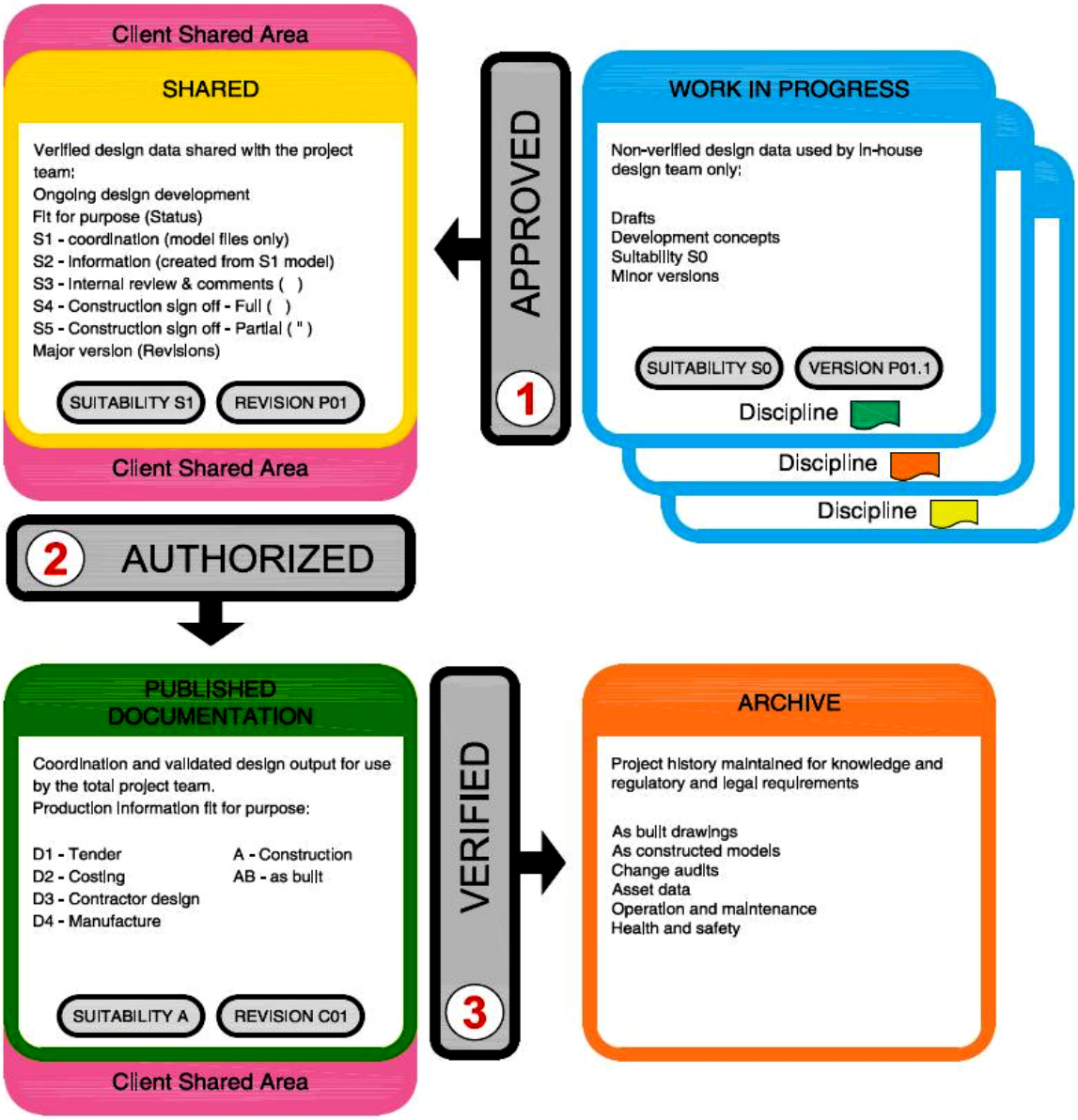

Figure 3: BS1192:2007 Common Data Environment structure

6.3.4 BS1192:2007 also addresses standards and conventions for file naming, layer naming and project co-ordination. It should be read as best practice guidance for management of construction project information. Adoption of its recommendations throughout the construction industry aims to instil efficient information management, sector wide.

6.3.5 Collaborative working requires a willingness of all parties to share their information for the benefit of the project. The CIC BIM Protocol (see Section 8.2) provides guidance on the use of models in a collaborative

environment and it makes arrangements for copyright and Intellectual Property Rights (IPR) through exchange of licenses and ownership of the data. The CIC BIM Protocol is a contractual document to be appended to existing contracts for use on BIM projects.

6.4 PAS1192-2:2013 (and future revisions) - BIM design and construction phases

6.4.1 PAS1192-2 is a key guidance document for BIM delivery of an asset during the design and construction stages. It builds upon the structuring of information referred to in BS1192:2007 and provides guidance on project assessment of need, procurement, contract award, mobilisation and production information.

6.4.2 The PAS1192-2 BIM Delivery Cycle (Figure 4 below) graphically explains the process for the Department's/CoPE's, Integrated Consultant Team's (ICT) and Integrated Supply Team's (IST) decision making. The blue arrows indicate the management process that flows around the information process in green. The information process is managed within a CDE leading to the creation of the Project Information Model (PIM). The 'As Constructed' PIM and its electronically linked information are provided to the Department upon handover of the project. The PIM is considered critical to the successful delivery of the project. This is because access to it during the operational phase of the asset is important for the Department in establishing, recording and benchmarking the asset's performance and also for maintenance purposes. Upon handover of the asset, the PIM becomes known as the Asset Information Model (AIM).

6.4.3 In consideration of all BIM Level 2 projects, facilities and asset management requirements should inform the strategic briefing process so that optimum performance of the asset's lifecycle is considered from the outset. This approach adopts the recommendations of the UK Government's Soft Landings (GSL) policy - see Section 6.8.

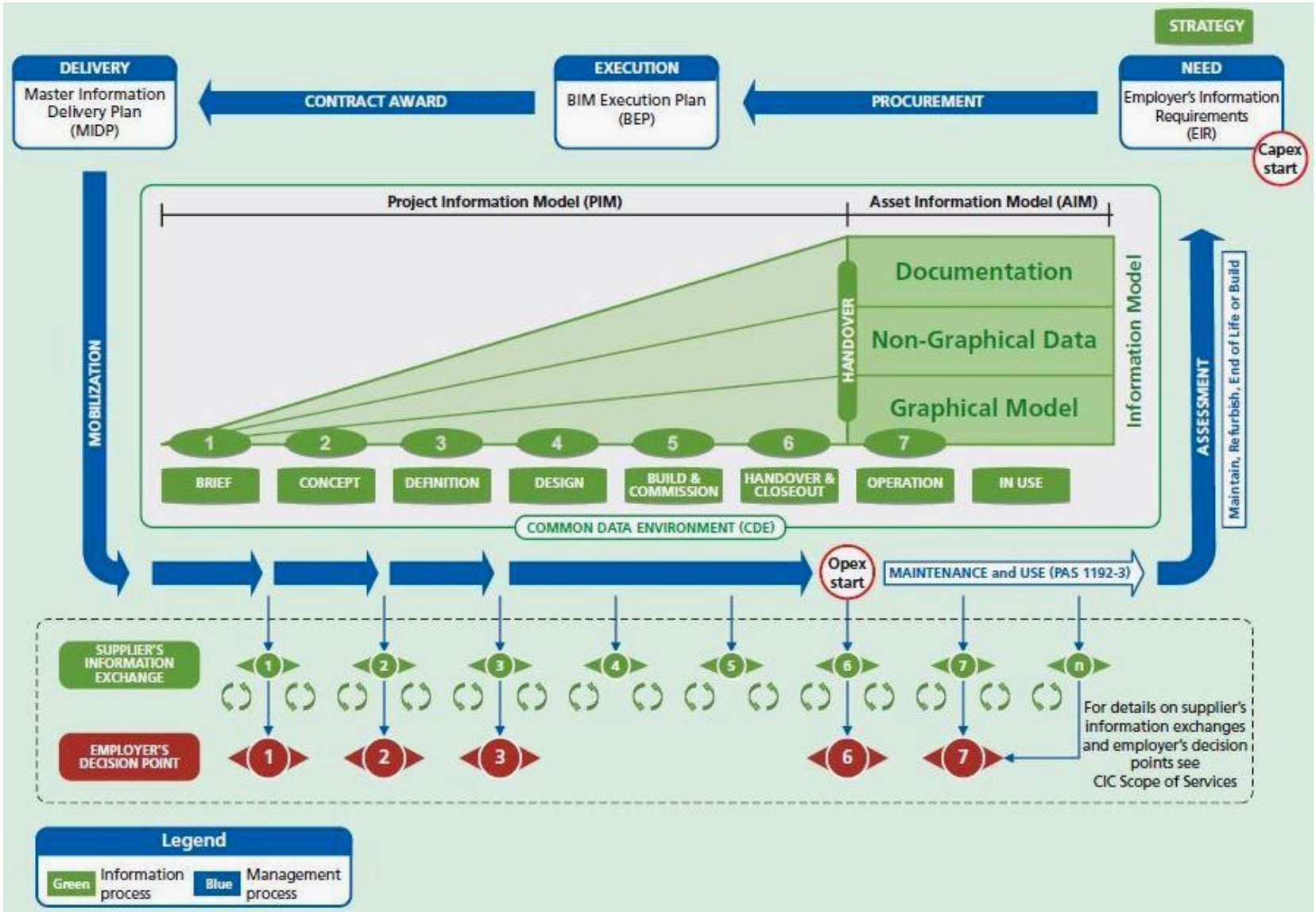

Figure 4: BIM Delivery Cycle

6.5 PAS1192-3:2014 (and future revisions) - BIM operational phase

6.5.1 PAS1192-3 provides guidance on the management of the AIM. It focuses on the operational phase of an asset, whether it was commissioned through major works, acquired through transfer of ownership or already existed in an asset portfolio.

6.5.2 The operational phase of an asset is deemed to commence at handover but the requirements within PAS1192-3 may also be applied to the development of information during design and construction. Therefore, PAS1192-3 should be considered when developing the EIR (see Section 7.1).

6.5.3 The flow of information requirements within a project incorporating BIM is of particular importance. The relationships between the Department's/CoPE's EIRs and how these inform the AIM are illustrated diagrammatically in Figure 5 below.

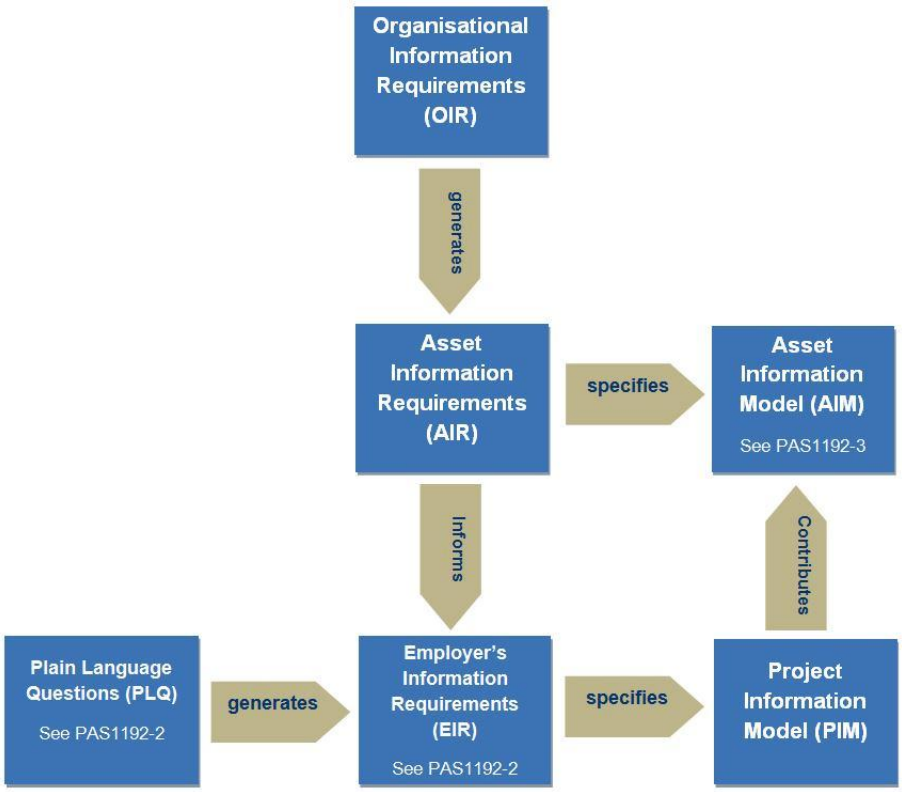

Figure 5: Relationship between elements of information management

6.6 BS1192-4:2014 - BIM information exchange

6.6.1 BS1192-4:2014 is a code of practice for the structuring of embedded information in BIM models. The embedded information is known as Construction Operations Building information exchange (COBie) data. It is important to structure this data in BIM models to ensure that the information best suits the needs of the Department/CoPE for the project's key stage assessment and/or its asset management.

6.6.2 COBie data is typically expressed in an electronic spreadsheet to provide a structured and standardised view of the non graphical information in the BIM. It can be used to provide evidence of compliance with the EIR and is one of the core deliverables for the key stage assessment process.

6.6.3 COBie provides a bridge between the digital design and construction BIM models and the Department's or CoPE's CAFM/CAMMS software which can significantly reduce the cost of transferring information into these systems when compared to existing manual data entry processes.

6.6.4 Uniclass 2015 has been adopted by the UK Government and the construction industry bodies as the preferred classification system for use with BIM. Referencing of project information in BIM models requires use of this system. It has been developed specifically for working with BIM in the UK and provides a means of structuring project information throughout the lifecycle of the project.

6.6.5 Uniclass 2015 replaces all previous versions of the Uniclass classification system and other similar systems such as CAWS and CI/SfB.

6.6.6 It has been adopted by the New Rules of Measurement (NRM 1-3) methodology for cost estimation and the National Building Specification (NBS) BIM Toolkit and NBS specification software.

6.7 PAS1192-5:2015 (and future revisions) - BIM security of information

PAS1192-5 is best practice guidance for the management of information within an online environment. Departments/CoPEs should familiarise themselves with this guidance because it provides advice on measures that can be taken to ensure that the online management of their digital built assets is cyber secure.

6.8 Government Soft Landings (GSL)

6.8.1 GSL is a key consideration in the delivery of BIM projects. Its purpose is to champion better outcomes for Government's built assets during the design and construction stages. It seeks to achieve this via BIM to ensure that value is achieved in the operational lifecycle of the asset. Consequently, it aims to align the interests of those who design and construct an asset with those who use it.

6.8.2 GSL has identified four focus areas where measurements, key questions and outputs are to be addressed along the project timeline. The four areas are:

- Functionality and Effectiveness;
- Environmental;
- Facilities Management; and
- Commissioning, Training and Handover.

6.8.3 Departments, in conjunction with their CoPEs, may wish to review their existing asset and facilities management strategies in consideration of adoption of GSL best practice recommendations. Departments/CoPEs may also wish to consider the nomination of a GSL Champion to undertake the following duties on BIM Level 2 projects:

- work with the Department's development team in assessment and preparation of the brief and EIR documents to ensure alignment with asset and facilities management strategies;
- partake in the key stage data drop assessment process;
- liaise with the IST during construction;
- oversee pre handover testing and commissioning;
- liaise with the IST during the GSL post handover occupancy period (where required) to ensure optimum performance is achieved;
- ensure project feedback is relayed back to the Department's development team; and
- ensure the AIM is maintained throughout the project's operational lifecycle.

6.8.4 GSL is referenced within BS8536-1:2015 Briefing for design and construction - Part1: Code of practice for facilities management (Buildings infrastructure). Departments/CoPEs may wish to review this standard as part of an AM/FM strategy development process.

7 PROCUREMENT OF BIM CONSTRUCTION PROJECTS

7.1 Employer's Information Requirements (EIR)

7.1.1 EIR provide prospective suppliers with the minimum information required by the Department/CoPE to meet the BIM objectives for the project. EIR form the basis on which the BIM Execution Plan (BEP) is prepared by prospective suppliers, in turn providing Departments with a benchmark for both tender and key works stage assessment.

7.1.2 EIR are normally compiled from the standard criteria outlined in Table 4 below:

Technical	Management	Commercial
Software Platforms Data Exchange Format Co-ordinates Level of Detail Training	Standards Roles and Responsibilities Planning the Work and Data Segregation Security Coordination and Clash Detection Process Collaboration Process Health and Safety, and Construction Design Management Systems Performance Compliance Plan Delivery Strategy for Asset Information	Data drops and project deliverables Clients Strategic Purpose Defined BIM/Project Deliverables BIM-specific competence assessment

Table 4: Standard EIR Criteria

7.1.3 CoPEs should prepare project specific EIR for issue with procurement documentation on BIM projects. CoPEs may wish to refer to the National Building Specification (NBS) BIM Toolkit when preparing their EIR. The specific BIM Goals and BIM Uses should be identified within EIR to provide

suppliers with clear objectives for the BIM process. The CoPE's Information Manager can assist in formulating the EIR.

7.2 Plain Language Questions (PLQ)

7.2.1 PLQ are simple, concise, unambiguous questions written in plain English. They are prepared by the CoPE and form part of the EIR. Their purpose is to assist the CoPEs to interrogate the information delivered by suppliers from the BIM Model at key project stage assessments following contract award. In addition to the other EIR criteria, PLQ inform prospective suppliers when preparing their tender documentation.

7.2.2 Key stage assessment of compliance with EIR, during the delivery phase, will be determined by the response to the PLQ for that stage. It is good practice that CoPEs review the PLQs following each key stage assessment during the delivery of the project.

7.3 Requirements for BIM at selection and award stages

Until such times as BIM becomes suitably embedded within the local construction industry[6], it is not proposed that evidence of previous experience of BIM will be a requirement at prequalification (PQQ) stage. However, from 1 April 2016[7], infrastructure procurements incorporating BIM should include qualitative award criteria that test how the firms bidding will apply BIM to that project. This can be applied through a requirement to submit a pre contract BIM Execution Plan.

[6] The Construction Industry Forum for Northern Ireland will be consulted on any proposed future date for the introduction of BIM requirements at selection stage.

[7] BIM Pilot Projects may be undertaken in advance of the 1st April 2016.

7.4 Pre-contract BIM Execution Plan (BEP)

7.4.1 The pre-contract BEP is prepared on behalf of the ICT or IST by the Economic Operator. The pre contract BEP should demonstrate the team's capability, capacity and competence in its application of BIM to the project and how this satisfies the EIR.

7.4.2 Any CoPE specific requirements for the Pre Contract BEP and associated Supply Chain Assessment Forms should be issued with Invitation To Tender (ITT) documentation. Standard CPIx Supply Chain Assessment Form templates should be appended to ITT documents on BIM projects. CoPEs can then consider assessment of each team's Pre Contract BEP as part of the quality award criteria.

7.5 Supply chain assessment

7.5.1 The supply chain assessment process informs the Economic Operator of strengths and weaknesses in BIM capability within its team. This allows the team to plan accordingly for delivery of the EIR. The supply chain assessment process informs the team's BEP through development of its Task Information Delivery Plan (TIDP) and Master Information Delivery Plan (MIDP). CoPEs should reserve the right to examine the Supply Chain Assessment Forms in advance of award of contract.

7.5.2 Figure 6 below indicates the flow of information leading to the production of the Pre Contract BEP:

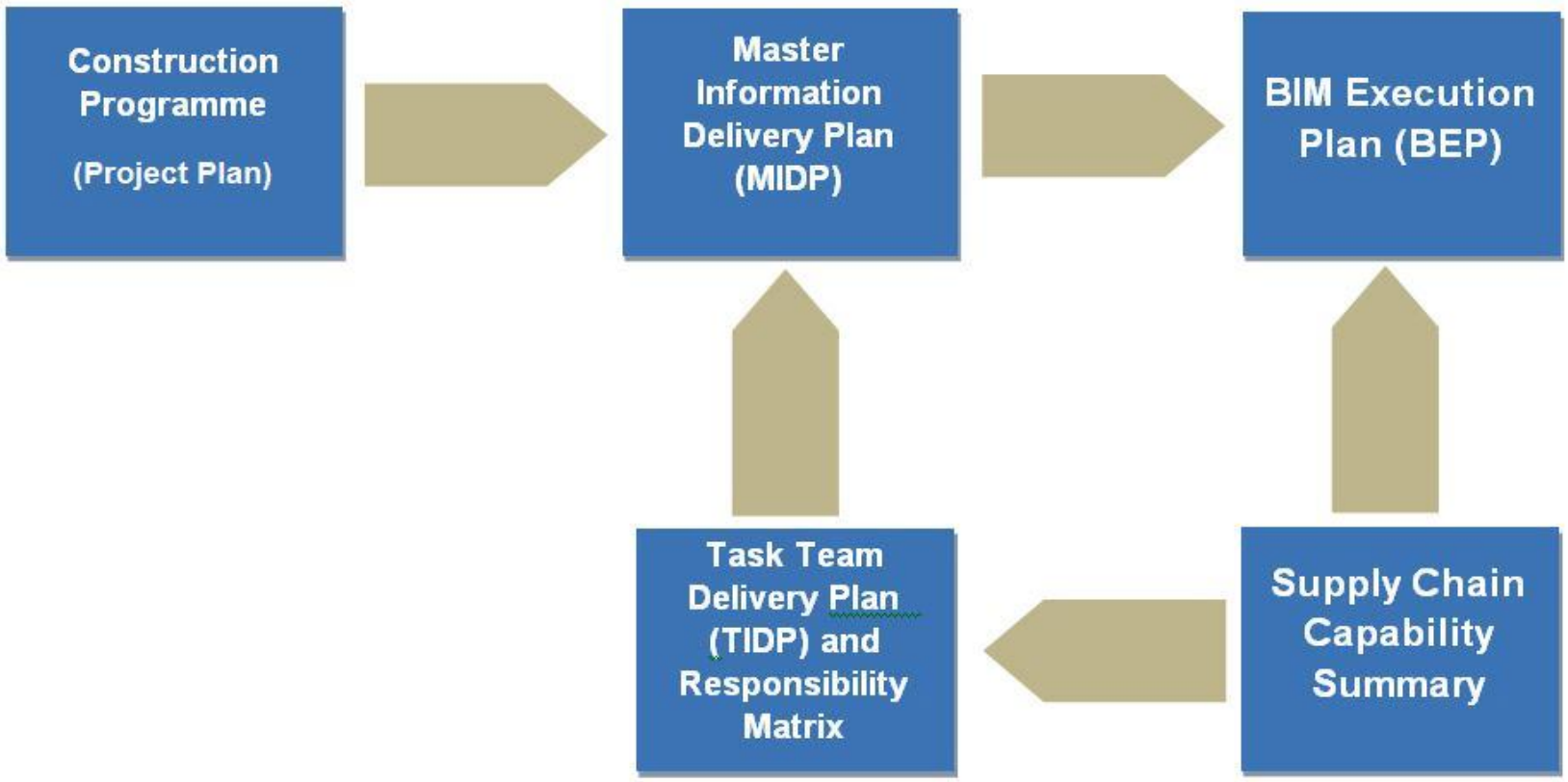

Figure 6: BEP document flow chart

8 DELIVERY OF BIM CONSTRUCTION PROJECTS

8.1 Post-contract BIM Execution Plan

8.1.1 The Post Contract Award BEP will be developed by the successful EO with their supply chain for CoPE approval. It is a document that adds additional procedural and technical detail to the Pre-Contract BEP, which encompasses the following components, necessary to deliver BIM Maturity Level 2 information:

- requirements of the EIR;
- management strategy;
- planning and documentation;
- standard methods and procedures; and
- IT Solutions.

8.1.2 The EIR data and Master Production Delivery Table (MPDT)[8] within the Post Contract Award BEP become a contractual requirement by incorporating them into the contract through the CIC BIM Protocol. This Protocol must be included in the additional conditions of the contract and be incorporated into all applicable suppliers appointments, cascading through the various tiers of the supply chain. In an NEC3 Engineering and Construction Contract, this is achieved by including an Option Z clause (see Clause Z26 included in PGN 01/15: Standardisation of NEC3 Engineering and Construction Contract Z Clauses). Similar arrangements need to be made in the NEC Professional Services Contracts, if appropriate.

8.2 CIC BIM Protocol

The CIC BIM Protocol is a contractual document that ensures there is an obligation on parties to provide defined elements of their works and services

[8] See Annex D.

using BIM models. The Protocol has been developed for use on BIM Level 2 projects via appendage to the project's contract. The conditions of the Protocol shall apply back to back across all subcontracts within the project. CoPEs' Client Advisors and/or Project Managers should ensure that the CIC BIM Protocol is appended to the successful bidder's contract and that its conditions apply throughout the team's supply chain subcontracts.

8.3 Information Manager

8.3.1 The CIC BIM Protocol sets out a requirement for the appointment of an Information Manager within the ICT and/or the IST. The Information Manager is responsible for the management of the CDE, project information management and information exchange. The Information Manager has no design responsibility. The role may be performed by an existing ICT/IST team member, a new team member or an individual appointed independently by the Department[9].

8.3.2 Further guidance on the role of an Information Manager is available within the:

- CIC BIM Protocol;
- CIC Outline Scope of Services for the Role of Information Management; and
- CIC Best Practice Guide for Professional Indemnity Insurance when using Building Information Models.

8.4 Project Information Model (PIM) delivery

Following contract award, the PIM will be developed by the ICT or IST. Its development must be in accordance with the process defined by the CoPE in

[9] The Information Manager role can be performed by an existing ICT/IST member in addition to their normal role. Where a Department/CoPE considers the project to be sufficiently complex to warrant an independent team member to undertake the role, it may examine previous Information Management experience as part of the pre qualification selection criteria.

the EIR, specifically the MPDT (a sample MPDT is included in Annex D). Models will be produced by each discipline and federated into a coordinated model by the lead team member as identified within the BEP. Individual models and associated information will be shared with the Department/CoPE and other team members within the CDE.

8.5 Key stage assessment/data drops

8.5.1 Key stage assessment points (data drops) in the BIM delivery process require 3D digital models, 2D electronic information and COBie data to be presented to the Department/CoPE for approval.

8.5.2 The file formats required by the Department/CoPE, the expected Level of Detail (LOD) and the Level of Information (LOI) for each key stage data drop should be outlined within the EIR. 2D electronic information shall be derived from the 3D digital model or sourced from within the supply chain, coordinated with and electronically linked to the BIM model. CoPEs should familiarise themselves with the LOD/LOI standards outlined within PAS1192-2 BIM Design and the NBS BIM Toolkit.

8.6 Handover and the AIM

8.6.1 In advance of handover, CoPEs should verify that the EIR, project deliverables and performance specifications have been met. The ‘As Constructed’ model should represent the ‘As Constructed’ project. Verification of the PIM/AIM should be undertaken with the ICT/IST in advance of accepting handover.

8.6.2 The purpose of an AIM is to be the single source of approved and validated information relating to the asset. Its data and geometry describe the asset, the spaces and items associated with it and data about the performance of the asset such as specifications, operation and maintenance manuals, and health and safety information.

8.6.3 The AIM is the product of the CDE process and comprises the ‘Published’ part of the CDE containing federated models, graphical and non graphical documents and metadata enabling the archiving and resourcing of the data.

8.6.4 Departments/CoPEs should review in their Post Project Evaluations (PPE) how the AIM delivered by the ICT/IST may be best utilised within their asset and facility management strategies. The PPE findings should be used to inform the Department’s next infrastructure project’s EIR.

8.7 Operation – In Use

8.7.1 During the operational phase of the asset’s lifecycle, the AIM should be updated to take account of all maintenance and refurbishment works. This work may be undertaken by the IST during the defects period and/or the Department’s asset management teams thereafter (see PAS1192:3 for trigger points).

8.7.2 Departments/CoPEs should consider the feasibility and practicalities of maintaining the AIM to inform the management of an asset throughout the operational and maintenance lifecycle phase until its decommissioning/disposal.

9 FURTHER INFORMATION

Further information regarding BIM, within Northern Ireland and the rest of the UK, is available at www.bimtaskgroup.org

Any queries on this guide should be addressed to:

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Belfast, BT3 9ED
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ANNEX A: GLOSSARY

Asset Information Model (AIM): is data and information regarding an asset to a level required to support an organisation's asset management system.

Asset Information Requirements (AIR): is information required for the management and operation of the asset through use of an AIM.

BIM Execution Plan (BEP): is a plan prepared by the bidding team to explain how the information modelling aspects of the project will be carried out.

Building SMART Alliance: an international alliance of construction, facilities management and information technology organisations dedicated to improving processes in the definition, use and sharing of information. Local representation is through Building SMART UK & Ireland.

Construction Operations Building information exchange (COBie): a framework for extracting non graphical information from BIM models and delivering the information, often in a spreadsheet format. The output information is used to inform decision making and operational use of asset and facilities management systems.

Computer Aided Facilities Management (CAFM): the software supporting facility management. Typical subjects facilitated include space, asset, portfolio, move and project management, facilities maintenance, strategic planning and sustainability.

Computer Aided Maintenance Management System (CAMMS): systems that use computer software to organise planning, scheduling and support of maintenance and repair.

Common Arrangement for Works Sections (CAWS): A construction industry working convention designed to promote co-ordination between bills of quantities and specifications. Originated in UK in 1987 to replace CI/SfB and was replaced by Uniclass in 1997.

Common Data Environment (CDE): A web based repository for the storage, transfer and recording of information between all involved in the construction project.

Construction Industry/Samarbetskomittén för Byggnadsfrågor (CI/SfB): Construction indexing manual that aligns building products with production information. Originated in Sweden in 1950s and adopted within the UK in the 1960s. Replaced by CAWS in UK in 1987.

Data Drop: term used for a Department or CoPE key stage assessment point in the BIM delivery cycle.

Digital Plan of Work (dPoW): structured process plan with defined works stages, roles and responsibilities for the delivery of BIM projects.

Employer's Information Requirements (EIR): 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 delivery process.

Government Soft Landings (GSL): UK Cabinet Office policy aligning operational strategies with development strategies for the benefit of employers and users in the delivery and operation of public sector buildings.

Industry Foundation Class (IFC): A platform neutral, open file format focused on the ease of interoperability between software platforms. It is based on a BuildingSMART data model for management of embedded information with object based file formats.

Integrated Consultant Team (ICT): a multi disciplinary team of construction professionals formed to work within a team environment. Its purpose is to deliver the design of a construction project to the highest standards and detail to meet with the objectives of the client brief.

Integrated Project Delivery (IPD): a project delivery method that integrates people, systems, business structures and practices into a collaborative process to optimise efficiency through all phases of design, fabrication and construction.

Intellectual Property Rights (IPR): exclusive rights afforded to the creators of music, art, literature, inventions, discoveries, words, phrases, symbols and designs, which (following registration) may be protected under common law. Types of IPR are copyright, patents and industrial design rights.

Integrated Supply Team (IST): a team of construction specialists including a main contractor, professional consultants and subcontractors formed to deliver the construction of a project to the highest standards and detail to meet with the objectives of the client brief.

Master Information Delivery Plan (MIDP): the primary plan for when project information is to be prepared, by whom and using what protocols and procedures, incorporating all relevant task information delivery plans.

New Engineering Contract 3 (NEC3): a construction industry standard contract for construction works and professional services. Written in plain English and designed to stimulate good management, it is Government's preferred construction contract in Northern Ireland.

Organisational Information Requirements (OIR): data and information required to achieve the organisation's objectives.

Plain Language Questions (PLQ): a set of simple concise questions used to examine the information submitted at each key works stage assessment.

Project Information Model (PIM): integrated and coordinated, graphical and non graphical documentation resulting from the design process. The information made available through the published area of the common data environment.

Publicly Available Specification (PAS): a sponsored fast-track standard driven by the needs of the client organisation(s) and developed according to guidelines set out by British Standards Institute (BSI).

Task Information Delivery Plan (TIDP): a plan for the sequenced delivery of information between team members aligned with, roles and responsibilities, the construction programme and EIR.

ANNEX B: SAMPLE BIM EFFICIENCY TEST

BIM Efficiency Savings Test Criteria

Project Name: **Department/CoPE:** **Date:**

SRO Name: **CA/PM Name:** **Bands:** **low** **medium** **high**

The BIM Efficiency Savings Test should be undertaken at OGC Gateway Review Gate 0 - Business Case Assessment in projects > £20 million OR during the Initial Peer Review Process in projects < £20 million. Departments/CoPEs may wish to undertake further reviews of the test during key project gateways. The CA/PM and SRO are to assess the potential for the listed BIM benefits to deliver efficiency savings within the project. Award RED for a low potential, AMBER for a medium potential, GREEN for a high potential in your consideration for BIM to deliver efficiency savings in this project.

Provide reasons for your decisions in the comments box. Where the total number of AMBER and GREEN outweigh RED, Departments should proceed with the implementation of BIM in the delivery of the project.

12 Areas of BIM Application	Sample Areas	Potential Benefits	Considered potential for BIM to deliver efficiency savings in this project	Comments (provide reasons for your decision)
1. Intelligent 3D Modelling	Architectural Model Structural Model Mechanical & Electrical Model Civil Model Landscape Model	a. Accurate, co-ordinated, visual design		
		b. Project common design elements, components, libraries and catalogues		
		c. Information in the model tailored to suit O&M/FM needs		
2. Life Cycle Cost (LCC) and Life Cycle Assessment (LCA) Analysis	Access to historical data Database Linkage Easier option planning	a. Accurate LCC estimation		
		b. Reduce risk in life cycle fund management		
		c. LCA for evaluation of environmental aspects		

Project Name: **Department/CoPE:** **Date:**

SRO Name: **CA/PM Name:** **Bands:** **low** **medium** **high**

The BIM Efficiency Savings Test should be undertaken at OGC Gateway Review Gate 0 - Business Case Assessment in projects > £20 million OR during the Initial Peer Review Process in projects < £20 million. Departments/CoPEs may wish to undertake further reviews of the test during key project gateways. The CA/PM and SRO are to assess the potential for the listed BIM benefits to deliver efficiency savings within the project. Award RED for a low potential, AMBER for a medium potential, GREEN for a high potential in your consideration for BIM to deliver efficiency savings in this project.

Provide reasons for your decisions in the comments box. Where the total number of AMBER and GREEN outweigh RED, Departments should proceed with the implementation of BIM in the delivery of the project.

12 Areas of BIM Application	Sample Areas	Potential Benefits	Considered potential for BIM to deliver efficiency savings in this project	Comments (provide reasons for your decision)
3. Facilities Management	Optimised Handover Asset register Health & Safety info linked to model O&M manuals linked to model Computer Aided FM (CAFM) linked to model	a. CAFM to ensure effective maintenance of assets		
		b. Performance history maintained		
		c. Effective management and optimisation of maintenance services		
4. Quantity Take Off and Cost analysis	Schedules from model Materials lists from model Components Lists from model BoQ generated from model	a. Rapid and accurate take off of quantities		
		b. Easier evaluation of design changes and impact on costs		
		c. Easier connection of quantities to, scheduling and procurement		
5. Visualisations	Bid & Tender Marketing Client Sign Off Enhanced engagement from team	a. Visualisations of project for marketing/sales		
		b. Fly Through/Orbit interior and exterior of model		
		c. Supports customer choices		

Project Name: **Department/CoPE:** **Date:**

SRO Name: **CA/PM Name:** **Bands:** **low** **medium** **high**

The BIM Efficiency Savings Test should be undertaken at OGC Gateway Review Gate 0 - Business Case Assessment in projects > £20 million OR during the Initial Peer Review Process in projects < £20 million. Departments/CoPEs may wish to undertake further reviews of the test during key project gateways. The CA/PM and SRO are to assess the potential for the listed BIM benefits to deliver efficiency savings within the project. Award RED for a low potential, AMBER for a medium potential, GREEN for a high potential in your consideration for BIM to deliver efficiency savings in this project.

Provide reasons for your decisions in the comments box. Where the total number of AMBER and GREEN outweigh RED, Departments should proceed with the implementation of BIM in the delivery of the project.

12 Areas of BIM Application	Sample Areas	Potential Benefits	Considered potential for BIM to deliver efficiency savings in this project	Comments (provide reasons for your decision)
6. Safety Planning	Analysis for Safe Operations Toolbox talks/safety briefings Improved method statements	a. Safety details and structures in libraries		
		b. Safety installations pre-planned		
		c. Visual safety tours, area plans and presentations		
7. Clash Detection	2D Plans derived from model 3D co-ordination Rule based clashes Object/Object clashes Object/Spatial clashes Virtual pre-construction inspections Plant & equipment installation	a. Zero defect design and construction (above and below ground)		
		b. Zero clashes through structured information BS1192: 2007		
		c. Sequencing works/orders with subcontractors		

Project Name: **Department/CoPE:** **Date:**

SRO Name: **CA/PM Name:** **Bands:** **low** **medium** **high**

The BIM Efficiency Savings Test should be undertaken at OGC Gateway Review Gate 0 - Business Case Assessment in projects > £20 million OR during the Initial Peer Review Process in projects < £20 million. Departments/CoPEs may wish to undertake further reviews of the test during key project gateways. The CA/PM and SRO are to assess the potential for the listed BIM benefits to deliver efficiency savings within the project. Award RED for a low potential, AMBER for a medium potential, GREEN for a high potential in your consideration for BIM to deliver efficiency savings in this project.

Provide reasons for your decisions in the comments box. Where the total number of AMBER and GREEN outweigh RED, Departments should proceed with the implementation of BIM in the delivery of the project.

12 Areas of BIM Application	Sample Areas	Potential Benefits	Considered potential for BIM to deliver efficiency savings in this project	Comments (provide reasons for your decision)
8. 4D Scheduling	Vehicle movements analysis Materials deliveries monitoring Crane & Hoist positioning Targeted sequencing Construction site layout	a. Scheduling from model based quantity take off		
		b. 4D design/simulations		
		c. Visualisations of schedules for workers and suppliers		
9. Production BIM	Targeted rehearsals of works sequence Progress monitoring Planned vs Actual analysis Subcontractor payment planning	a. Buildability analysis		
		b. Accurate materials lists for production/construction		
		c. GPS machine control		
10. Procurement	Accurate quantities Reduced tender periods Optimised procurement plans	a. Coded/Tagged materials linked to model viewer and project programmes for accurate ordering		
		b. Location based deliverables		
		c. 'Just on Time' deliveries management		

Project Name: **Department/CoPE:** **Date:**

SRO Name: **CA/PM Name:** **Bands:** **low** **medium** **high**

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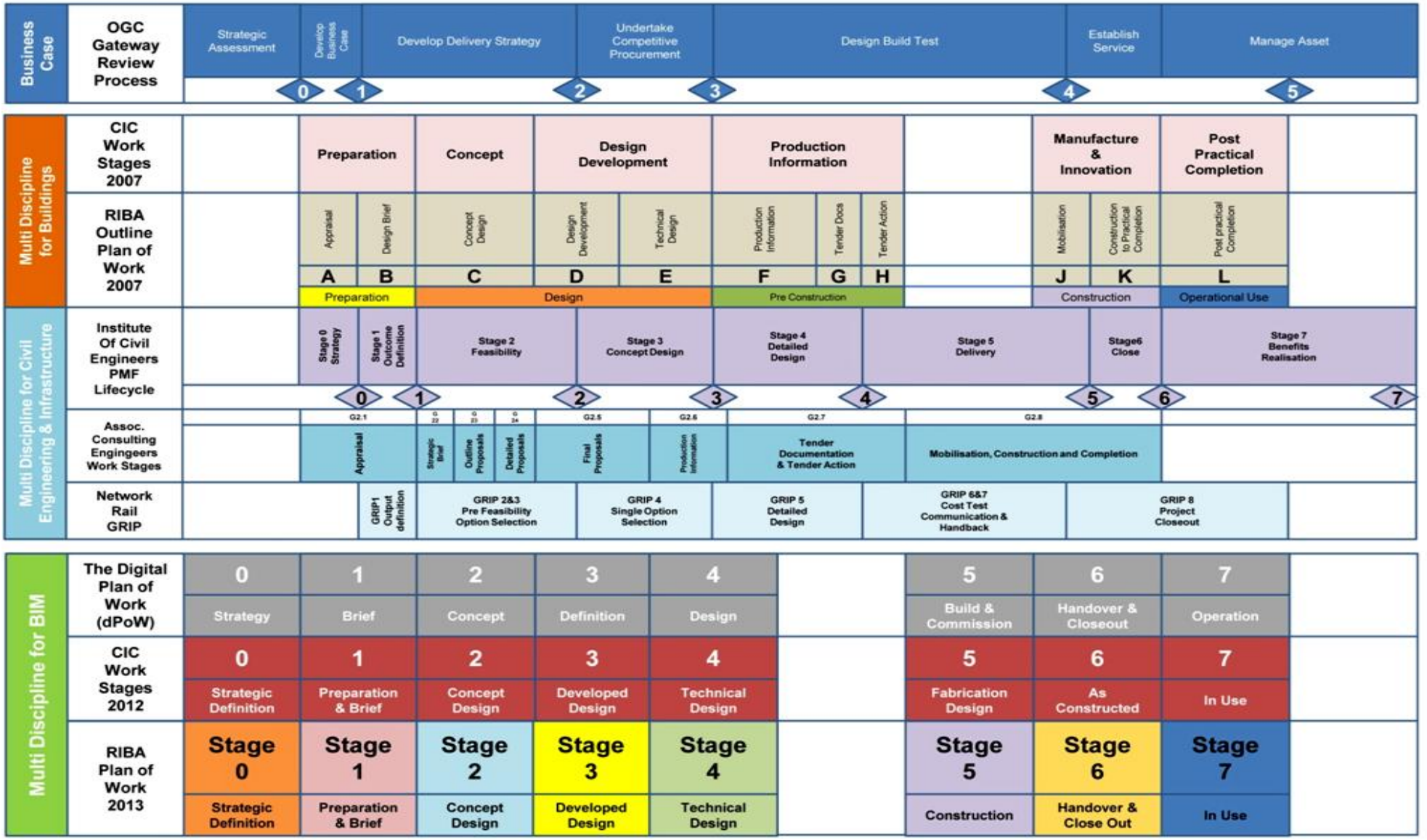
Provide reasons for your decisions in the comments box. Where the total number of AMBER and GREEN outweigh RED, Departments should proceed with the implementation of BIM in the delivery of the project.

12 Areas of BIM Application	Sample Areas	Potential Benefits	Considered potential for BIM to deliver efficiency savings in this project	Comments (provide reasons for your decision)
11. Supply Chain Management	Object/Spatial/Sequence clash prevention Reduced tender periods Early warning notifications	a. Exact component codes from models (libraries)		
		b. Bills of materials from models with accurate quantities		
		c. Accessible common data/work environment for key suppliers and subcontractors		
12. Simulations (Energy, Fire etc)	Environmental Structural Thermal Daylight Ratios	a. Accurate and easier energy calculations		
		b. Indoor simulations (fire smoke climate)		
		c. Assists construction goals (BREEAM, LEED, WRAP, CO2, etc)		

ANNEX C: PROCESS PLAN ALIGNMENT



ANNEX D: SAMPLE MODEL PRODUCTION DELIVERY TABLE

	Drop 1 Stage 1		Drop 2a Stage 2		Drop 2b Stage 2		Drop 3 Stage 3		Drop 4 Stage 6	
	Model Originator	Level of Detail	Model Originator	Level of Detail	Model Originator	Level of Detail	Model Originator	Level of Detail	Model Originator	Level of Detail
Overall form and content										
Space planning	Architect	1	Architect	2	Contractor	2	Contractor	3	Contractor	6
Site and context	Architect	1	Architect	2	Contractor	2	Contractor	3	Contractor	6
Surveys							Contractor	3		
External form and appearance			Architect	2	Contractor	2	Contractor	3	Contractor	6
Building and site sections					Contractor	2	Contractor	3	Contractor	6
Internal layouts					Contractor	2	Contractor	3	Contractor	6
Design strategies										
Fire			Architect	2	Contractor	2	Contractor	3	Contractor	6
Physical security			Architect	2	Contractor	2	Contractor	3	Contractor	6
Disabled access			Architect	2	Contractor	2	Contractor	3	Contractor	6
Maintenance access			Architect	2	Contractor	2	Contractor	3	Contractor	6
BREEAM					Contractor	2	Contractor	3	Contractor	6
Performance										
Building	Architect	1	Architect	2	Contractor	2	Contractor	3		
Structural	Architect	1	Str Eng	2	Contractor	2	Contractor	3		
MEP systems	Architect	1	MEP Eng	2	Contractor	2	Contractor	3		
Regulation compliance analysis							Contractor	3	Contractor	6
Thermal Simulation							Contractor	3	Contractor	6
Sustainability Analysis							Contractor	3	Contractor	6
Acoustic analysis							Contractor	3	Contractor	6
4D Programming Analysis										
5D Cost Analysis										
Services Commissioning							Contractor	3	Contractor	6
Elements, materials components										
Building			Architect	2	Contractor	2	Contractor	3	Contractor	6
Specifications			MEP Eng	2	Contractor	2	Contractor	3	Contractor	6
MEP systems					Contractor	2	Contractor	3	Contractor	6
Construction proposals										
Phasing							Contractor	3		
Site access							Contractor	3		
Site set-up							Contractor	3		
Health and safety										
Design							Contractor	3		
Construction							Contractor	3		
Operation							Contractor	3	Contractor	6

LOD definitions (from PAS 1192)

1 Brief
2 Concept
3 Developed Design
4 Production
5 Installation
6 As constructed
7 In use

Stage definitions (from APM)

0 Strategy
1 Brief
2 Concept
3 Definition
4 Design (production information)
5 Build & Commission
6 Handover & Closeout
7 Operation and end of life

Model Originators identified by name