ENABLING BIM THROUGH PROCUREMENT AND CONTRACTS

A Research Report by the Centre of Construction Law and Dispute Resolution, King's College London

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The Research Report comprises analysis based on the experience of BIM Research Group members using third party sources as quoted and findings from King's interview research data.

The research methodology was agreed by the multi-disciplinary BIM Research Group. It comprised reviews of 12 leading BIM projects and confidential interviews with 40 leading practitioners. The Research Report was also informed by a full day workshop (20 participants) and a full day conference (115 participants), following which all those present were issued with a draft of the Research Report and were invited to comment.

The work leading to the Research Report was partly grant funded by the *Society of Construction Law* and the *Association of Consultant Architects* whose support is very much appreciated.

King's College London Centre of Construction Law and Dispute Resolution and the BIM Research Group are very grateful for the time and valuable contributions offered by interviewees, by workshop and conference participants, and by Rob Garvey of University of Westminster who kindly reviewed the draft Research Report.

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Introduction - Mark Bew MBE, Chair, UK Government BIM Working Group

In just five years Building Information Modelling (BIM) has moved from a theory to a reality. Convinced of its transformational powers – its ability to drive efficiencies, reduce costs and add long-term value to the development and management of built assets – the BIM Task Group and Paul Morrell met to thrash out a strategy for its implementation.

Morrell, then the Government's Chief Construction Adviser, seized on two key strategic criteria – keep the complexity in the supply chain and don't change the rules of engagement. The roll-out of BIM Level 2 – then, half a decade ago, a radical concept – should focus, he recognised, on process, collaboration, discovering what data was and how to buy, create, validate and use it.

The work by the King's College London team has presented us with a fascinating cross-sectional view of the current market state. The dynamics between change, culture, emotion and competition have created real shift in our industry.

As in all change programmes some scenarios and views are later found to be baseless. This study has confirmed the basis of the original hypothesis – that Level 2 BIM does not change the contractual relationship between the employer and the supplier. It does, however, through the use of accurate data deliverables, place a sharp focus on the performance of traditional working methods that should have been addressed many years ago. So as we reach the end of the Level 2 development phase and industry picks up the baton to incorporate processes into business as usual, we move up a gear and turn to the challenges of designing Level 3.

Level 3 – and the move to a fully digitised construction economy – will require new methods of engagement. Key areas will include the drive for more manufactured solutions and the need to provide assets which are far more functionally effective than we see today.

I look forward to working with the commercial community and the King's team particularly on the journey to defining this new world.

Mark Bew MBE FRICS FICE

1 Why is this research important?

"The primary aim of BIM is to make more efficient buildings and gain efficiencies highlighted by the Government": Ian Ogden, Design Director, Westfield

"It is a learning curve, it's a culture change and the more disciplines and supply chain members engage and understand the process more the benefits can be delivered": Peter Trebilcock, Director of BIM, Balfour Beatty

1.1 Background

In summer 2014 the Centre of Construction Law and Dispute Resolution at King's College London commenced research into the links between Building Information Modelling (*"BIM"*) and the procurement models and contracting arrangements selected for construction and engineering projects. In early 2015 the Centre obtained grant funding from the Society of Construction Law and the Association of Consultant Architects , and brought together leading specialists in the field of BIM, procurement and construction contract to comprise the BIM Research Group.

The work of the BIM Research Group has informed the structure of this Research Report which focuses primarily on BIM *Level 2*[1] while also touching on the future development of BIM *Level 3*[2].

BIM has attracted a number of definitions[3]. For the purposes of this Research Report we will view BIM as a set of systems that create digital three dimensional models, intended to provide more accessible and versatile design and cost data to identify efficiencies and improvements throughout the life of a built facility. UK Government procurement policy since 2011 has included strong support for BIM, such as the requirement that BIM Level 2 is achieved on all Government projects from April 2016[4].

The link between BIM and procurement models has been tested on UK Government Trial Projects[5], and the time is right to examine how these procurement models can have a wider impact on the successful delivery of other BIM-enabled projects, particularly in securing the appointment of all team members at the best time to obtain their optimum BIM contributions.

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[1] Under BIM Level 2, each design team member creates and develops its own digital model; together these comprise a *federated model* of the overall project. See also Glossary at Appendix D

[2] BIM Level 3 signifies full collaboration by the project team members and anticipates the use of a single BIM model held by all project team members to access, use and modify at any time within a centrally held *Common Data Environment*. See also Glossary at Appendix D

[3] BSI – http://www.bsigroup.com/en-GB/Building-Information-Modelling-BIM/
NBS – https://www.thenbs.com/knowledge/what-is-building-information-modelling-bim
Autodesk – http://www.autodesk.com/solutions/bim/overview
RICS – http://www.rics.org/uk/knowledge/glossary/bim-intro/
ICE – http://www.ice-conferences.com/ice-bim-2014/what-is-bim/

[4] Government Construction Strategy (2011) – https://www.gov.uk/government/publications/government-construction-strategy

[5] See Chapter 10 and https://www.gov.uk/government/publications/government-construction-trial-projects

BIM increases the scope and speed of data exchanges which highlights questions as to who provides what data, when it is best provided and how it is used and relied upon. These questions are brought into sharper focus by the greater scope for the integration and collaboration enabled by BIM and by increasing attention to asset performance over a full project life-cycle.

Meanwhile, concerns as to the reliability of BIM computer software programs and as to the licensing of BIM models appear to have encouraged a defensive contractual approach to legal liability[6]. This apparent caution needs closer scrutiny so as to establish a balance that gives BIM users the confidence to work efficiently while offering appropriate and insurable legal commitments.

For these reasons it is important to examine how the evolution and potential of BIM can be influenced by the choice of procurement models and the agreement of contract terms and processes.

1.2 Methodology and themes

King's College London Centre of Construction Law had previously been appointed as *"Project Mentor"* on the UK Government's first two BIM Trial Projects[7], and had obtained valuable data as to the impact of procurement and contract issues and as to the measurable benefits obtained. The BIM Research Group agreed to examine 10 other projects and to interview 40 individuals with experience in delivery of BIM. The selected projects and interviewees are listed in Part 1 of Appendix A. Each interview was confidential, with a transcript provided for approval of the interviewee and for review only by the BIM Research Group. Quotes from interviewees appear in the text and in Part 2 of Appendix A, and the interview questions and summaries of answers are set out in Part 3 of Appendix A.

The research methodology did not involve a formal survey and the data obtained from interviewees is not claimed to be entirely representative of the industry as a whole. Instead the interviewees gave informal personal insights which were interpreted alongside the experience of BIM Research Group members and third party sources as quoted.

The BIM Research Group have explored the following themes:

- How BIM affects legal liability
- How BIM is treated in standard form contracts
- How the CIC BIM Protocol works
- Contractual provisions that support BIM

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[6] *"There is a perceived lack of confidence in technology…Whilst attempts have been made to resolve issues of interoperability as between different parametric modelling software packages, a lack of confidence still remains as to whether the original file is presented as intended outside its native file format"* Gibbs, Lord, Emmitt, Ruikar p172, CLJ, Issue 3 2015. See also Chapters 4.3 and 7

[7] Cookham Wood at https://www.gov.uk/government/publications/procurement-trial-case-study-cookham-wood-prison and North Wales Prison at http://constructingexcellence.org.uk/wp-content/uploads/2015/12/Trial-Projects-North-Wales-Prison-Case-Study_Final.pdf

- The contractual status of BIM documents
- Reliance on BIM software
- The role of the BIM Information Manager
- The effect of procurement models on BIM
- Evidence of links between BIM, procurement and contracts
- BIM and long term asset management
- Future BIM procurement and contract options.

2 How does BIM affect legal liability?

None of the interviewees reported the need for additional contractual exclusions or limitations of liability by reason of adopting BIM[8], but the workshop and conference revealed concern as to additional liability resulting from the use of BIM. This Chapter 2 examines how BIM can affect duties of care agreed under contract or imposed by law, recognising that the aspirations of BIM users to improve collaboration and efficiency need to be framed within appropriate and insurable legal commitments.

The duty of a consultant to use *"reasonable skill and care"* in creating a design or providing other advice[9], and its duty to produce a design that is buildable[10], should not be affected by the adoption of BIM. Likewise, the risk of raising a consultant's duty of care to *"fitness for purpose"* in respect of what a design or other advice will achieve, with the consequent concern that this will not be supported by professional indemnity insurance, should not occur by reason of adopting BIM. In either case, any change to the consultant's duty of care occurs only by agreement of additional contractual commitments[11].

Meanwhile, the implied design duty of fitness for purpose that is the starting point for a design and build contractor[12], or for the supplier or manufacturer of a product[13], should also not be affected by adoption of BIM and can only be replaced by a duty of reasonable skill and care through clear wording of the type found in most building contracts[14].

2.1 Reasonable skill and care

In calculating what is reasonable skill and care in the world of BIM:

[8] See Appendix A Part 3 Question 2.6

[9] *George Hawkins v Chrysler (UK) Ltd and Burne Associates* (1986) 38 BLR 36 (CA); see also Supply of Goods and Services Act 1982, section 13

[10] *Equitable Debenture Assets Corporation Ltd v William Moss Group Ltd* [1984] 2 Con LR 1

[11] *Greaves & Co (Contractors) Ltd v Baynham Meikle & Partners* [1975] I WLR 1095; *Consultants Group International v John Worman Ltd* (1985) 9 Con LR 46

[12] *Viking Grain Storage Ltd v TH White Installations Ltd* (1985) 33 BLR 103; see also Sale of Goods Act 1979, section 14

[13] Sale of Goods Act 1979, 1994, section 14(3)

[14] For example, JCT DB 2011 clause 2.17.1; NEC3 Option X15; PPC2000 clause 22.1

- a consultant, in its approach to BIM, as in any other activity, is expected *"not to lag behind other ordinarily assiduous and intelligent members of his profession in knowledge of the new advances, discoveries and developments in his field"*[15]. This means keeping up with the profession, firstly in advising on the benefits and risks of adopting BIM, and secondly in applying BIM to the design process and to related costing, programming and project management services[16];

- when advising a client on the adoption of BIM for the first time, *"architects who are venturing into the untried or little tried would be wise to warn their clients specifically of what they are doing and to obtain their express approval"*[17], and should be aware that *"the law requires even pioneers to be prudent"*[18];

- the professional knowledge and practices relating to BIM are continually evolving and a consultant is entitled to claim that it applied *"the state of the art"* at the time of giving its advice, although this defence will be judged by reference to the guidance and publications available to the profession as a whole at that time[19];

- a contractual commitment to comply with statutory obligations relevant to BIM will influence the duty of care, for example under the CDM Regulations 2015 which provide that a designer has a duty when *"preparing or modifying a design"* to *"eliminate, so far as is reasonably practicable, foreseeable risks to the health and safety of any person"* or otherwise to reduce or control those risks, and *"to take all reasonable steps to provide, with the design, sufficient information about the design, construction or maintenance of the structure to adequately assist the client, other designers and contractors to comply with their duties"*[20].

2.2 Duty to review designs

As regards a designer's duty to review and check its own designs and those of other designers at each stage of BIM model development:

- increased access to BIM data emerging throughout the life of a project could increase the likelihood that a designer has become aware, or should become aware, of the need to reconsider an earlier design[21];

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[15] *Eckersley T E & Others v Binnie & Partners* [1988] 18 Con LR 1(CA)

[16] *"Those who do not follow recommended best practice are likely to be exposed by BIM. Claims will therefore still form part of BIM projects, but it is hoped that the process of working in a "Level 2" environment will help reduce the likelihood and severity of these developing into disputes"* Gibbs, Lord, Emmitt, Ruikar p179, 31 CLJ Issue 3 2015

[17] *Victoria University of Manchester v Hugh Wilson and Lewis Womersley (A Firm) and Pochin (Contractors) Ltd* (1984) 1 Const LJ 162

[18] *Independent Broadcasting Authority v EMI Electronics Ltd and BICC Construction Ltd* (1980) 14 BLR 1 (HL)

[19] *Wimpey Construction UK Ltd v Poole* [1984] 2 Lloyds Rep 499

[20] The Construction (Design and Management) Regulations 2015, Regulation 9

[21] For the purposes of the tests in *Samuel Payne v John Setchell Ltd* [2002] BLR 489 (TCC)

- increased access through BIM to other team members' designs could affect a designer's duty to warn of errors or problems it notices in another team member's work[22].

- contractors should keep in mind the common law duty to check, and even to validate, the designs provided by a consultant[23].

- a duty to review and work to a design is likely to include an enforceable obligation to use BIM models if made available[24].

3 How is BIM treated in standard form contracts?

"JCT Constructing Excellence, PPC2000 and NEC3, in order of unfamiliarity, are seen as the vanguard of the contracts of tomorrow": Richard Saxon CBE, Growth Through BIM, 2013

The BIM Research Group sought the views of 40 interviewees as to the impact of contracts on the success of BIM using questions that were developed by reference to legal themes rather than selection of a specific form of contract[25]. The 12 project teams selected by the BIM Research Group were also asked to confirm the form of contract they used[26] .

Some commentators have suggested that it is difficult to define responsibilities and contractual risks appropriate to BIM[27], and others propose that BIM requires a completely new contractual approach[28]. Meanwhile the UK Government Construction Clients Group suggested in March 2011 that *"Little change is required in the fundamental building blocks of copyright law, contracts or*

[22] For the purposes of the tests in *Tesco Stores Ltd v The Norman Hitchcox Partnership Ltd* (1997) 56 Con LR 42 and in *J Murphy & Sons Ltd v Johnston Precast Ltd (formerly Johnston Pipes Ltd)* [2008] EWHC 3104 (TCC)

[23] In the case of *Cooperative Insurance Society Ltd v Henry Boot Scotland Ltd and others* [2002] EWHC 1270 (TCC) Judge Seymour stated: *"Someone who undertakes… an obligation to complete a design begun by someone else agrees that the result, however much of the design work was done before the process of completion commenced, would have been prepared with reasonable skill and care"*. However, note also the US "*Spearin*" doctrine implying a duty on a design consultant to ensure that documents passed to a contractor are "*free from defect*". There is concern in the USA that more collaborative processes and early contractor involvement through BIM could remove this protection from contractors. For example Consensus Docs 301 BIM addendum clause 5.1 states that: *"Each Party shall be responsible for any contribution it makes to a model or that arises from that party's access to that model."*

[24] Note for example the US legal case *Matthews D. (2011)* concerning a life sciences building where the mechanical and electrical engineer did not inform the contractor about ventilation ducting the construction sequence. The main contractor worked off 2D drawings despite the availability of a BIM model, and ran out of space with only 70% of the sequence complete

[25] See Appendix A Part 3.

[26] See Appendix A Part 3 Question 1.1 and Chapter 3.2

[27] For example Hamdi and Leite, 2013

[28] For example Olatunji and Sher, 2010

insurance to facilitate working at Level 2 of BIM maturity"[29]. The 2011 statement was presumably intended to encourage the early adoption of BIM Level 2 but it does not reflect the evolving treatment of BIM in contract terms over the last five years.

Before looking at contract forms the place to start is in the scope of a contractor's project brief or a consultant's schedule of services. The following key points should be checked:

- Does the contract contain a clear set of obligations as to how the consultant or contractor will be expected to implement BIM, including for example whether this will start with the project procurement process and also continue into post-completion operation?[30]

- Are there clear statements of a consultant's or a contractor's promised level of BIM experience and expertise?[31]

- Is it made clear what effect the use of BIM will have on the consultant's or contractor's specific duties in respect of design, costing, programming, project management, construction and asset management?[32]

- Do all parties understand who will be the *BIM Information Manager*[33], what duties this role will comprise and how these duties will interface with those of the design lead and the project manager so as to avoid gaps or duplications? [34]

3.1 Standard form BIM provisions

Standard form building contracts, consultant appointments and related guidance have so far used a light touch in relation to BIM. Some standard form publishers recommend how their contracts should take BIM into account. Examples are the *JCT Public Sector Supplement*[35], *PPC2000 Appendix 10*[36], the *CIOB Time and Cost Management Contract Suite*[37] and *How to use BIM with NEC3 Contracts*[38].

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[29] Government Construction Client Group BIM Working Party Strategy Paper, March 2011: www.bimtaskgroup.org, paragraph 5.2. However, in the same document the GCCG noted that: *"Contractual and commercial issues have the potential to act as a source of inertia holding back adoption on projects"*

[30] See also Chapters 9 and 11

[31] See also Chapter 2

[32] See also Chapters 2 and 5

[33] See Glossary at Appendix D

[34] As to the role of the BIM Information Manager see also Chapter 8 and, for example, PAS 1192-2(2013)

[35] JCT Public Sector Supplement Fair Payment, Transparency and Building Information Modelling 2011, which contains amended contract clauses relevant to BIM. JCT are publishing a new suite of contracts during 2016, after conclusion of this Research Report and therefore beyond the opportunity for further analysis. As to JCT2011 see also the Glossary at Appendix D

[36] PPC2000 Standard Form of Contract for Project Partnering (Amended 2013), Appendix 10 which sets out amended contract clauses relevant to BIM. As to PPC2000 see also the Glossary at Appendix D

[37] Chartered Institute of Building published their Complex Projects Contract in 2013, which included specific BIM provisions, but which has not been adopted by any of the BIM Research Group or by any of the selected projects or interviewees. The CIOB contract form was relaunched in June 2016 as the Time and

Other standard forms such as *FIDIC*[39] are silent on BIM, which leaves uncertainty for the user as to whether BIM has been considered at all by the drafting bodies. Most standard form consultant appointments are also silent on BIM[40], although some refer in their guidance to the *CIC BIM Protocol*[41] which is reviewed in Chapter 4.

However, to look for a mention of BIM in a contract is not the most effective way of determining its suitability to support the adoption of BIM in practice. It is more valuable to consider how the contract deals with the key issues affected by BIM, and the following are examined in Chapter 5:

- agreement of deadlines and interfaces in respect of submission and approval of design information and other data;

- clash detection, early warning and risk management;

- mutual agreement of intellectual property rights.

It is also valuable to consider other contractual means by which BIM can be enabled and supported, and this Research Report examines:

- the need for clarity as to the status of documents that enable BIM (Chapter 6);

- the need for reliance on BIM software (Chapter 7);

- the need for clarity as to the responsibilities of the BIM Information Manager (Chapter 8);

- the benefits of a procurement model under which contracts achieve early contractor, sub-contractor and manufacturer involvement (Chapters 9 and 10);

- the potential for greater integration of capital contracts with repair and maintenance contracts (Chapter 11).

3.2 Integration of building contracts and consultant appointments

It is arguable that BIM requires a set of contracts which integrate all the team members' roles and which do not focus only on the responsibilities of the main

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Cost Management Contract Suite 2015, after conclusion of this Research Report and therefore beyond the opportunity for further analysis in this Research Report.

[38] How to use BIM with NEC3 Contracts, 2013, which contains additional contract clauses relevant to BIM. As to NEC3 see also the Glossary at Appendix D

[39] See Glossary at Appendix D

[40] For example the CIC Consultants' Contract 2011

[41] Construction Industry Council Building Information Model (BIM) Protocol (2013) CICBIM/Pro. As to reference in guidance see for example How to use BIM with NEC3 contracts

contractor. Without corresponding consultant appointments and sub-contracts, it is difficult to see how any building contract can support a team in adopting and implementing BIM.

Standard forms that provide contracts covering the appointment of all team members include:

- *FIDIC*, which offers corresponding forms of consultant appointment, main contract and sub-contract[42]. Although the interviewees did not include users of FIDIC, the potential benefits of BIM to transnational projects justifies comments on FIDIC as the most widely used international standard form;

- *JCT 2011*, which offers corresponding forms of consultant appointment (limited to the public sector)[43], main contract and sub-contract. JCT contracts were used on two of the projects reviewed;

- *NEC3*, which offers corresponding forms of consultant appointment, main contract and sub-contract[44] and was used on seven of the projects reviewed;

- *PPC2000*, which offers a multi-party contract integrating all consultant appointments with the main contractor appointment and a corresponding sub-contract[45]. PPC2000 is less well-known than FIDIC, JCT2011 or NEC3 and was used on three of the projects reviewed, including the two UK Government BIM Trial Projects.

A tabular comparison summarising provisions relevant to the treatment of BIM in FIDIC, JCT 2011, NEC3 and PPC2000 is set out at Appendix C.

3.3 Standard forms and collaborative working

All the interviewees described the ways in which BIM enables collaborative working, for example through the use of BIM models to assist joint working by design consultants and through the improved ability to explain design proposals to the client[46]. Many interviewees also described their contract form as collaborative, particularly those who used NEC3 or PPC2000[47].

57% of the respondents to the NBS National BIM Survey 2015 agreed that BIM is *"all about real time collaboration"*, and 31% regarded lack of collaboration as one

[37] FIDIC *"Red Book"* First Edition 1999 and corresponding sub-contract plus FIDIC *"White Book"* Client/Consultant Model Services Agreement. See also Glossary at Appendix D

[43] JCT2011 suite of contracts

[44] NEC3 suite of Engineering and Construction Contracts, Sub-Contracts and Professional Services Contracts

[45] PPC2000 and SPC2000 forms of Project Partnering Contract and Specialist Partnering Contract amended 2013

[46] See Appendix A Part 2

[47] See Appendix A Part 2 and Part 3 Question 1.1

of the main barriers to BIM [48]. This Research Report describes how the foundations for effective collaborative working through BIM are provided by a clear and integrated contractual framework.

The adoption of a more collaborative approach to construction procurement and contracting has been widely encouraged in the UK construction industry, particularly between 1998 and 2008, although some teams have failed to translate general collaborative declarations into specific project processes[49]. BIM has been hailed as a new medium for collaborative working, attracting comments such as: *"What partnering needed to succeed was BIM and this risk managing collaboration concept will probably return to favour in supply chain relationships"*[50].

Contract provisions that can support BIM through encouraging a collaborative culture include mutual agreement to act in *good faith* or otherwise in a collaborative manner. Relevant provisions appear, for example, in the following standard forms:

- JCT 2011: provision for *"good faith"* in optional Appendix 8 but no equivalent commitment in the JCT Consultant Agreement (Public Sector);

- NEC3: provision for *"mutual trust and co-operation"* in clause 10.1 of all building contracts and consultant appointments;

- PPC2000: provision for *"trust, fairness and mutual cooperation"* in clause 1.3 of the integrated building contract/consultant appointment form and sub-contract forms.

There are no equivalent provisions in FIDIC or in the CIC BIM Protocol.

However, an undertaking to act in good faith or its equivalent has limited impact under English law as the courts examine these declarations of principle cautiously[51]. Contractual support for collaborative working through BIM also depends on specific processes and machinery of the type examined in Chapters 5, 6, 7 and 8, and on selecting an appropriate procurement model of the type examined in Chapters 9, 10 and 11.

Specific contract provisions that support collaborative working through BIM are not necessarily expressly collaborative. These include for example the agreement of deadlines and interfaces for model production, delivery, comment and

[48] https://www.thenbs.com/knowledge/nbs-national-bim-report-2015

[49] For example, in *Birse Construction Ltd v St David Ltd (No 1)* [2000] 1 BLR 57 a *"non-binding"* charter stated that the parties would *"produce an exceptional quality development within the agreed time frame, at least cost, enhancing our reputations through mutual trust and cooperation"*. A building contract was never signed and within 10 months the project descended into disputes that the charter could do nothing to avoid or resolve

[50] Richard G Saxon CBE (2013), "*Growth Through BIM*"

[51] See for example the narrow interpretation of *"good faith"* wording in the TPC2005 form of contract in *TSG Building Services Plc v South Anglia Housing Ltd* [2013] EWHC 1151

approval[52], and provisions for team members to resolve issues through clash detection, early warning and a forum for joint risk management[53].

Effective collaborative working can also be developed through a procurement model that brings all BIM contributors onto the team at the optimum time, that uses BIM to build reliable shared data and mutual confidence and that considers the operational impact of BIM on those who will repair, maintain and operate the completed capital project[54].

4 How does the CIC BIM Protocol work?

The CIC BIM Protocol is the best known UK template for integrating BIM Level 2 with standard form contracts. The understanding of the BIM Research Group is that it was created firstly to establish a consistent contractual approach to BIM across all team members, and secondly to provide comfort that working through BIM would not expose team members to additional liability.

This Chapter 4 will examine how the CIC BIM Protocol works and in some cases how it may require review. Criticisms in this Chapter 4 and elsewhere in this Research Report are intended as constructive proposals for potential improvement and do not detract from the intent of the CIC BIM Protocol or its achievements in advancing the adoption of BIM.

4.1 Overriding effect

The CIC BIM Protocol is designed as a series of supplementary contract documents:

- to be signed by the client (in addition to each consultant appointment and building contract) bilaterally with each project team member including every consultant and the main contractor;

- to be signed by the main contractor (in addition to each sub-contract) bilaterally with all sub-contractors and suppliers who make design contributions;

- taking precedence in the event of conflict or discrepancy with any consultant appointment, building contract or sub-contract (clause 2.2)[55].

As regards the creation of CIC BIM Protocols, the client is under a strict obligation to secure protocols in substantially the same form from all project team members (clause 3).

[52] See Chapter 5.1 Treatment of deadlines and interfaces
[53] See Chapter 5.2 Clash detection, early warning and risk management
[54] See Chapters 9, 10 and 11
[55] CICBIM/Pro clause 2.2

The overriding contractual status of the CIC BIM Protocol has significant impact on the standard form contracts to which it is annexed. Each of these forms has been developed over many years by their respective drafting bodies, and there is the risk that the wording of the CIC BIM Protocol will give rise to problems of interpretation when read alongside the provisions of each standard form.

NEC3 suggests that parts of the CIC BIM Protocol should be *"additional conditions of contract"*, including clause 2 regarding its overriding effect in the event of discrepancies, but also suggests that other parts such as clauses 3 and 4 should be included in the NEC3 *"Works Information"*[56]. This leaves unclear, for example, how the wording of clause 4 in relation to events outside a team member's *"reasonable control"*[57] will be reconciled with the detailed *"compensation events"* described in NEC3 clause 60[58].

JCT 2011 refers to protocols in general terms and suggests that a protocol should be an additional *"Contract Document"* or should be included as part of the *"Employer's Requirements"*[59]. Neither of these options clarifies the status of a protocol where it clashes with the JCT contract conditions, for example as between clause 4 of the CIC BIM Protocol and JCT *"Relevant Events"* giving rise to extension of time.[60] It is therefore relevant to note JCT Practice Note 2016[61] which states that, in the event of conflict with a protocol, the relevant JCT contract should take precedence. This contradicts clause 2.2 of the CIC BIM Protocol and has yet to be clarified in specific JCT contract wording.

PPC2000 makes no reference to the CIC BIM Protocol and does not recommend adoption of any protocol that amends its contract terms[62].

4.2 Licensing of models

The provisions the CIC BIM Protocol and its supporting guidance set out a reasonably balanced approach to the licensing of BIM models, including:

- the grant of a non-exclusive licence for the client to transmit, copy and use models for the agreed project-related purposes for which they were prepared (clause 6.3);

- the right for the client to grant equivalent sub-licences and for team members to grant equivalent sub-sub-licences (clauses 6.3, 6.6, 6.7);

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[56] The NEC3 Works Information specifies what is required by the employer and any constraints on how other team members should deliver the project

[57] See Chapter 4.5 Duty of care

[58] NEC3 compensation events describe entitlements to additional time and money arising in specific circumstances rather than generally from matters outside a party's reasonable control

[59] See JCT Public Sector Supplement *"[BIM]"* wording proposed for each JCT2011 contract form

[60] See for example JCT SBC/Q 2011 clause 2.29

[61] JCT Practice Note 2016 Building Information Modelling (BIM) Collaboration and Integrated Team Working

[62] PPC2000 Appendix 10. See also Chapter 10.

- exclusion of the right to amend models except for agreed purposes (clause 6.5.1) and exclusion of the right to reproduce models for the purpose of project extensions (clause 6.5.2);

- mutual obligations on the client and project team members to procure licences as required to meet their agreed licence obligations under the protocol (clauses 6.9, 6.10).

4.3 Limits of liability

The CIC BIM Protocol includes the following limits on a project team member's liability:

- no warranty as to the integrity of electronic data transmission, and no liability for corruption or alteration occurring after transmission (clause 5)[63];

- cross-reference to a right to revoke or suspend a licence to use models in the event of non-payment (clause 6.4);

- no liability for the modification, amendment, transmission, copying or use of BIM models other than for agreed purposes (clause 7).

4.4 Appendices

The Appendices of the CIC BIM Protocol comprise the following important practical documents:

Appendix 1 The *Model Production and Delivery Table*[64], setting out the *Levels of Detail*[65] to be achieved in respect of each BIM model by each project team member at each stage;

Appendix 2 Details of the BIM Information Manager, and details of the *Employer's Information Requirements*[66], setting the *Common Data Environment*[67] created through BIM including agreed software and formats plus cross-reference to the *BIM Execution Plan*[68] and related project procedures.

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[63] *"The degree of responsibility for the integrity of the data used in the design models does not rest on the consultant – who does not warrant as to the integrity of the electronic data in the submitted design model, and is not liable for corruption or unintended amendment to such data unless this is as a result of non-compliance with the standards set. This is not really market standard."* Will Cooper, *"Professional appointments and BIM"*, Construction Law 24(7) p26. See also Chapter 7

[64] See Glossary at Appendix D and also Chapters 5.1 and 6.2

[65] The CIC BIM Protocol does not use *"Level of Information"* or *"Level of Definition"* which are emerging as more widely used terms. See Glossary at Appendix D and also Chapters 5.1 and 6.2

[66] See Glossary at Appendix D and also Chapter 6.2

[67] See Glossary at Appendix D and also Chapter 6.2

[68] See Glossary at Appendix D and also Chapter 6.3

These documents need to be integrated with the consultant services schedules, the contractor's project brief and the project programme in each consultant appointment, main contract and sub-contract[69].

4.5 Duty of care

The obligation on project team members to produce models in accordance with agreed Levels of Detail specified in the Model Production and Delivery Table is limited to *"reasonable endeavours"* which is a lower, less clear duty of care than the accepted standard of reasonable skill and care (clause 4).[70]

Also a team member's compliance with the Model Production and Delivery Table and the Information Requirements is stated to be *"subject to events outside its reasonable control"* (clause 4), a generic exception which overrides the detailed provisions for extension of time contained in most standard form building contracts.

4.6 Client concerns

Some of the above provisions dilute what a client or its advisers would expect as commercial norms[71], and any party recommending the CIC BIM Protocol should make clear all of its terms so as not to be liable for any reduced client rights[72].

The absolute obligations on the client to secure protocols in substantially the same form from all other project team members, and to update the Information Requirements and the Model Production and Delivery Table (clause 3), should also be made clear to clients before the CIC BIM Protocol is adopted.

Very few interviewees mentioned adoption of the CIC BIM Protocol. While this does not provide any data as to the extent of take up, interviewees expressed the unanimous view that no exclusions or limitations of liability are required by reason of adopting BIM[73], a position which does not align with the exclusions and limitations expressed in the current CIC BIM Protocol[74].

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[69] See also Chapter 6

[70] The meaning of the term *"reasonable endeavours"* is itself unclear and the term has been interpreted in many different ways by the courts according to the context in which it is used. As to reasonable skill and care see Chapter 2.1

[71] For example, *"the consultant only has to use 'reasonable endeavours' to deliver the design models in accordance with the Protocol and not the usual standard of care which relates to its responsibility for the design contained within these models"* Will Cooper, *"Professional appointments and BIM"*, Construction Law 24(7) p26

[72] See for example consultant liability for lack of fully informed procurement recommendations in *Plymouth and South West Co-operative Society Ltd v Architecture Structure and Management Ltd* [2006] EWHC 5 (TCC)

[73] See Appendix A Part 3 Question 2.6

[74] See Chapters 4.3 and 4.5

5 What contractual provisions support BIM?

There are practical measures by which project teams can use contracts to get the best out of BIM while not exposing themselves to additional liability, and these are reviewed in this Chapter 5. Some of these issues are dealt with to varying degrees in existing standard form contracts and others need additional attention, particularly to ensure consistency as to how they are addressed in consultant appointments and building contracts. In all cases it will be important for advisers on a project using BIM to check how these issues are dealt with in the contract terms and processes before making a recommendation.

5.1 Treatment of deadlines and interfaces

"Efficiencies are beginning to be seen as the process is a much better way of working, like for example significantly reducing the number of RFIs (request for information) or reducing waste or re-work on site": Ralph Montague, Managing partner, ArcDox Architecture, Dublin

The efficient development of BIM models requires clarity as to when each *LoD*[75] will be provided in each BIM model at each stage of design, supply and construction required to deliver a project. The links between contracts and the timing of BIM contributions have not been fully defined beyond linking 3D models to the sequencing of information during the construction phase (described as *4D BIM*[76]).

The timing of BIM contributions was addressed by nearly half the interviewees according to the existing programming provisions of their chosen contract forms, yet timing is treated very differently in current standard form contracts[77]. In order to obtain the benefits of 4D BIM the team members need deadlines supporting the agreed commitments by all team members (including the client):

- to produce and deliver their BIM models to the agreed Level of Definition by agreed deadlines at each stage;

- to provide comments and approvals by agreed deadlines at each stage;

- to specify what matters may prevent agreed deadlines being met.

BIM deadlines at each stage of a project need to be spelled out in the applicable contract documents. Standard form consultant and building contract provisions that can embody agreed deadlines in respect of BIM include:

- the JCT *Information Release Schedule*[78], although this only relates to the construction phase and only commits the client to procure release of

[75] See Glossary at Appendix D

[76] See Glossary at Appendix D

[77] See Appendix A Part 3 Question 2.4. See Appendix C for treatment of timing in FIDIC,JCT2011, NEC3 and PPC2000

[78] JCT SBC/Q 2011 clause 2.11

designs to the main contractor by stated dates. It appears only in the JCT 2011 building contract forms, with no corresponding commitment in the JCT Consultant Appointment (Public Sector);

- NEC3 provision for *Key Dates*[79], which appear both in the NEC3 Building Contract and in the NEC3 Professional Services Contract;

- the PPC2000 *Partnering Timetable* and *Project Timetable*[80] which under the two stage, multi-party structure relate firstly to the pre-construction phase and then the construction phase, creating mutual commitments to agreed deadlines by the client, main contractor, all consultants and selected key sub-contractors[81];

- a full set of matching CIC BIM Protocols which can provide some clarity through cross-reference to *BIM Execution Plans*[82] but which leave the commitment to achieve agreed deadlines diluted in the current version[83].

The treatment of timing is not covered by Appendices 1 or 2 of the CIC BIM Protocol and is left to be set out in *BIM Execution Plans*. The recommended templates for *BIM Execution Plans* published by the CIC include agreements to agree successive layers of timing detail. The Pre-Contract *BIM Execution Plan* refers to *"Major project milestones"* relating to information delivery, but *"Only the major milestones are listed. A more detailed and co-ordinated Master Information and Delivery Plan must be developed and agreed with the stakeholders following contract award and included in the post-contract award BEP"*[84].

Equivalent wording appears in in Section 3.2 of Post Contract-Award *BIM Execution Plan* plus a template at section 4.4 of the Post Contract-Award *BIM Execution Plan* for a *Task Information Delivery Plan (TIDP)*[85] with delivery dates at milestones, but without defining tasks.[86] *The Master Information Delivery Plan (MIDP)*[87] is then *"to be developed from the separate TIDPs produced for each task within the project. This more detailed, coordinated MIDP must be developed and agreed with the stakeholders. When completed the MIDP must be published in this document appendix and on the project extranet as a project plan"*[88].

Only 2 interviewees referred to the use of *BIM Execution Plans* as a means to describe agreed deadlines for BIM contributions and comments/feedback while

[79] NEC3 clause 30.3
[80] PPC2000 clauses 6.1 and 6.5
[81] See also Chapter 10
[82] See also Chapter 6.3 BIM Execution Plans and Glossary at Appendix D
[83] CICBIM/Pro clause 4. See Chapter 4 as regards the effect of obligations of a project team member being *"subject to events outside its reasonable control"*
[84] Pre-Contract BIM Execution Plan Section 5
[85] See Glossary at Appendix D
[86] Links to the *"Agreed matrix of responsibilities across the supply chain"* are set out at Section 4.3 of Post Contract-Award BEP in respect of each stage in the Plan of Work but without further explanation
[87] See Glossary at Appendix D
[88] *"Post Contract-Award Building Information Modelling (BIM) Plan (BEP)"*, Construction Project Information Committee (CPi), March 2013 Section 4.5, p17

4 referred to use of the *MIDP* for this purpose [89]. Closer attention needs to be given to agreement of clear and binding timescales in contract terms, and in *BIM Execution Plans*, if the construction phase sequencing of 4D BIM is to evolve into a full set of mutually agreed deadlines at all project stages. Improved mutual reliance among team members as to the timing of all parties' contributions is a priority if BIM is to help achieve greater efficiency and a practical spirit of collaboration.[90]

5.2 Clash detection, early warning and risk management

Interviewees reported that BIM provides a major advance for designers working together insofar as it facilitates risk management. For example, Tom Oulton, BIM Manager, Turner & Townsend stated *"I have seen time–cost–quality benefits as well as risk reduction in all the projects I have worked on"*. Also a Pinsent Masons 2014 survey found that 57% of respondents considered a major benefit of BIM to be risk mitigation[91]. However, interviewees also expressed concerns as to the risk of poor interoperability between different types of BIM software and differing views as to who should manage the *Common Data Environment (CDE*) and the BIM Level 2 *Federated Model*[92].

BIM enables design inconsistencies to be revealed through clash detection, but clashes can give rise to additional work (possibly for no additional fee) whenever a project team member amends its BIM model in order to resolve the clash. In order to avoid this giving rise to disputes there needs to be a contractual mechanism to determine what action the team members are required to take in respect of clashes that are detected and notified but that cannot be resolved by agreement in a design team meeting. This mechanism could be a forum tasked with seeking a constructive solution to BIM clashes, in relation to which:

- NEC3 Option X12 provides for a *"Core Group"* which could act as a forum but further detail needs to be added in respect of its meeting and decision-making procedures[93]. Also NEC3 clause 16 provides for an *"early warning"* system linked to *"risk reduction meetings"* which can act as a forum for notifying and resolving BIM clashes;

- PPC2000 provides for an *"Early Warning"* system linked to a *"Core Group"*, with details of how meetings and decision-making are to be conducted, which can act as a forum for notifying and resolving BIM clashes[94];

- JCT 2011 and FIDIC do not provide an early warning system or a forum for resolving BIM clashes;

[89] See Appendix A Part 3 Question 2.4

[90] See also Chapter 5 Treatment of deadlines and interfaces

[91] http://www.pinsentmasons.com/en/media/press-releases/2014/governments-bim-target-unachievable-says-pinsent-masons-survey/

[92] See Appendix A Part 3 Questions 1.3, 1.4 and 2.1. See also Glossary at Appendix D and Chapter 6.2

[93] NEC3 Option X12: Partnering, clauses X12.2 and X12.3

[94] PPC2000 clauses 2.5 and 3

- the CIC BIM Protocol does not provide an early warning system or a forum for resolving BIM clashes.

5.3 Intellectual property licences

"There is a concern in some innovative Tier 2s that their IPR can be stolen more easily through BIM as it is easy to copy files that show how innovative approaches work": Richard Saxon CBE, Growth Through BIM 2013

Interviewees took differing views as to who owns and should own the intellectual property rights in BIM models, some accepting that these rights are owned by the client and others stating that they refuse to hand them over [95]. Concerns as to loss of intellectual property rights were reported by a number of interviewees as a reason for failure to share BIM data[96].

This may be primarily a commercial issue rather than a new legal problem as intellectual property rights should not need additional legal protections by virtue of attaching to BIM models. For example, existing statutory copyright protection already covers graphic and non-graphic design work plus *"computer programs"* and *"preparatory design material for a computer program"*[97].

Commentators note that *"intellectual property rights (IPR) and copyright issues do not present any major roadblocks to BIM adoption"* if there is a clear understanding as to:

- each team member's ownership or permission in respect of all contributions to models;

- grant of limited, non-exclusive licences to reproduce, distribute, display or otherwise use those contributions;

- equivalent clarity in respect of contractor and sub-contractor contributions[98] ;

- the use of models for facilities management during the operation and maintenance phase[99].

A distinction has been drawn between intellectual property rights at BIM Level 2, where contributions to BIM models can be traced to their authors, and the position at BIM Level 3, where contributions may become indistinguishable.[100] Commentators have raised concerns as to the intellectual property implications of BIM Level 3 where contributions cannot be separated and if a contributor

[95] See Appendix A Part 3 Question 2.7
[96] See Appendix A Part 3 Questions 2.1 and 2.7
[97] Copyright Designs and Patents Act 1988, section 3(1)
[98] As regards contractor, sub-contractor and supplier contributions see also Chapters 9.2 and 9.3
[99] RICS "International BIM implementation Guide" 1 March 2015, p56 section 4.1. As regards facilities management see also Chapter 11
[100] https://www.thenbs.com/knowledge/bim-levels-explained

cannot prevent or even see amendments made to its work by another contributor. The difference is more a question of insurable liability than intellectual property as it is possible to protect joint authorship if that is how a BIM Level 3 model is to be jointly owned[101].

For the purposes of BIM Level 2 it is important that team members can rely on each other's ownership of intellectual property in their respective BIM contributions and that those rights are licensed in way that supports completion, use and operation of the project.

Intellectual property rights are treated as follows in the standard form contracts:

- FIDIC: two party licence under clause 1.10;
- JCT 2011: two party licence under clause 2.41;
- NEC3: two party licence under clause 22.1;
- PPC2000: direct mutual licences and indemnities under clause 9 as between all the project team members who sign the multi-party *"Project Partnering Agreement"* or a *"Joining Agreement"*[102].

As stated in Chapter 4.2, the CIC Protocol offers a balanced approach to the licensing of BIM models, but it creates an additional burden on the client as the contractual gatekeeper obliged to create and maintain a full set of matching BIM model licences[103]. It also leaves project team members without direct remedies against each other in respect of any breach of those licences[104]. A multi-party structure of the type used in PPC2000 provides a solution to these problems by creation of direct mutual licences, and this was one of its attractions to Ministry of Justice when choosing a form of contract to support its BIM-enabled projects[105].

6 What is the contractual status of BIM documents?

"If you look at it as a whole system, it may look quite daunting. But if you understand the framework and understand the reasons behind the processes that need to be put in place then you begin to understand their importance and how to use them": Krigh Bachmann, BIM Manager, Pollard Thomas Edwards Architects

There are a number of BIM acronyms and terms that do not match familiar construction contract wording. Hence, there may be a lack of clarity as to which

[101] As noted by Will Cooper "Professional Appointments and BIM" (2013) 24 7 *Construction Law* 26

[102] See also Chapter 10

[103] CICBIM/Pro clause 6.10

[104] The CIC BIM Protocol is a bilateral arrangement between the client or the main contractor and each designer, and as a result the provisions of clause 6 relating to licences only create rights against the client or main contractor

[105] See also Chapter 10

documents mentioned in the context of BIM (*BIM documents*) should form part of which procurement documents and construction contracts.

A flowchart at Appendix B provides an overview of how different BIM documents fit into the contractual framework/procurement process. Also a Glossary of BIM terminology appears at Appendix D. In simple terms, the main BIM documents are intended to function as follows:

6.1 BIM protocol and/or amended contract terms

- a BIM protocol and/or suitable amendments to contract terms in consultant appointments, main contracts and sub-contracts set out the parties' contractual roles and responsibilities if these are not already covered by the contracts. Only a minority of interviewees saw contracts as clarifying roles and responsibilities and none saw a protocol as serving this purpose. Many interviewees stated that roles and responsibilities are described in the *BIM Execution Plan* or in *PAS 1192:2-2013*[106];

- the protocol and/or amended contract provisions may also annex or refer to other relevant documents such as, in the case of the CIC BIM Protocol, agreed applicable *"BIM standards"*, the *Employer's Information Requirements*, the *BIM Execution Plan* and the *"Project Procedures"* each of which should be defined and identified as tender/contract documents;

- the term *"BIM standards"* is not defined in the CIC BIM Protocol and could comprise for example the relevant PAS documents referred to at Appendix D. All relevant standards should form part of the client's brief issued to any consultant or contractor at tender stage, and should also form part of their respective contracts;

- the term *"Project Procedures"* in the CIC BIM Protocol describes processes for matters such as spatial coordination, model approval, archiving, information security and resolution of conflicts. The CIC BIM Protocol envisages these as a separate set of terms but they are closely related to the *Employer's Information Requirements* and, in relation to conflict resolution, they are closely related to the contract terms.

6.2 Employer's Information Requirements

- The *Employer's Information Requirements* set out the Employer's BIM requirements and/or specifications and should form part of the client's brief to any consultant or contractor at tender stage, and part of their respective contracts.[107] They set out the details of the *Common Data Environment* created through BIM, including agreed software and

[106] See Appendix A Part 3 Question 2.3

[107] *"In summary the EIRs establish a consistent digital format for providing data that can be reviewed by the client in order to assess and approve the project's progress and viability at each work stage*". "*In effect the pre-contract EIRs constitute a consistently structured Request for Proposals relating to BIM*" David Shepherd BIM Management Handbook, NBS 2015 p19 and p21

formats, and cross-refer to the *BIM Execution Plan* and related project procedures[108]. Only 10 of the 40 interviewees referred to use of *Employer's Information Requirements*[109];

6.3 BIM Execution Plans

- the *BIM Execution Plan* formulates each consultant's and contractor's intended processes to fulfil and achieve the *Employer's Information Requirements*, and should form part of the commitments offered by each party, firstly in their respective tender submissions and secondly in their contracts, for example in a set of JCT 2011 Design and Build *"Contractors' Proposals"* or PPC2000 *"Project Proposals"*. 18 interviewees referred to use of a *BIM Execution Plan*[110];
- the *BIM Execution Plan* may also set out the timing of each party's BIM contributions examined separately in Chapter 5.1.

There are differing practices and perceptions in the industry as to the use of the CIC BIM Protocol and its Appendices. For example, it is understood by BIM Research Group members that the standard *BIM Execution Plans* published separately by the CIC were intended, by their authors, not to be contract documents but rather to be supporting documents setting out the internal processes of each team member in applying the contractual obligations set out in the *Employer's Information Requirements* and CIC BIM Protocol. However, this is not clear in the CIC BIM Protocol, nor is it logical for the *BIM Execution Plans* to describe important obligations of team members without these being contractual commitments.

Almost half the interviewees saw the *BIM Execution Plan* as setting out the roles and responsibilities of team members[111], and in the experience of BIM Research Group members, it is not uncommon for BIM protocols, *Employer's Information Requirements* and *BIM Execution Plans* all to form binding contract documents. This is a logical approach as it is difficult to see how team members can commit to BIM without being able to rely on the BIM documents that they are asked to use. Where a team member expects a BIM document to be non-binding, for example because it is intended for guidance only, then this should be spelled out in order to avoid the risk of misunderstanding.

A surprising number of interviewees reported creating their own bespoke BIM documents[112]. These differences of approach highlight the need for greater clarity in agreeing the contents and priority of the BIM documents, regardless of the labels or acronyms placed on them, and in agreeing the intended compliance of parties to the BIM-enabled terms.

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[108] *"Pre-Contract Building Information Modelling (BIM) Execution Plan"* April 2013 and *"Post Contract-Award Building Information Modelling (BIM) Execution Plan"* March 2013

[109] See Appendix A Part 3 Question 1.2

[110] See Appendix A Part 3 Question 2.3

[111] See Appendix A Part 3 Question 2.3

[112] See Appendix A Part 3 Question 2.10

7 What reliance can be placed on BIM software?

"The fundamental requirement for producing information through a collaborative activity is to share information early and to trust the information that is being shared as well as the originator of that information": PAS 1192-2:2013[113]

63% of the respondents to the NBS National BIM Report 2015 considered that *"BIM is not about software, but a more collaborative way of working"*[114] and 26% of respondents had, over the last year, produced a model that did not rely on a particular single piece of software. However, the wider reliance on software for the successful implementation of BIM has given rise to significant liability concerns. Interviewees expressed differing views as to whether the client or the design team should select BIM software, while the majority noted particular concern that the interoperability of BIM models is not dealt with satisfactorily[115].

7.1 Reliance on data and communication

Reliance on data is fundamental to the ability of project team members to fulfil their contractual obligations. Computer aided design has been widely used for many years, as have on-line document management and project management systems, without attracting defensive contract terms in respect of access arrangements and data corruption.

Electronic communication is a ubiquitous phenomenon not confined to BIM, and is widely used on construction projects without contract exclusions as to the risk of data security in transmission. Contract documents need to clarify BIM-related software processes and provide for balanced risk allocation, bearing in mind that clients will expect a reasonable level of protection[116].

Standard form construction contracts and appointments have not typically limited or excluded liability for the accuracy of two dimensional drawings or computer-aided three dimensional designs. Hence, contractual silence on this issue is the starting point in the FIDIC, JCT, NEC3 and PPC standard forms.

7.2 Exclusions of liability

However, the CIC BIM Protocol excludes any warranty as to the integrity of electronic data transmission, and also excludes any liability for corruption or alteration occurring after transmission[117]. These exclusions place all the excluded

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[113] See Glossary at Appendix D

[114] NBS National BIM Report 2015 p12 https://www.thenbs.com/knowledge/nbs-national-bim-report-2015

[115] See Appendix A Part 3 Questions 1.4 and 2.8

[116] *"The promoter will want to ensure as far as possible that the licence terms under which the BIM software is supplied make allowance for a reasonable degree of liability on the part of the software provider for losses incurred by participants and losses to the project overall attributable to failings in the software"* p115, ICE proceedings Vol. 167 Issue MP3 June 2014 - Building information modelling and the law

[117] CICBIM/Pro clause 5

risks with the client, and do not require project team members to pass any liability at all to BIM software providers.[118]

The importance of this issue is illustrated by disputes where a loss clearly results from a software error but where typical exclusions of liability used by software providers in respect of even basic functionality prevent any remedy[119]. For example, the standard Autodesk License and Services Agreement limits any warranty to a 90-day period (or the licence term if shorter) and limits Autodesk's liability (to the extent permitted by law) to *"attempt to correct or work around errors"* or to *"refund the license fees"* .This is accompanied by extensive disclaimers including the exclusion of any warranty that *"the operation or output of the licensed materials will be uninterrupted, error-free, secure, accurate, reliable or complete"*[120]. Autodesk also excludes liability for any *"incidental, special, indirect, consequential or punitive damages, for loss of profits, use, revenue or data; or for business interruption"*[121].

If exclusions of this type are accepted without question and are passed on to clients, there is the risk that clients will question whether these exclusions dilute the benefits obtained from the adoption of BIM.

8 What is the role of the BIM Information Manager?

"The key with BIM is realising value from our digital assets through clear and consistent ways of defining data requirements, consistency in data management and improved data procurement, which gives us greater provenance and assurances in the quality of data we receive": Sonia Zahiroddiny, BIM Strategy Manager, HS2

Interviewees adopted varying approaches in order to gain access to specialist BIM expertise, including the appointment of a *BIM Information Manager* or a *BIM Consultant*[122] or their own members of staff, and there was general consensus among interviewees that more guidance is required as to the BIM Manager role[123].

8.1 Reliance on expertise

The ability of team members to rely on the specialist BIM expertise of a BIM Information Manager or BIM Consultant will depend on:

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[118] *"Residual liability for the integrity of the electronic data rests with the employer"* Lewis S., "Playing games of risk", *Building* February 2014

[119] See for example the US case of *M. A. Mortenson Company Inc. v Timberline Software Corporation, et al* (1999) 93 Wash. App 819 where a software error resulted in a bid being too low. The software provider's wide limitation clause excluded liability for "*any damages of any type*" and was upheld by the court

[120] Autodesk License and Services Agreement clauses 5.1 and 5.2

[121] Autodesk License and Services Agreement clause 7.1

[122] See for example Thomas Lane *"The Rise of the BIM Consultant"* in Building November 2011 http://www.building.co.uk/the-rise-of-the-bim-consultant/5026614.article

[123] See Appendix A Part 3 Question 2.5

- clarifying exactly what the BIM Information Manager or BIM Consultant does[124];

- whether reliance on representations made by the BIM Information Manager or BIM Consultant give rise to a special relationship[125];

- other team members acting reasonably in their reliance[126].

In the CIC Outline Scope of Services for Information Management there are requirements for the BIM Information Manager to:

- *"initiate, agree and implement the Project Information Plan and Asset Information Plan"*;

- *"enable integration of information within the Project Team and co-ordination of information by the Design Lead"*;

- *"provide the services to host the Common Data Environment"*[127].

To quote from the BIM Task Group *"The Information Manager has a key role in setting up and managing the Common Data Environment (CDE). The CDE is a key tool for effective collaboration, quality control and avoidance of waste"*. As to who should fulfil this role *"The BIM Task Group anticipates that the role will be incorporated into existing appointments"*[128]. It is also relevant to note the CIC Protocol guidance note, which states that *"The Information Manager has no design related duties. Clash detection and model coordination activities associated with a 'BIM coordinator' remain the responsibility of the design lead"*[129].

As regards the role of BIM Consultants, in their answers to frequently asked questions, the BIM Task Group state that:

- *"BIM consultants typically undertake coordination and clash detection in connection with models"*;

- *"Employers are advised to avoid blurring design responsibility through the direct appointment of BIM consultants to undertake model coordination. Use of sub-consultancy appointments under an existing design consultant appointment will maintain the existing allocation of design responsibility"*[130].

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[124] Noting for example the "*Outline Scope of Services for Information Management*" created by the Construction Industry Council CIC/INF/MAN/S2013

[125] See for example *Hedley Byrne & Co. Ltd v Heller & Partners Ltd* [1964] AC 465

[126]See for example *Cooperative Group Ltd v John Allen Associates Ltd* [2010] EWHC 2300 (TCC)

[127] CIC/INF MAN/S 2013 "*Outline Scope of Services for Information Management*"

[128] BIM Task Group, Scope of Services for Information Management FAQs

[129] CIC BIM Protocol Guidance Note 4 [Building Information Model (BIM) Protocol BIM (CIC/BIM Pro) First edition 2013, p.vi]

[130] BIM Task Group, Scope of Services for Information Management FAQs

8.2 Need for clarification

Whichever team member's appointment included the BIM Information Manager role, there was little evidence from interviewees that this role was seen as central to any aspect of BIM. Many interviewees reported greater reliance on the use of BIM Consultants to support and inform the use of BIM, but generally they are not appointed to take responsibility for model coordination and clash detection in the way that the BIM Task Group envisages. Rather than being appointed as team members with a schedule of project deliverables, some BIM Consultants are brought in only to facilitate the performance and interfaces of other team members[131].

The responses from interviewees suggest that there remains a lack of clarity as to who should take on the role of BIM Information Manager and how this interfaces with the role of the design lead as party responsible for BIM model coordination. As long as these roles are not fully understood and as long as team members each rely primarily on their own staff, or on BIM Consultants who are not themselves members of the team with clear services, there will be limits on the extent to which BIM can support integrated teams.

9 Is BIM affected by procurement models?

"Informed clients recognise the value of having their BIM strategy in place right at the outset to better start the process": Lucas Cosack and Tom Inglis, Digital Engineers, Laing O'Rourke

"Early contractor involvement and bringing tier 2 & tier 3 in early to advise on design has brought in efficiencies": Paul Davis, Information Modelling & Management Capacity Programme (IMMCP) Delivery Team, Transport for London

9.1 Choice of procurement model

The majority of projects reviewed by the BIM Research Group adopted a procurement model that involved early contractor involvement[132]. This is in line with the perception of the UK Government that: *"BIM is a way of working that facilitates early contractor involvement, underpinned by the digital technologies which unlock more efficient methods of designing, creating and maintaining our assets".*[133]

Advice on selection of a procurement model often focuses primarily on identifying which team member or members are liable for design, and on how to transfer design and construction risk away from the client. If BIM is intended to support a more integrated team approach, a procurement model also needs to

[131] See Appendix A Part 3 Question 2.5

[132] See Appendix A Part 3 Question 2.2

[133] Section 22, Government Construction Strategy 2016-20, Infrastructure and Projects Authority

focus on how to obtain early enough BIM model contributions from the main contractor and from specialist contractors without causing delay or fragmenting the warranties relied on by the client. Incorrect advice on procurement models can create liability for advisers[134]. Miscalculations by bidders resulting from software errors in procurement can give rise to significant disputes.[135]

Arguably a decision as to who should take a lead role in managing the *Common Data Environment* should be determined alongside and according to the choice of procurement model. Surprisingly, the views of interviewees varied widely as to whether this responsibility should rest with the lead designer, main contractor or the client[136] .

The concept of early contractor involvement and early tier 2/3 supply chain design input has been advocated for many years, for example by the ICE: *"Designers must involve the contractors, specialist subcontractors and key manufacturers as soon as possible. In order to interpret and develop a functional brief it is essential that designers (including specialist subcontractors and key manufacturers) are able to get close to clients."*[137] Various forms of early contractor involvement have become familiar in the UK construction sector but until recently it was not recognised as a distinct procurement model.

In 2010 the newly elected UK Coalition Government embarked on a fresh analysis of public sector construction procurement in consultation with representatives of the construction industry. They assessed the merits of early contractor involvement under a *Trial Projects* programme pursuant to their 2011 *Government Construction Strategy*[138]. This strategy, now updated in 2016[139], recommended new procurement models designed to achieve savings and efficiencies which do not succumb to the temptations of market-led low pricing, but which instead rely on a combination of collaborative working, early contractor involvement and BIM.

The UK Government's recommended procurement models comprise:

Cost-Led Procurement – use of a framework mini-competition to obtain proposals for savings and improved value, within stated cost ceiling, prior to team selection and appointments[140];

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[134] See for example consultant liability for lack of fully informed procurement recommendations in *Plymouth and South West Co-operative Society Ltd v Architecture Structure and Management Ltd* [2006] EWHC 5 (TCC)

[135] See for example the US case of *M. A. Mortenson Company Inc. v Timberline Software Corporation, et al* (1999) 93 Wash. App 819 where a software error resulted in a bid being too low.

[136] See Appendix A Part 3 Question 1.3

[137] Strategic Forum for Construction, Accelerating Change (2002), section 26: *www.strategicforum.org.uk*

[138] Government Construction Strategy (2011) – https://www.gov.uk/government/publications/government-construction-strategy

[139] https://www.gov.uk/government/publications/government-construction-strategy-2016-2020

[140] https://www.gov.uk/government/publications/cost-led-procurement

Two Stage Open Book – use of pre-construction phase conditional appointments of the team to obtain proposals for cost savings and improved value, within a stated budget, after selection but prior to construction phase appointments[141];

Integrated Project Insurance – use of project insurance without recourse, including cover for design problems and cost overruns, to create a no blame culture and to obtain additional proposals for savings and improved value[142].

9.2 BIM and Two Stage Open Book

Two Stage Open Book is the procurement model that was adopted on Trial Projects combining BIM with early contractor involvement and collaborative working, two of which were among the projects examined by the BIM research Group. It creates a single project team, including the main contractor, all of whose members are appointed early under a conditional contract and a binding timetable describing how they agree to work together through BIM in order to develop designs, agree costs and reduce risks ahead of the client approving start on site[143].

At the same time that Two Stage Open Book was being trialled by the UK Government as a basis for procuring projects with BIM, the RIBA launched its Plan of Work 2013 identifying scope for procurement models under which the pre-construction phase design can be led by an early appointed main contractor and its specialist supply chain as members of a single design team.[144] This approach recognises that *"Specialist sub-contractors, suppliers and consultants (e.g. sustainability, ecology, building modelling and post-occupancy evaluation experts) need to know where they come into a project"*[145].

Based on the evidence of the projects examined and the responses of interviewees, it is arguable that full adoption of BIM with planned contributions by all parties will be difficult to deliver through a traditional single stage procurement system, to the extent that:
- contractor bids are invited later in the pre-construction phase;
- the design, cost and risk information supporting the winning bid is not subject to transparent joint review and analysis;
- there is little scope to agree improvements with the winning team before commencement of construction.

9.3 BIM and construction management

Two Stage Open Book is not the only alternative to a single stage procurement model. Interviewees linked to major private sector developers described the benefits of using BIM in conjunction with procurement of individual trade

[141] https://www.gov.uk/government/publications/two-stage-open-book
[142] https://www.gov.uk/government/publications/integrated-project-insurance
[143] www.gov.uk/government/collections/new-models-of-construction-procurement
[144] www.architecture.com/TheRIBA/AboutUs/Professionalsupport/RIBAOutlinePlanofWork2013
[145] Lamia Shamma, *"Out with the old, in with the new – the RIBA Plan of Work 2013"*, NBS Design and Specification, 21 May 2013

packages through construction management.[146] They emphasised the differences in the appropriate treatment of BIM according to the complexity and capabilities of the trades and the ways that this can be accommodated in a construction management procurement model[147]. They also noted the risks of adopting a one size fits all approach which can be the temptation when setting out BIM requirements in a main contract tender.

Early contractor involvement under Two Stage Open Book and construction management provides new opportunities to develop detailed knowledge of the cost of project components and to ensure that BIM models are accurately costed in line with what is known as *5D BIM*[148].

10 Evidence of links between BIM, procurement and contracts

"BIM closes down the besetting sin of recent years: contractors under-pricing their bids to win, followed by clawing back profit from claims based on the always imperfect information provided by consultants": Growth Through BIM, p61

"We started our BIM journey 3 years ago by consulting extensively with industry ahead of developing our third generation suite of infrastructure delivery models. We found that there was a strong link between BIM and the underlying contract models and that – before we could fully implement BIM – we had to get those contract models right. It soon led us to the conclusion that – firstly – integrated project delivery (IPD) was required to enable BIM and – secondly – the level of integration required from project to project would vary. For that reason, 3 years down the track, we have arrived at a third generation suite of 6 bespoke IPD delivery models (all capable of enabling BIM to the required level)": Bob Baird AM and Jolanta Skawinski, Australian Department of Defence.

This Chapter 10 examines Cookham Wood and North Wales Prison, two of the 12 projects that were analysed by the BIM Research Group and in respect of which separate case studies were published by Cabinet Office and Constructing Excellence[149]. In each case the case studies considered evidence of connections between BIM, the selected procurement model and the contract terms.

Both projects were procured using the Ministry of Justice (MoJ) multi-party framework alliance which was recognised as an example of an effective framework[150] and which influenced the drafting of the new *FAC-1 Framework*

[146] See Appendix A Part 3 Question 2.2

[147] Construction management is a procurement model under which there is no main contractor. Instead the different trades are appointed direct by the client alongside a consultant construction manager. See for example JCT2011 CM/A and CM/TC forms of contract.

[148] See Glossary at Appendix D

[149] https://www.gov.uk/government/publications/procurement-trial-case-study-cookham-wood-prison; http://constructingexcellence.org.uk/wp-content/uploads/2015/12/Trial-Projects-North-Wales-Prison-Case-Study_Final.pdf

[150] https://www.gov.uk/.../Procurement-and-Lean-Client-Group-Final-Report-v2.pdf

Alliance Contract[151]. Both projects also used the PPC2000 form of contract and made no amendments to its standard terms by reason of the adoption of BIM[152].

10.1 Cookham Wood case study

The team that delivered the Cookham Wood Trial Project reported that a combination of early contractor involvement, collaborative working and BIM were integral to the results that they achieved. BIM Level 2 models were used in the brief issued to prospective main contractors and were developed by bidders as part of their proposals for project team selection. Interserve Construction were appointed as main contractor and lead designer, bringing with them Arup as consulting engineers, EMCOR as mechanical and electrical specialists and SCC as precast volumetric cell providers. HLN Architects were MoJ's appointed designer and technical assessor.

10.2 Savings and improved value on Cookham Wood

The Cookham Wood Trial Project case study, which was independently audited, attributed significant improved value to Two Stage Open Book and BIM. These included 20% agreed savings, namely a cost of £2,332 per square metre against a baseline benchmark of £2,910 per square metre. For example, the main contractor Interserve and its tier 2 specialist subcontractor SCC submitted a precast volumetric cell proposal in response to the MoJ brief which was developed through BIM by the wider design team and led to a time saving of six weeks and a saving in overheads of £85,000[153].

Other innovations reported to be obtained through Two Stage Open Book and BIM included:

- use of solid precast floor slabs in place of pre-stressed floor slabs, resulting in a time saving of twelve days;
- creation of much more resilient lighting in the education block through a bespoke solution proposed by EMCOR that also created a significant cost saving;
- development by Arup and EMCOR of service ducts and cell risers that could be serviced by repair and maintenance engineers more quickly and reliably.[154]

[151] The FAC-1 Framework Alliance Contract is published by the Association of Consultant Architects and was launched in June 2016, hence beyond the opportunity for further analysis in this Research Report. It was drafted by King's College London and includes express provision for BIM.

[152] https://www.gov.uk/government/publications/procurement-trial-case-study-cookham-wood-prison page 2

[153] Cookham Wood at https://www.gov.uk/government/publications/procurement-trial-case-study-cookham-wood-prison page 3

[154], Cookham Wood at https://www.gov.uk/government/publications/procurement-trial-case-study-cookham-wood-prison pages 3-4

10.3 BIM deadlines on Cookham Wood

On the Cookham Wood project Interserve prepared a *BIM Execution Plan*, which was developed in detail during the pre-construction phase by the wider project team. In order to create greater clarity in respect of timing, as discussed in Chapter 5.1, the *BIM Execution Plan* was linked to deadlines agreed by all parties, firstly in relation to the pre-construction phase of the project (the PPC2000 *Partnering Timetable*), and secondly in relation to its construction phase (the PPC2000 *Project Timetable*).[155] By this means specified *COBie*[156] data drops and the related detailed activities of each team member at each stage of design development were set out against a single agreed set of integrated deadlines, which through the multi-party structure were supported by direct mutual contract obligations.

10.4 Early warning and clash detection on Cookham Wood

Under the multi-party contract each Cookham Wood team member agreed directly with the others to be responsible for errors, omissions and discrepancies in the BIM models it prepared or contributed to: *"except to the extent of its reliance (if stated in such Partnering Documents) on any contribution or information provided by any one or more other Partnering Team members"*.[157] As the sequence and nature of each contribution were spelled out, each team member was contractually entitled to rely on all earlier designs and was made aware of who will rely on the completeness, accuracy and timeliness of its contributions.

As envisaged in Chapter 5.2 the team members agreed to provide Early Warning to each other *"of any error, omission or discrepancy of which they become aware and (within the scope of their agreed roles, expertise and responsibilities) to put forward proposals to resolve any such error, omission or discrepancy fairly and constructively within the Partnering Team without adversely affecting the agreed cost or time for completion or quality of the project"*[158]. This clause underpinned the commitment of all parties to BIM clash detection and to the notification of pragmatic solutions. It helped to establish that, by notifying a warning of clash detection and a proposal to resolve it, a team member would not acquire any additional responsibilities beyond those already within its agreed contractual role and expertise.

BIM processes and Early Warning were subject to collective governance by agreed individuals comprising the Core Group, who were required to meet whenever requested by any team member, for example to approve design development proposals and to resolve questions and problems arising from BIM

[155] See PPC2000 clause 6 (Partnering Timetable and Project Timetable) and Appendix 6 (Form of Partnering Timetable)
[156] See Glossary at Appendix D
[157] PPC2000, clause 2.4 (Responsibility for Partnering Documents)
[158] PPC2000, clause 2.5 (Partnering Documents complementary)

clash detection[159]. Their decision-making adopted a collaborative model through unanimous agreement of all individuals present at a Core Group meeting[160].

10.5 Intellectual property rights on Cookham Wood

Under the multi-party structure, a set of mutual intellectual property licences were directly entered into between all team members *"for any purpose relating to the completion of the Project and (only in regard to the Client) the Operation of the Project"*[161]. As regards liability arising from the licensing of intellectual property rights, the liability of team members was excluded *"for the use of any design or document that it prepares for any purpose other than that for which it was agreed to be prepared as stated in, or reasonably inferred from, the Partnering Documents"*[162].

10.6 Duty of care on Cookham Wood

The Cookham Wood contract included no exclusions or limitations of liability of any kind arising by reason of the adoption of BIM, and MoJ adopted the approach that BIM did not require changes in the duty of care adopted prior to the introduction of BIM. The MoJ contract did not contain any of the limits and exclusions of liability that appear in the CIC BIM Protocol in respect of duty of care or data integrity.[163]

10.7 BIM Information Manager on Cookham Wood

MoJ did not appoint a separate BIM Information Manager on the Cookham Wood project. All roles and responsibilities of team members had been agreed prior to the adoption of BIM, and MoJ treated BIM as the agreed medium for fulfilment of those roles and responsibilities[164].

10.8 North Wales Prison case study

The North Wales Prison Trial Project applied the same procurement and contract approach as Cookham Wood[165]. The team also used lessons learned on Cookham Wood in agreeing an extended pre-construction appointment with main contractor Lendlease and its mechanical and electrical specialist Crown House. The client, main contractor and mechanical and electrical specialist worked alongside the consultants in co-located offices during a 38-week pre-construction phase without this causing any delay in the overall project

[159] PPC2000 clause 3.3 (Core Group and members), 3.4 (Responsibility for Core Group members), 3.5 (Core Group meetings)
[160] PPC2000 clause 3.6 (Core Group decisions)
[161] PPC2000, clause 9.2 (Licence to copy and use)
[162] PPC2000, clause 9.3 (Liability for use of designs and documents)
[163] See Chapters 4.3 and 4.4
[164] Cookham Wood at https://www.gov.uk/government/publications/procurement-trial-case-study-cookham-wood-prison pages 1and 5
[165] North Wales Prison at http://constructingexcellence.org.uk/wp-content/uploads/2015/12/Trial-Projects-North-Wales-Prison-Case-Study_Final.pdf

programme. This Trial Project adopted the UK *Government Soft Landings*[166] initiative, using a two-year extended warranty from Lendlease and its team as a means to ensure that BIM models and related data are understood and properly used for the repair, maintenance and operation of the completed prison.

The North Wales Prison Trial Project has so far recorded savings of 26%, reducing a cost estimate of £212 million to an agreed price of £159,923,058. The team reported agreed savings and improvements, obtained through Two Stage Open Book and BIM, that included:

- value engineered lighting;
- review of the building footprint;
- environmental improvements and cost savings through use of an open swale in place of an attenuation tank;
- reprogramming to make up for delayed start on site caused by the client approval process;
- £4 million of reduced cost through asbestos mitigation on site[167].

10.9 BIM and security

Both the Cookham Wood and North Wales Prison projects involved significant security issues and the selected contract form included special terms to deal with MoJ security requirements. An additional PAS document is now available comprising a specification for security-minded building information and modelling[168] **.** The document relates primarily to what it defines as *"sensitive built assets"* which may be vulnerable to hostile or criminal behaviours.

If a project is not classed in any way as a sensitive built asset, then this level of planning is not required. The availability of this additional guidance offers a response to any suggestion that the collaborative sharing of data required for BIM to succeed is not possible for reasons of data security. This is particularly relevant in light of the views of interviewees that project team members are not always willing to share relevant BIM data[169].

11 BIM and long term asset management

"Great value to be had in the ability to utilise the process to analyse and predict the performance of a building whilst at the modelling stage": Ian Rye, Regional Director, AHR Architects

BIM can promote the data capture required to deliver a better asset both at the capital expenditure stage of a project and in the operational lifecycle. To date there has been a focus primarily on the capital delivery of an asset and the role BIM has to play in gathering and verifying data during the design development,

[166] See Glossary at Appendix D and also Chapter 11.1

[167] North Wales Prison at http://constructingexcellence.org.uk/wp-content/uploads/2015/12/Trial-Projects-North-Wales-Prison-Case-Study_Final.pdf pages 2 and 3

[168] PAS 1192-5: 2015

[169] See Appendix A Part 3 Question 2.1

construction and handover stages. However, the operational life-cycle of an asset is likely to be far more costly than the capital expenditure stage and BIM is now increasingly being used to define, measure and manage this cost.

Interviewees recognised the importance of as-built BIM models for the purposes of long term-asset management, particularly for clients who retain ownership of their completed projects[170]. The benefits of BIM can extend long beyond completion of a capital project if it is used to create accessible data that supports interactive operation and maintenance systems in place of traditional operation and maintenance manuals. This is *6D BIM*[171] and is supported by guidance on the development of an *AIM* or *Asset Information Model*[172].

Asset management through BIM requires contracts that do not focus only on the capital works phase of a project but also on its repair, maintenance and facilities management. For example, FIDIC does not publish a form of contract governing repair, maintenance and facilities management, and available forms include:

- *JCT Measured Term Contract*[173];
- *NEC3 Term Service Contract*[174];
- *TPC2005 Term Partnering Contract*[175], which was adopted by one of the twelve project teams interviewed[176]

11.1 Government Soft Landings

The closer integration of the design, construction and operation phases in the life of a built asset forms part of the UK Government's approach to BIM Level 3. For example, *"Digital Built Britain"* includes proposals at BIM Level 3A for the *"Development of BIM and asset data enabled FM and AM Contracts"*[177]. However, the development of contract models that help to fulfil the operational potential of BIM data also depends on the adoption of procurement models that invite the market to submit whole-life asset management proposals. For example, the UK *Government Soft Landings (GSL)* initiative includes trials of new project team contract commitments supported by BIM that extend beyond the typical defects liability period[178].

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[170] See Appendix A Part 3 Question 2.9

[171] See Glossary at Appendix D

[172] See Glossary at Appendix D

[173] PAS1192:2 2014. If a high level of security is required, the document recommends the appointment of a *"built asset security manager"* and the creation of a *"built asset security management plan"* to ensure the security of asset data through all the periods of its life-cycle, from planning to design, construction and operation

[174] https://www.neccontract.com/Products/Contracts/Term-Service-Contract/NEC3-Term-Service-Contract-TSC

[175] http://www.ppc2000.co.uk/tpc2005.htm and which is the basis for the *TAC-1 Term Alliance Contract* currently under consultation

[176] City of London Corporation, Central Criminal Court

[177] *"Digital Built Britain"*, Level 3 Building Information Modelling – Strategic Plan, February 2015

[178] See also Chapter 10.8 as to the use of GSL on North Wales Prison Trial Project

The objectives of GSL include *"Supporting collaboration in the supply chain including Designers, Suppliers, Constructors, and Asset Managers throughout the whole asset lifecycle … The contractor shall allow for the participation of appropriate sub-contractors in design reviews, and record and act on identified access, commissioning and potential maintenance risks, where appropriate"*: Introduction and Section D2, GSL Employer's Requirements, Design and Construction Team Specification[179].

BIM *"Early Adopter Projects"* at Liverpool Local Prison (Ministry of Justice) and Shonk Mill Flood Storage Area (Environment Agency) used BIM in conjunction with GSL to reduce operational costs[180].

11.2 BIM retrofit

Among the projects reviewed by the BIM Research Group, the City of London Corporation project for replacement of mechanical and electrical systems at the Central Criminal Court (the Old Bailey) adopted BIM to retrofit digital designs and data that will support the future repair, maintenance and facilities management of the building.

Among interviewees Faithful+Gould (*"F+G"*) reported working with clients such as Ministry of Justice and Network Rail in mapping existing asset data into an *Asset Information Model* and summaries of this work are set out below. F+G reported that MoJ have used BIM to survey and data-log over six million assets for condition, life to replacement, priority ranking and impact. F+G report that this has helped to reduce unplanned maintenance by over 20% and to identify critical asset maintenance programmes. MoJ are currently taking the current asset management data further, classifying it to the RICS *"NRM"* [181] and *"SFG20"*[182] structure and into what will become the AIM. The classification of the assets supports the sharing of asset data, automatically, into Asset Management Systems (*"AMS"*) and Computer-Aided Facility Management (*"CAFM"*) systems and supports COBie extracts to be taken from the AIM for use in capital projects and then updated via further COBie extracts back into the AIM.

F+G also reported that Network Rail are creating an asset surveying template based around the Rail Method Measurement which adopts the NRM 3 for operational buildings, and aligning with the SFG20 and CIBSE life standards. Standard asset structure data models are being developed for five function models (stations, depots, national service units, maintenance units and lineside buildings) that have been generated using standard asset classification structures. Once collected the data should create an active *Asset Information Model* that is able to share data with AMS and CAFM systems. This approach is

[179] http://www.bimtaskgroup.org/gsl-policy-2/

[180] See for example http://www.bimtaskgroup.org/wp-content/uploads/2013/11/Liverpool-Prison-Case-Study-Final-18-11-13-web.pdf;

[181] http://www.rics.org/uk/knowledge/professional-guidance/guidance-notes/new-rules-of-measurement-order-of-cost-estimating-and-elemental-cost-planning/

[182] http://www.sfg20.co.uk/

expected to unlock robust asset intelligence on maintenance whilst reducing the cost of surveying. It should also support critical asset maintenance planning and budget forecasting.

12 Future BIM procurement and contract options

This Research Report has demonstrated how contracts and procurement models can enable BIM Level 2. It has revealed through interviews and wider consultation a range of current concerns and a wide variety of current practices. It has also illustrated how some project teams have used their selected contracts and procurement models in conjunction with BIM to achieve improved value.

A question that remains is whether improvements to existing contract forms and guidance can allay concerns and can do more to encourage and support successful implementation of BIM. This Chapter 12 looks at a number of options which, based on the findings of this Research Report, may merit further attention.

12.1 Revised two party protocols

The CIC BIM Protocol has forged a path in tackling contractual issues relevant to BIM that are not dealt with in most standard form building contracts, and in attempting to integrate a team approach to BIM through requiring the same protocols to be entered into by all project team members with the benefit of consistent supporting documents.

This has created a reasonably clear and balanced approach among a set of two party contracts but needs to be viewed alongside the protocol's various limitations on liability. Advisers may find that clients resist adopting the current CIC BIM Protocol for the reasons identified in this Research Report[183].

As we consider the impact of the April 2016 UK public sector BIM mandate, it may be time to review how the CIC BIM Protocol can be updated. For example, it should be possible to encourage wider use of the CIC BIM Protocol without damaging the legitimate interest of team members by:

- removing or restricting the disclaimer of liability for electronic data exchange[184];

- removing the diluted duty to exercise only reasonable endeavours in delivering BIM models, and reverting to the more usual duty of reasonable skill and care linked to agreed roles and claimed expertise;

[183] See Chapter 4

[184] "*Agreement and Contract Conditions CIC/BIM Pro*", Construction Industry Council 2013, clause 5 p3

- reviewing the generic overriding excuse for failing to deliver a BIM model at the agreed LoD or in accordance with the Information Requirements by reason of events outside a team member's control, so as to remove the risk that this cuts across the agreed grounds for extension of time specified in standard form building contracts [185].

Also, in maximising the benefits of BIM, a revised protocol could provide guidance on links to recommended procurement models, including the importance of engaging with those who will manage and repair the completed project.

12.2 A multi-party contract

There is growing interest in the role that a multi-party contract can play in supporting the delivery of BIM enabled projects, for example in the following publications:

- ICE: *"Despite the popularity of the NEC3 and JCT suite of contracts in conventional construction projects, PPC2000 was the contract chosen for the UK government's Level 2 BIM trial projects. The multi-party contract was favoured as it governs the duration of the procurement process and promotes collaboration by bringing in key project participants at the design phase of the project."*[186]

- RIBA: *"It is logical given the move toward Integrated BIM (iBIM), new procurement models which consider ways of harnessing the skills of all the parties involved in the design, construction and management of a building will need to be developed alongside the new collaborative and multi-party contractual documents."*[187]

- ACIF and APCC: *"The future of the construction industries of Australia and New Zealand can be transformed through the adoption of BIM and Project Team Integration, which can drive substantial productivity improvements, expand business opportunities and encourage investment."*[188]

- BIM2050: *"A focus on relational contracting supports this recommendation using multi-party contracts to discourage legal disputes and costly litigation."*[189]

The potential of this option is illustrated by the projects delivered under PPC2000, as described in Chapter 10. Comparable multi-party contracts are

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[185] "*Agreement and Contract Conditions CIC/BIM Pro*", Construction Industry Council 2013 clause 4.1.2 p2

[186] ICE proceedings Vol 168, Issue MP6 p287 – *BIM and construction contracts – CPC2013's approach;* See also Tyerman 2013 CLJ 29(4) 295–307 "*Building information modelling and change management – a single version of the truth"*

[187] BIM Overlay to the RIBA Outline Plan of Work 2012

[188] Australian Construction Industry Forum and Australasian Procurement and Construction Council through the Strategic Forum for the Australasian Building and Construction Industry

[189] BIM 2050 Built Environment 2050 p23

being developed in Australia[190] and are already in use in the USA[191], the latter with a BIM Addendum clarifying (as in the case of PPC2000) that *"Each Party shall be responsible for any contribution it makes to a model or that arises from that party's access to that model"*[192].

The track record of multi-party contracts such as PPC2000 in avoiding disputes[193] is also relevant as BIM advances towards Level 3: *"Forms of contract and insurance suitable for integrated team working will need to be ready for BIM Level 3. Today's collaborative contracts, plus their BIM protocols, will need to develop into ones which can support shared responsibility but also manage disputes."*[194]

12.3 A multi-party BIM protocol

Interviewees adopted a range of contract forms[195] and it is unlikely that clients and team members will change to a multi-party contracting model solely in order to implement BIM. Meanwhile, despite the potential for improvements in a two party protocol, there remains the issue of how to conclude substantially the same protocols with every other team member. For example, it will be challenging for a main contractor to obtain the same two party protocols from each specialist sub-contractor when in practice sub-contracts take different forms and are concluded at different points in the project process.

It may be appropriate to develop and make available the option of a multi-party BIM protocol that leaves two party contracts in place while:

- creating direct relationships between project team members in relation to BIM and not depending on the client and the main contractor acting as intermediaries;

- enabling mutual reliance on agreed deadlines in respect of BIM contributions and approvals;

- creating an agreed forum for resolution of clashes between BIM models;

- creating direct mutual intellectual property rights[196];

- establishing clarity as to the reliance on data and on BIM software[197];

- spelling out links in relation to the repair, maintenance and operation of the completed capital project[198];

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[190] See Appendix E Part 2
[191] USA ConsensusDocs
[192] USA ConsensusDocs 301 BIM addendum clause 5.1
[193] Only two court cases in 15 years of use on up to 6% of all UK projects
[194] Growth Through BIM p412
[195] See Appendix A Part 3 Question 1.1
[196] See Chapter 5.3
[197] See Chapter 7

- providing for joining agreements to bring in additional members as they join the team.

12.4 Towards BIM Level 3

"Innovation is fundamentally changing business models. For example, the change from producing scaled 2D deliverable to 3D digital ones has already begun to transform the industry": Dale Sinclair, Director of Technical Practice, AECOM

Interviewees were cautious about progression to BIM Level 3 and considered that more work needed to be done first to embed BIM Level 2[199]. Digital Built Britain describes incremental progression in the development of BIM where at Level 3A: *"Collaborative models of working facilitated by data will permit greater engagement with lower tier suppliers."*[200] The recommendations in this report offer an approach to contracts and procurement that will assist in achieving that goal.

The future outlined in BIM 2050 includes the prediction that *"Design consultants and principal contractors will be appointed simultaneously, early in the lifecycle, to enable concurrent working at outline business case stage."*[201] This vision is consistent with the procurement models described in this report.

Digital Built Britain recommends the following commercial actions in attaining Level 3A through enabling improvements on Level 2:

"a. Improve Level 2 from lessons learnt – including more effective data exchange and data-enabled collaborative working based on transactional contracts

b. New protocol to address certainty associated with asset performance – including validated data and digital briefing, building on the foundations of Government Soft Landings"[202].

These commercial actions are consistent with the procurement and contract recommendations set out in this Research Report, and reflect the optimism many interviewees have expressed that:

"It's a new world, a new concept and mind-set that the industry is trying to get to grips with. We are getting there": Gary Fannon, Head of BIM, Willmott Dixon

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[198] See Chapter 11
[199] See Appendix A Part 3 Question 1.5
[200] Digital Built Britain p23
[201] Built Environment 2050, September 2014, A Report on Our Digital Future p23
[202] Digital Built Britain p24

APPENDIX A – Projects, Interviewees, Quotes, Questions and Answers

Part 1: List of Projects and Interviewees

Projects:

City of London Corporation, Central Criminal Court

Crossrail

Francis Crick Institute, London

East Riding Leisure Centre, East Riding

Ministry of Justice, Cookham Wood

Ministry of Justice, North Wales Prison

University College London Hospital

UBS, 5 Broadgate

Foxwood & Highview School, Kent

Champion Hill, King's College London

Birmingham City University

Northern Line Extension

Interviewees:

AECOM, Dale Sinclair – Director of Technical Practice

AHR Architects, Ian Rye – Regional Director

Allies and Morrison, Indu Ramaswamy – Director

ArcDox Architecture (Dublin), Ralph Montague – Managing Partner

Association of Consultant Architects, Alison Low – Secretary General

Balfour Beatty, Peter Trebilcock – Director of BIM

BAM Design, Andrew Pryke – Managing Director

Constructing Excellence, Don Ward – Chief Executive; John Lorimer – Chair of BIM

Construction Products Association, Francis Noble – Economic Director

City of London Corporation, Richard Chamberlain – Project Manager

Crossrail, Malcolm Taylor – Head of Technical Information

East Riding of Yorkshire Council, Anne Chamberlain – Group Manager Building Design

Faithful+Gould, Terry Stocks – Head of UK Public Sector

Freeform, James Bowles – 4D BIM Consultant

GRFN BIM Consultancy, Stephen Griffin – Director

Hampshire County Council, Nigel Midmer – Framework Manager

Hoare Lea, Ewan MacGregor – Director Legal and Risk Management; Ben Roberts – Associate BIM Delivery Leader

HS2, Sonia Zahiroddiny – BIM Strategy Manager

ISG Group, Steve Bagland – Pre-Construction Project Manager; Richard Oldfield – Framework Director (Retail); Andrew Stanford – BIM Manager

King's College London, Kevin Little – Director Capital Projects and Development

Laing O'Rourke, Neil Smith – Project Director; Lucas Cusack – Lead Digital Engineer; Tom Inglis – Senior Digital Engineer; Philip Rowen – Commercial Manager; Ronan Burke – Quantity Surveyor

Lendlease, Brett Wharton – Executive General Manager, Integrated Projects

Pick Everard, Owen Cockle – BIM Consultant/Senior Architect

Pollard Thomas Edwards Architects, Krigh Bachmann – BIM Manager

PRP Architects, Scott Sanderson – Director; Michael Richardson – BIM Manager

Specialist Engineering Contractors Group, Rudi Klein – Chief Executive

Tekla UK, Duncan Reed – Digital Construction Process Manager

Transport for London, Paul Davis – IMMCP (Information Modelling and Management Capability Programme) Delivery Team

3DReid Architects, Neil Sterling – Divisional Director

Turner & Townsend, Tom Oulton – BIM Manager

UBS, Jason Clark – Director

University College London Hospital, Paulina Zakrzewska –BIM Lead

Westfield, Ian Ogden – Design Director

Willmott Dixon, Garry Fannon – Head of BIM

Allies and Morrison

ARCDOX

Balfour Beatty

Part 2: Interview Quotes

Ralph Montague, **ArcDox Architecture**: *"Efficiencies are beginning to be seen as the process is a much better way of working, like for example significantly reducing the number of RFIs (requests for information)."*

Dale Sinclair, **AECOM**: *"Innovation is fundamentally changing business models now. Change from scaled deliverable to digital deliverable has already begun to transform the industry."*

Ian Rye, **AHR Architects**: *"Great value to be had in the ability to utilise the process to analyse and predict the performance of a building whilst at the modelling stage."*

Indu Ramaswamy, **Allies and Morrison**: *"The greater time spent at early stages of the BIM process, is time gained on site."*

Peter Trebilcock, **Balfour Beatty**: *"It is a learning curve, it's a culture change and the more disciplines engage and understand the process the more benefits can be delivered."*

Andrew Pryke, **BAM Design**: *"Efficiency, collaboration and de-risking are key traits."*

Malcolm Taylor, **Crossrail**: *"There is nothing new or magical about the BIM world, it's just about trying to use the information in a more smart manner."*

Anne Chamberlain, **East Riding of Yorkshire Council**: *"The adoption of the process has created far less issues to be resolved during construction."*

Stephen Griffin, **GRFN**: *"Accessibility of information is very important."*

Nigel Midmer, **Hampshire County Council**: *"At project level, everything was resolved pre-construction. We only had a few handful of queries during the construction."*

Sonia Zahiroddiny, **HS2**: *"The key thing for us working within the BIM environment is assurances and trust. The consistency in producing and managing information, would give us the trust and confidence we need in the data received."*

Lucas Cosack & Tom Inglis, **Laing O'Rourke**: *"Informed clients recognise the value of having their BIM strategy in place right at the outset to better start the process."*

Philip Rowen, **Laing O'Rourke**: *"We are now able to run model option scenarios to ensure efficiencies on site, not previously possible."*

Owen Cockle, **Pick Everard**: *"Once the supply chain comes along in the journey we can start to see the real benefit."*

Krigh Bachmann, **Pollard Thomas Edwards Architects**: *"If you look at it as a whole system, it may look quite daunting. But if you understand the framework and understand the reasons behind the processes, need to be put in place then you begin to understand their importance and how to use them."*

Scott Sanderson, **PRP Architects**: *"A lot of the construction's frustration comes down to poor process control and this is where BIM as a process can change that."*

Paul Davis, **TfL**: *"Early contractor involvement and bringing tier 2 & tier 3 in early to advise on design has brought in efficiencies."*

Tom Oulton, **Turner & Townsend**: *"I have seen time, cost quality benefit as well as risk reduction in all the projects I have worked on. It has proved to be a better way of working."*

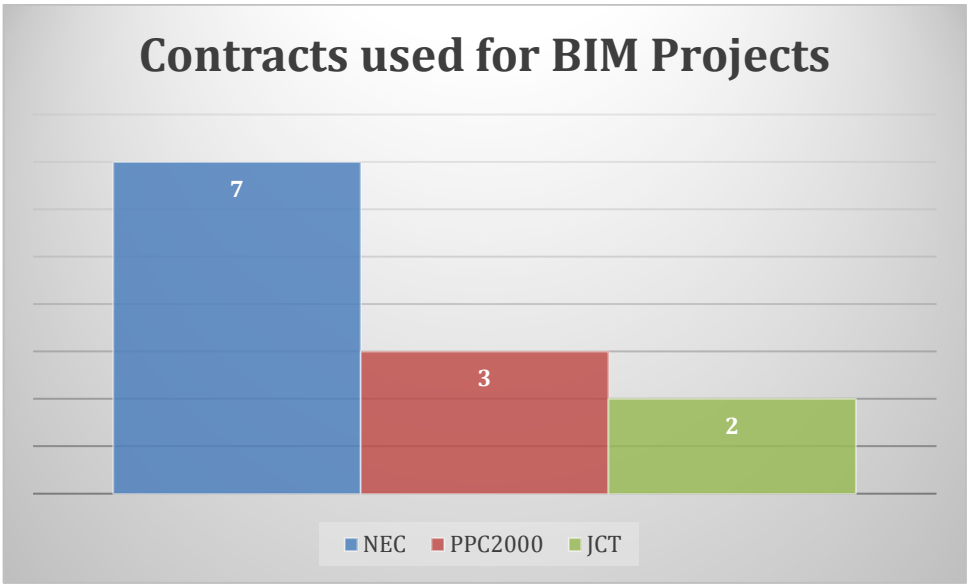
Paulina Zakrzewska, **UCLH**: *"BIM is not just about 3D, it is about the information."*

Ian Ogden, **Westfield**: *"The primary aim of BIM is to make more efficient buildings and gain efficiencies highlighted by the Government."*

Gary Fannon, **Willmott Dixon**: *"It's a new world, a new concept and mind-set that the industry is trying to get to grips with. We are getting there."*

Part 3: Interview Questions and Answers

1.1 What contract was used for BIM-enabled projects?

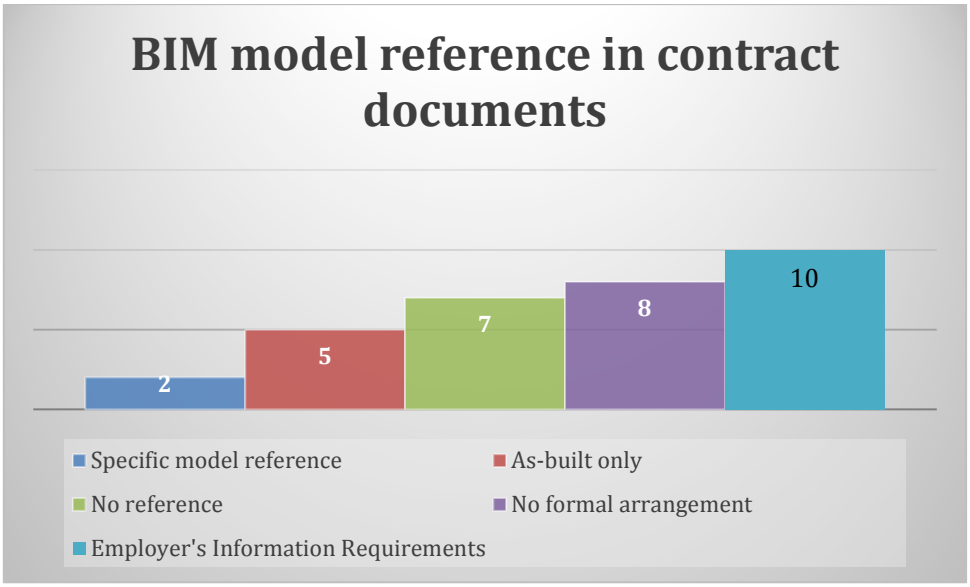


Contract form

Of the 12 BIM projects reviewed:

- 7 used NEC3 contracts
- 3 used PPC2000 contracts
- 2 used JCT contracts.

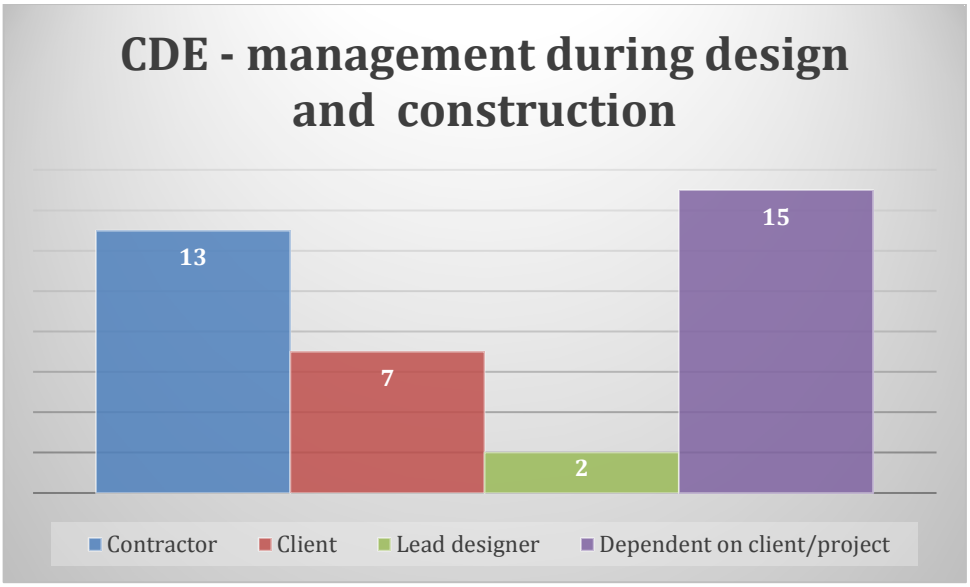
1.2 How were the BIM models incorporated or referred to in the contract documents?



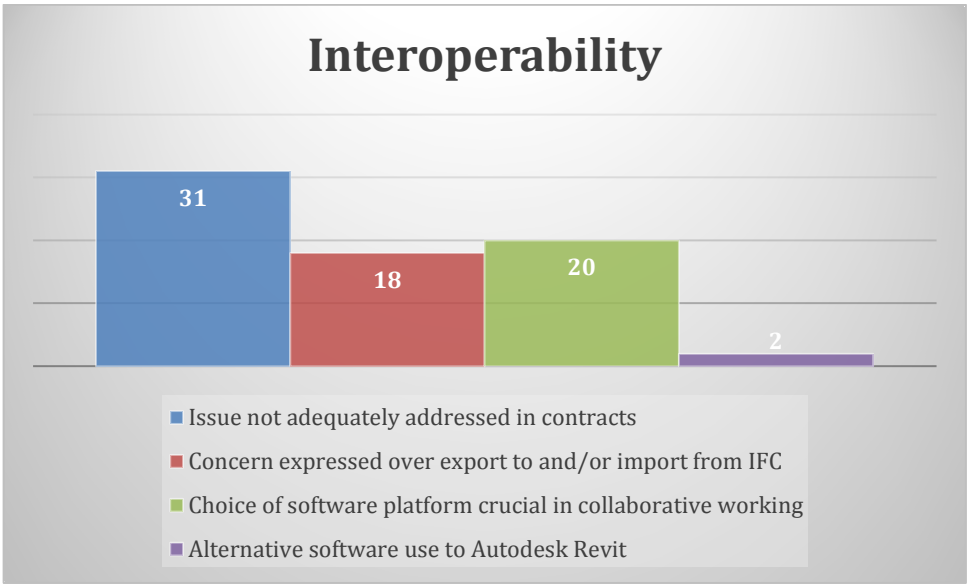
- 10 interviewees made reference to using Employer's Information Requirements (EIRs).
- 7 specifically noted that no reference was made to EIRs, or to BIM generally, in their contract documents.
- 5 related the requirement for BIM models to an existing way of working, for example requiring *"as-built only"* or *"handover information"* or even just a *"data model"*.
- 8 commented that the requirement for BIM was incorporated *"only loosely"*.
- Only 2 interviewees made specific reference to a requirement for BIM models in their building contracts.

1.3 How did the contract documents set out the process/procedure for managing a common data environment (CDE)?

- 7 interviewees stated that the client manages the CDE during both the design development and construction stages.
- 13 interviewees stated that the contractor manages the CDE once appointed.
- Only 2 interviewees stated that lead designers manage the CDE.
- 15 interviewees stated that it is all dependant on client and/or project.



1.4 How was interoperability dealt with in tender documents/contracts and/or in practice?



- 31 interviewees stated that interoperability is currently an issue and, at present, not dealt with very well.
- 20 interviewees emphasised the importance of clear agreement as to the choice of a BIM software platform to work on collaboratively.
- 18 interviewees expressed concern as to the export/import of data to and from an IFC platform.
- 2 interviewees stated specifically that they use an alternative software to Autodesk Revit.

1.5 Views with regards to the Level 3 proposals set out in Digital Built Britain.

All interviewees expressed caution as regards progression to BIM Level 3 and comments included:

- *"The changes will require work and technology advancement"*;
- *"The notion is great but early days in terms of how it all comes together";*
- *"Aspirational and idealistic";*
- *"This is a utopian vision, a long way away"*;
- *"The industry needs to concentrate on how to deliver Level 2. A lot to achieve before moving towards this culture shift".*

2.1 In what ways did the project involve consultants providing comments/ feedback on each other's BIM models and how has the practice of BIM changed your perception of data sharing?

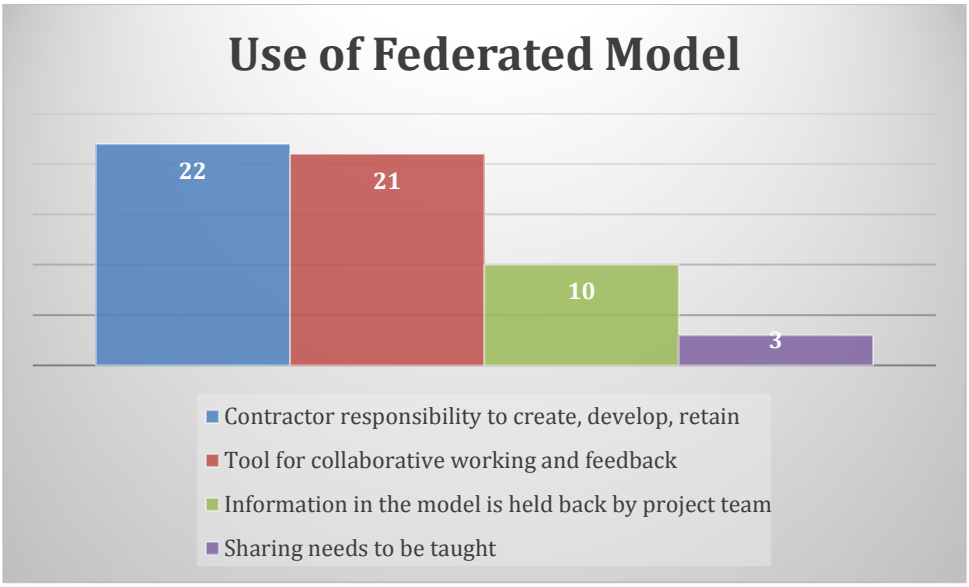
Most interviewees saw the BIM comment and feedback processes as an extension to traditional design coordination meetings and site meetings, with clash detection increasing visibility of issues arising and assisting the team in addressing a range of issues such as health and safety concerns.

There were differing views among interviewees as to data sharing:

- Many considered that data sharing has been *"done for years"*, with comments such as *"At the end of the day it is still all about the teams and how well they work together".*
- 3 interviewees suggested it needs to be *"taught"* so as to ensure a methodical approach under BIM, with comments such as: *"It is all about collaboration. People need to be helped to collaborate".*
- 9 interviewees admitted that information in the model is not being properly shared, with comments such as: *"Some struggle as to obtaining the information which team members say they are not going to provide",* and *"Industry is holding back information in the model due to concerns over IP loss".*

On management and use of the Federated Model:

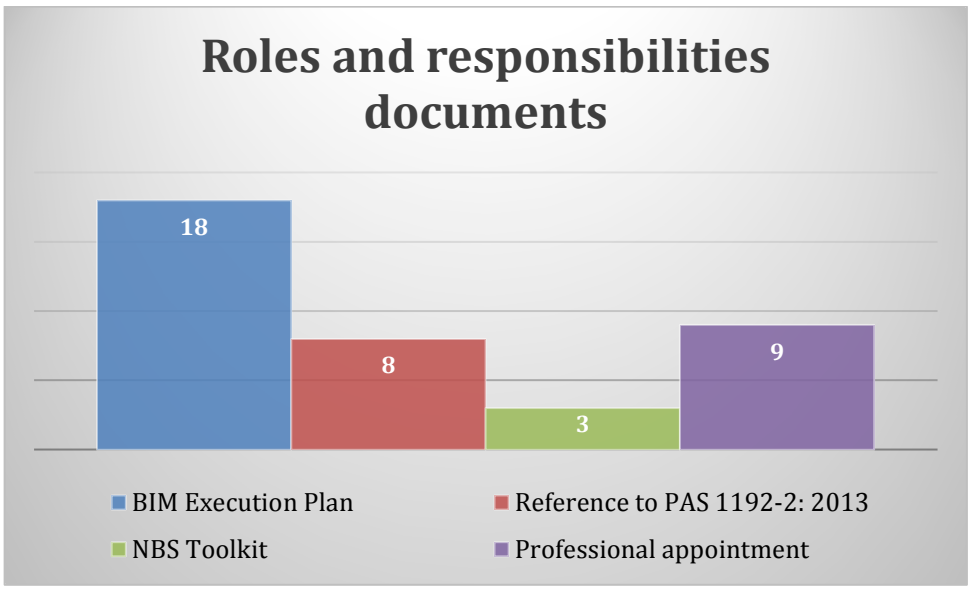
- 22 interviewees were of the opinion that the Federated Model is the contractor's responsibility to create, develop and retain during the delivery period.
- 21 interviewees suggested that this is a tool for collaborative working and providing feedback.
- 10 interviewees confessed that the information in the Federated Model is usually held back by the project team and not appropriately shared.
- 3 interviewees were of the opinion that sharing of data is something that needs to be taught to the industry.



2.2 In what ways did the project involve BIM models prepared or contributed to by the main contractor and/or trade contractors/sub-contractors/ suppliers, and/or in what ways did these team members provide comments/feedback on consultant BIM models?

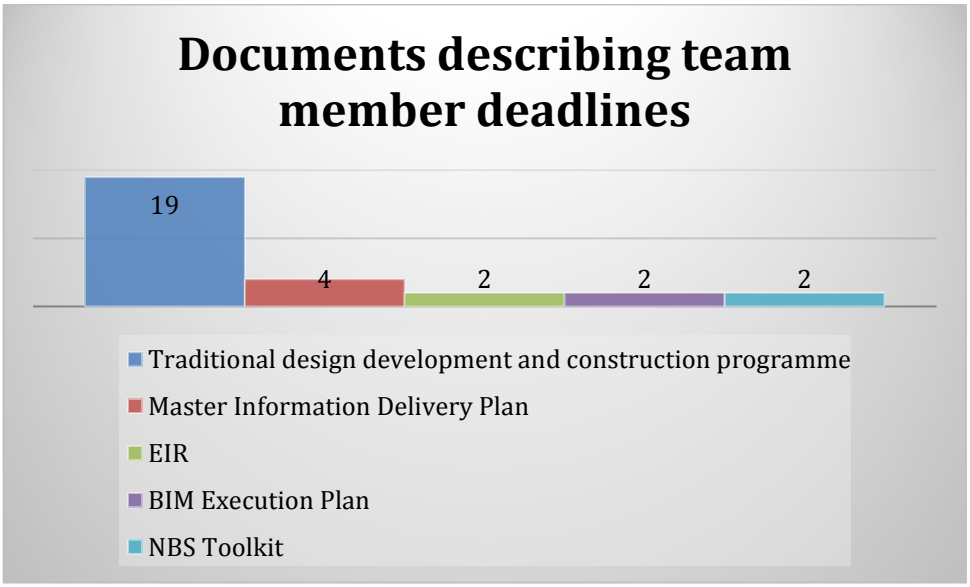
- Most of the project teams interviewed created a procurement model and contract terms specifically designed to involve main contractors and key sub-contractors at an early stage in order to obtain their BIM contributions during the tender process and/or during the pre-construction and/or construction phases.
- 8 interviewees expressed the opinion that the tier 2 and tier 3 *"supply chain is not yet ready to embed the new processes required for BIM".*

2.3 What documents described the roles and responsibilities of each team member in relation to BIM?



- 8 interviewees made specific reference to PAS 1192-2 2013, and the BIM processes described by all interviewees generally appeared to be consistent with this guidance.
- 18 interviewees referred to use of a BIM Execution Plan to describe the roles and responsibilities of team members.
- 3 interviewees confirmed they were starting to try out the NBS BIM Toolkit.
- 9 interviewees referred to roles and responsibilities set out in their professional services appointment documents.

2.4 What documents described the deadlines for each team member to achieve agreed progress in its BIM model development to the agreed levels of detail and in its comments/feedback on other BIM models?



- 19 interviewees referred to use of a traditional design development programme, and then a construction programme, but without expressing a clear view as to their enforceability or contractual status.
- Others mentioned timelines expressed in:
  the Master Information Delivery Plan (4)
  the NBS BIM Toolkit (2)
  the EIRs (2)
  the BIM Execution Plan (2)

2.5 Who fulfilled the role of BIM Information Manager and what reliance was placed on the BIM Information Manager for data security, for ensuring agreed progress of BIM model development in agreed levels of detail, for the coordination, integration and clash detection in respect of BIM models, and for creation and development of the federated BIM model?

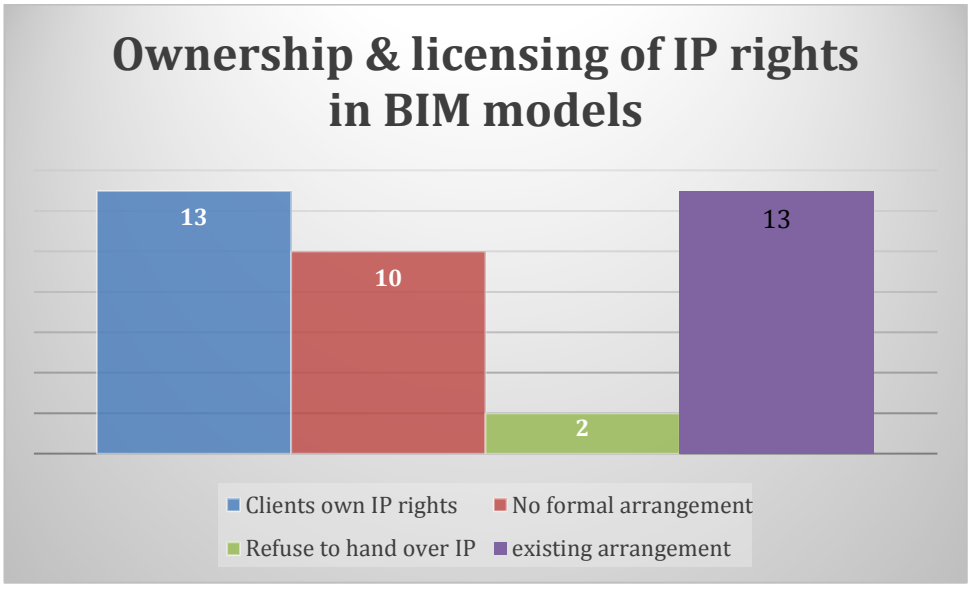
- The general consensus among interviewees was that *"the guidance out there does not seem to clarify who should take up this role".*

- All architects interviewed confirmed they had been approached by clients to act as BIM Information Managers.
- Contractor interviewees advised that the more informed clients are beginning to appoint BIM Consultants.
- Two client interviewees appointed an independent BIM Information Manager separate from their design team members.
- All design consultant and contractor interviewees stated that they appoint their own in-house BIM coordinators/managers to help setting up BIM processes internally and to provide a project-specific watching brief.

2.6 Were any of the responsibilities of any team member reduced, by means of disclaimers, exclusions or limitations, by reason of adopting BIM?

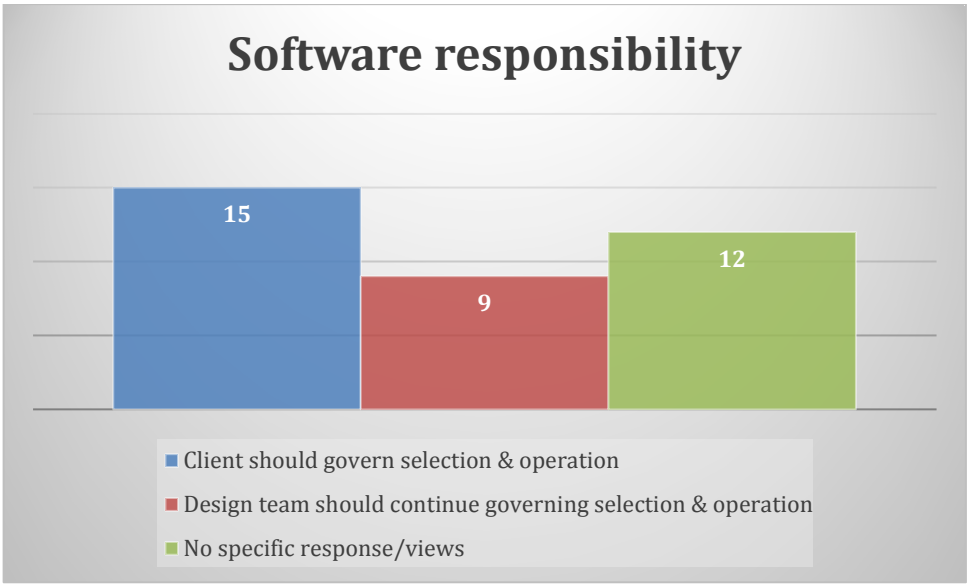
100% of interviewees' answers were simply *"no"*, with comments such as: *"The team are in it together and they need to deliver together"*.

2.7 On what basis did you arrange ownership and licensing of intellectual property rights in BIM models and their permitted uses?



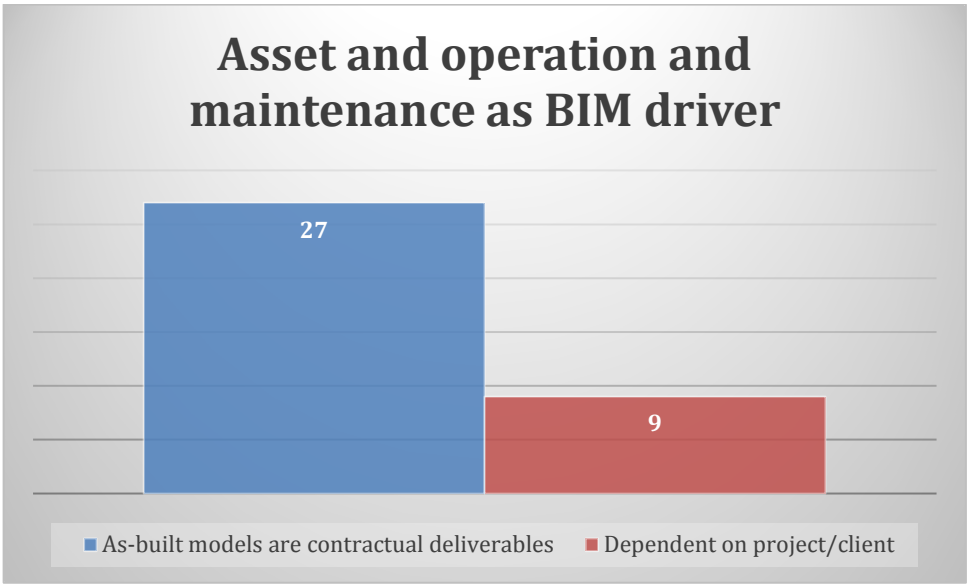
- 13 interviewees stated that IP rights are treated in the same way as pre-BIM arrangements, with comments such as it is *"still all about granting license for IP rights"* and *"the same as with drawings, no difference"*.
- 13 interviewees confirmed that clients own the IP rights.
- 2 consultant interviewees mentioned that they have refused to hand over IP rights when requested with comments such as *"Clients have realised the value created within the model. So they are asking for them and say that they will subsequently use them, as they own them. This has defeated the creation of a collaborative working environment."*
- 10 interviewees stated that they had no formal arrangement in place.

2.8 On what basis did you establish responsibility for software selection and operation, including data integrity, compatibility and interoperability?



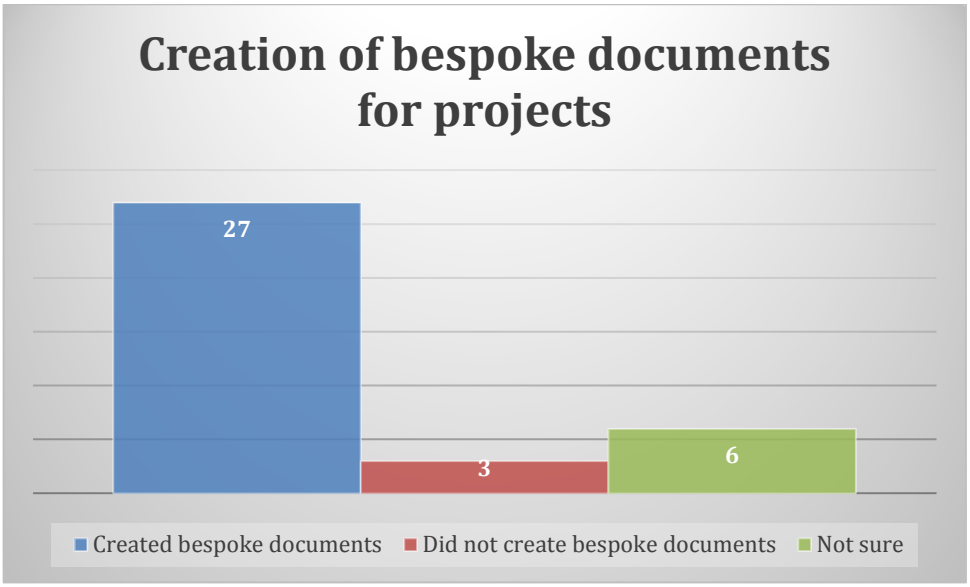
- 15 interviewees stated that clients should lead the software selection process.
- 9 interviewees stated that the design team have always dealt with this issue and should be allowed to continue to choose how they work, with clients stipulating *"the output they want"*.
- 12 interviewees provided no specific response/views on the matter.

2.9 To what extent was management of the asset and its operation and maintenance the driver in the use of BIM?



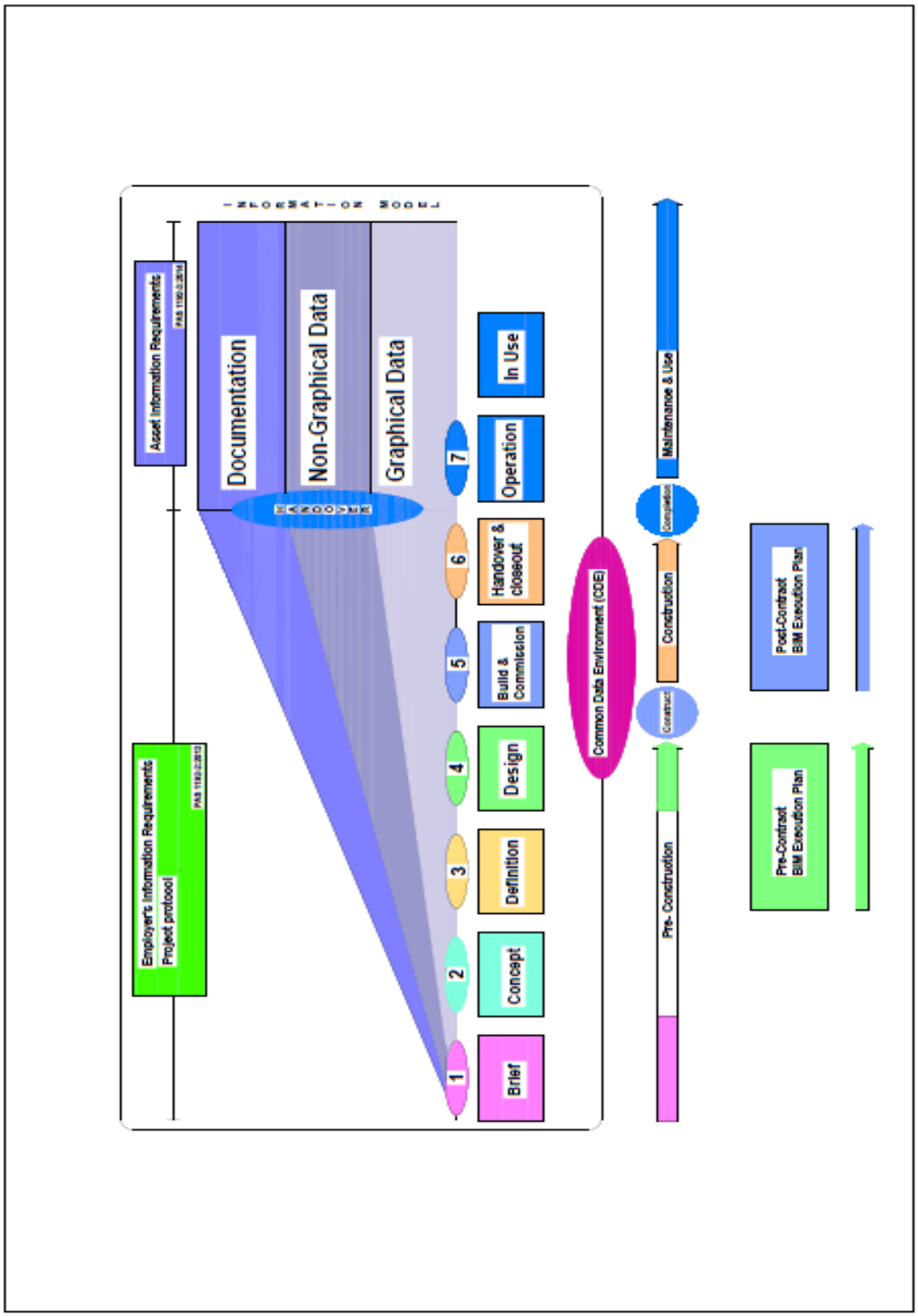
- Client owner interviewees with a long-term interest in their assets acknowledged the importance of *"as-built"* BIM models, with comments such as *"ease of asset replacement is an obvious benefit during operation and maintenance".*
- 27 interviewees confirmed that *"as-built"* BIM models were contractual deliverables, with comments such as *"There was specific request (within building contract) requiring the contractor to hand over as-built model".*
- 9 interviewees stated that this is dependent on the project and/or the client.

2.10 In working on BIM-enabled projects, did you create bespoke documents to implement BIM?



- 27 interviewees stated that they have created bespoke documents for use in their BIM enabled projects.
- Only 3 interviewees stated they had not created any bespoke documents.
- 6 interviewees were not in a position to comment.

APPENDIX B – BIM Procurement Flowchart



APPENDIX C – Treatment of BIM in standard form contracts

	FIDIC	JCT 2011	NEC 3	PPC2000
BIM provisions in contract terms	No	Yes, in 2011 Public Sector Supplement	Yes, in 2013 How to use NEC3 with BIM	Yes, in Appendix 10 added in 2013
Requires addition of CIC BIM Protocols to all contracts	Not stated	Refers to unspecified protocols and JCT contracts taking precedence	Yes, with amendments	No
Early warning system to support BIM clash detection	No	No	Yes	Yes
Direct mutual intellectual property licences among team members	No	No	No	Yes
Provision for early contractor involvement to bring in pre-construction phase BIM contributions of main contractor and sub-contractors/suppliers	No	Yes, using Pre-Construction Services Agreement with separate construction contract	Yes, using ECI clause added November 2015	Yes, in two stage contract structure
Agreed mutual deadlines for specific activities	No	Yes, in optional Information Release Schedule	Yes, in Accepted Programme and Key Dates	Yes, in multi-party Partnering Timetable and Project Timetable
Link to asset management through corresponding repair and maintenance contract	No	Yes	Yes	Yes
Provision for collaborative working	No	Yes, if optional Schedule 8 is used	Yes, if Option X12 is incorporated	Yes
Provision for role of BIM Information Manager	No	No	No	No, although provision for BIM Coordinator
Corresponding main contract, sub-contract and consultant appointment forms	Yes	Yes, JCT2011 Consultant Appointment is only for public sector clients	Yes	Yes

APPENDIX D – Glossary, Further Reading and Useful Links

Part 1: Glossary

AIM: Asset Information Model – data and information contained within a model used for managing, maintaining and operating an asset

BEP: BIM Execution Plan – sets out how the information on a project will be developed and managed

BIM: Building Information Modelling – for the purposes of this report a set of systems that create digital three dimensional models, intended to provide more accessible and versatile design and cost data to identify efficiencies and improvements throughout the life of a built facility. See cross-references to other definitions at footnote 3

BIM Levels: The evolution of BIM has been categorised under three maturity levels as follows:

- **Level 1**: comprises both 2D and 3D work in an agreed format with shared standards and information, but with work by each team member created and maintained separately

- **Level 2**: comprises a move towards more collaborative working by combining the information prepared by each team member into a single Common Data Environment, accessible for sharing and exchange of data. Each team member's 3D models are set up through a common file format for analysis, checking, coordination and integration via the creation of a Federated Model and are capable of export to a common file format such as IFC and COBie

- **Level 3**: signifies full collaboration by the project team members and anticipates the use of a single BIM model held by all project team members to access, use and modify at any time within a centrally held Common Data Environment

BS1192-4 2014: Code of practice for fulfilling the employer's information exchange requirements using COBie

CDE: **Common Data Environment** – a central source of information for the project that is used to collect, manage and disseminate graphical model and non-graphical data for the whole project team

CIC BIM Protocol: UK Construction Industry Council Building Information (BIM) Protocol CIC/BIMPro 2013

CIOB Time and Cost Management Contract Suite: published by Chartered Institute of Building, based on CIOB Complex Projects Contract and launched June 2016

COBie: Construction Operations Building Information Exchange – an information exchange format for recording project data supporting the operation and maintenance of the built asset

EIR: Employer's Information Requirements – used for the procurement and appointment of team members, which may be divided into technical, management and commercial sections

Federated Model: The assembly of all project team members' separate models to create a single reference source for design development and coordination and clash detection, but with the authorship of individual models (within the Federated Model) remaining identifiable

FIDIC : FIDIC *"Red Book"* First Edition 1999 and corresponding sub-contract plus *"White Book"* Client/Consultant Model Services Agreement

IFC: Industry Foundation Class – an international standard for sharing and exchanging BIM data across different software platforms, set up to aid interoperability but subject to the software that interfaces with IFC

FAC-1: Framework Alliance Contract published by the Association of Consultant Architects June 2016

Government Soft Landings (GSL): The UK Government's initiative to extend the commitments of the capital project team so as to enable more efficient long-term asset management http://www.bimtaskgroup.org/gsl-policy-2/

JCT2011: Joint Contracts Tribunal 2011 suite of contracts, due to be updated 2016

LoD: Level of Definition – description of the level of completeness of a model element. In the NBS BIM Toolkit (See link at Appendix D Part 3) the deliverables are defined by Level of Definition and are divided into Level of Detail (referring to the geometric definition of objects) and Level of Information (referring to the non-geometric attached data). However, see also Level of Detail as used in the CIC BIM Protocol

LoI: Level of Information – description of the level of information/data attached to the model element

MIDP: Master Information Delivery Plan – a comprehensive responsibility plan, including responsibility matrix, of all information deliverables by team members. It identifies who needs to prepare what information, using what procedures, in accordance with pre-defined work stages

MPDT: Model Production and Delivery Table – Appendix 1 of the CIC BIM Protocol setting out specific obligations for each project team member for delivering model information at a certain LoD at specific project work stages

NEC3: New Engineering Contract 3rd Edition, published by Thomas Telford

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 operation phase of assets using building information modelling

PAS1192-5:2015: Specification for security-minded building information modelling, digital built environment and smart asset management

PIM: Project Information Model – prepared and completed for completion of the project and handed over for contribution to the AIM

PIP: Project Implementation Plan – forms part of the BIM Execution Plan (BEP), to be submitted by organisations tendering for the project, includes Supply Chain Capability Summary (SCCS) in terms of human resources and IT capabilities

PPC2000: Project Partnering Contract published by the Association of Consultant Architects, amended 2013 to provide for BIM

TIDP: Task Information Delivery Plan – incorporated into the MIDP, listing each task responsibility and the deliverables in respect of each task

Uniclass 2015: classification of building information for all stages of the project life-cycle

2D: two dimensional drawing

3D: three dimensional model

4D: the time dimension within the 3D BIM modelling environment linking the 3D model to sequencing information in the construction process

5D: the cost dimension within the BIM modelling environment. The ability to link the 3D model of the building components to supporting data attached creates the opportunity to extract cost-related information

6D: the lifecycle and facilities management dimension within the BIM environment under which the as-built model links construction information (components, assembly methods, etc.) with project life-cycle management information

Part 2: Further reading

AEC (UK) *"AEC (UK) BIM Protocol – Implementing UK BIM Standards for the Architectural, Engineering and Construction Industry"* September 2012 Version 2.0 https://aecuk.files.wordpress.com/2012/09/aecukbimprotocol-v2-0.pdf

BIM Academy (2014) *"First Steps to BIM Competence – A guide for Specialist Contractors"* Specialist Engineering Contractors Group and National Specialist Contractors Council

Built Environment 2050 (2014) *"A Report on Our Digital Future"*

Construction Industry Council (2013) *"Best practice guide for Professional Indemnity Insurance when using BIM"*

Construction Industry Council (2013) *"Building Information Model (BIM) Protocol: Standard protocol for use in projects using Building Information Models"*

Construction Industry Council (2013) *"Outline scope of services for the role of information management"*

Cooper, W and Chaplin, R (2013) *"Professional appointments and BIM"*, *Construction Law* 24(7) p26

Digital Built Britain (2015), Level 3 Building Information Modelling – Strategic Plan, February 2015

Gibbs, DJ, Lord, W, Emmitt, S and Ruikar, K (2015) *"Building Information Modelling"*, *Construction Law Journal* 31(3) p167–179

Government Construction Client Group BIM Working Party Strategy Paper, March 2011: www.bimtaskgroup.org

Government Construction Strategy (2011) – https://www.gov.uk/government/publications/government-construction-strategy

Government Construction Strategy (2016-20) - https://www.gov.uk/government/.../government-construction-strategy-2016-2020

Hamdi, O and Leite, F (2013) "Conflicting Side of Building Information Modeling Implementation in the Construction Industry", *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 10.1061/(ASCE)LA.1943-4170

ICE (2013) *"BIM and construction contracts – CPC2013's approach"*, ICE proceedings Vol 168, Issue MP6 p287

JCT Practice Note (2016) *"Building Information Modelling (BIM), Collaboration and Integrated Team Working"*

Lane, T (2001) *"The Rise of the BIM Consultant"*, *Building* November 2011

Lewis, S (2014) *"Playing games of risk"*, *Building* February 2014

Mosey, D (2014) *"BIM and Related Revolutions A review of the Cookham Wood Trial Project"*, Society of Construction Law Paper D 171

NBS (2015) National BIM Report, April 2015: www.thenbs.com/pdfs/NBS-National-BIM-Report-2015.pdf

NEC (2013) *"How to use BIM with NEC3 Contracts"*

RICS (2015) *"International BIM implementation guide"* 1 March 2015

Saxon, R (2013) *"Growth Through BIM"*, Construction Industry Council

Shamma, L (2013) *"Out with the old, in with the new – the RIBA Plan of Work 2013"*, NBS Design and Specification, 21 May 2013

Shepherd, D (2015) (Chapter 7: David Mosey) *"BIM Management Handbook"*, RIBA Publishing, November 2015

Strategic Forum for the Australasian Building and Construction Industry (2014) *"A Framework for the Adoption of Project Team Integration and Building Information Modelling"*, Australian Construction Industry Forum and Australasian Procurement and Construction Council

Tyerman, D (2013) *"Building information modelling and change management – a single version of the truth"* *Construction Law Journal* 29(4) p295–307

Winfield, M (2015) *"Building Information Modelling, The Legal Frontier, Overcoming Legal and Contractual Obstacles"* Society of Construction Law Paper D178

Part 3: Useful links

Building Information Modelling Task Group: www.bimtaskgroup.org/

Construction Project Information Committee: www.cpic.org.uk/

Government Trial Projects:
www.gov.uk/government/publications/government-construction-trial-projects

National Building Specification: www.thenbs.com/topics/BIM/index.asp

NBS Toolkit: www.thenbs.com/bimtoolkit/

Designing Buildings: www.designingbuildings.co.uk/wiki/Building_information_modellingBIM

APPENDIX E – Research Workshop and Conference 5/6 May 2016

Part 1: Workshop 5 May 2016

The BIM Research Group invited an international group of specialists and practitioners to explore how procurement models and contracts can help get the best out of BIM-enabled projects. The workshop was chaired by Professor David Mosey and participants included:

- Matt Olsen, Allies and Morrison
- Alison Low, Association of Consultant Architects
- Bob Baird and Jolanta Skawinski, Australian Department of Defence
- Christopher Howard and Darya Bahram, Centre of Construction Law, King's College London
- May Winfield, Carillion
- Marko Misko, Clayton Utz
- Malcolm Taylor, Crossrail
- Stephen Griffin, GRFN
- Graham Cossons, Hoare Lea
- Rahoul Shah, Lendlease
- Antje Boldt, Arnecke Sibeth, Frankfurt
- Andy Taylor, Sweett
- Tim Willis, Trowers & Hamlins
- Rob Garvey, University of Westminster

The workshop analysed research themes developed in this Research Report in advance of a public conference the following day. Participants received extracts from the draft Research Report for review in advance of the workshop. The workshop was structured as follows and discussions were treated as confidential so that participants could speak freely:

- Short presentations by participants on their work in the field of BIM
- Agreement of themes and expected outputs
- (Theme 1) Planning for BIM – what procurement processes work best for BIM and who should take the lead
- (Theme 2) Clarifying the who, what and when – in what ways can contracts make a difference?
- (Theme 3) The BIM Information Manager – a new and challenging role for consultants to embrace or avoid?
- (Theme 4) The big picture – can BIM-enabled contracts deliver better whole life asset management?
- Review and conclusions

Questions and debate covered the following:

- How is BIM affected by the procurement process?
- Does BIM enable greater transparency emerge from procurement?
- When is early contractor involvement important and does it depend on the type of project?
- Can a BIM model be relied on contractually?
- How does the cost of BIM for consultants vary according to what clients ask for?
- Does all or part of the BIM Execution Plan need to be contractually binding?
- Should BIM Execution Plans include binding deadlines?
- Does collaborative working need a forum for clash detection/early warning beyond the design team, including for agreement of who resolves clashes and who pays for the extra work?
- How is it possible to contract for collaborative commitments?
- Do we need an express good faith clause for BIM collaboration?
- How and when does 2D data transform into 3D?
- Does the BIM Information Manager role need to be better defined, long-term and independent?
- Can BIM deliver better FM and how can FM providers be more involved in BIM?

Workshop outputs were taken into account if the finalisation of this Research Report.

Part 2: Contributions from Australia

Representatives from the Australian Department of Defence (Bob Baird AM and Jolanta Skawinski), together with Marko Misko from Clayton Utz, participated in the full day research workshop at KCL on 5 May 2016 and then presented at the conference the following day. The purpose of this was to gain an understanding of the procurement and contract models being used by them to better implement BIM and integrated project delivery (*"IPD"*) in the Australian market.

The Australian Department of Defence has had its own bespoke suite of infrastructure delivery models since 1992. Most recently, the team has been working on a new suite of contracts for optimal implementation of BIM and IPD, for over three years. That suite has been finalised (following extensive consultation with industry), is presently being piloted on several projects, and will be formally released to the Australian market later this year.

The key principles underpinning that suite (known as the *"Defence IPD Suite"*) are:

a) early contractor involvement (ECI) in the planning and design process is highly beneficial (and necessary to optimise BIM and IPD outcomes, such as clash detection, optimisation of design and buildability input), but the level of early contractor involvement and integration required from project to project will vary;

b) a multi-staged procurement system is essential, to enable ECI, on a transparent open-book basis to optimise derisking of the project, innovation and client value for money;
c) significant value for money can be derived from deconstructing the supply chain and involving key trades and suppliers/manufacturers in the design process (early key trade involvement);
d) the facilities manager must be involved from the outset (early FM involvement) to optimise whole of lifecycle costs, facilities performance and facilities information;
e) a multi-party umbrella arrangement is required – to establish an integrated project team – under which all relevant project contractors (designers, contractor, key trades/suppliers and the FM) truly collaborate to maximise project objectives.

Based on those key principles, three broad levels of integration have been identified, and six separate delivery models have been developed:

a) strong form integration:
    (i) integrated managing contractor (design and construct) – known as *"IMC-1 2016"*;
    (ii) integrated head contract (design and construct) – known as *"IHC-1 2016"*;
b) medium form integration:
    (i) integrated managing contractor (document and construct) – known as *"IMC-2 2016"*;
    (ii) integrated head contract (document and construct) – known as *"IMC-2 2016"*;
c) mild form integration:
    (i) integrated managing contract (construct only with buildability review) – known as *"IMC-3 2016"*;
    (ii) integrated head contract (construct only with buildability review) – known as *"IHC-3 2016"*.

Each delivery model involves an over-arching integrated project team agreement (known as *"IPTA-1 2016"*), under which all project contractors collaborate on a transparent basis to maximise the stated project objectives.

A discussion of the differences among the delivery models is beyond the scope of this report. Suffice to say, each delivery model is distinct, and is designed to be used in specific project circumstances to maximise the project objectives having regard to the level of integration required/possible, the project risk profile and other salient features.

The current suite of contracts (and collateral documentation) is available on the Australian DOD website known as *"DEQM"*. The new Defence IPD Suite will shortly be posted on that website; at present, advance copies of the standard forms may be obtained by contacting Bob Baird (on bob.baird@defence.gov.au) or Jolanta Skawinski (on jolanta.skawinski@defence.gov.au).

Part 3: Conference 6 May 2016

115 delegates from the UK, Ireland, Germany and Australia attended a conference organised by the King's College London Centre of Construction Law with the Society of Construction Law at The Great Hall, King's Building where the following papers were presented:

- Mark Bew MBE, Chair, UK Government BIM Working Group: *Keynote Speech – BIM and the future of global construction*
- Richard Saxon CBE, Chairman, JCT: *What does a BIM client need?*
- Simon Rawlinson, Head of Strategic Research, Arcadis, member of UK Government Client Leadership Council and BIM Task Group: *Using the documents and tools that enable BIM*
- Professor David Mosey: *BIM and new models of procurement- the North Wales Prison Government Trial Project*
- Terry Stocks, Head of Public Sector, Faithful and Gould, former head of Capital Projects at the UK Ministry of Justice: *Delivering whole life asset management through BIM*
- Marko Misko, Partner, Clayton Utz: *New procurement models for integrated project delivery with BIM in Australia*
- Bob Baird and Jolanta Skawinski, Australian Department of Defence: *BIM, IPD and the experience of the Australian Department of Defence*
- May Winfield, Solicitor, Carillion: *Crafting the right balance of BIM rights and responsibilities*
- Stephen Griffin, GRFN: *Getting results – the role of the BIM Consultant*
- Chris Howard and Darya Bahram, King's College London: *Launching the King's College London BIM Research Report*
- *Panel Discussion* led by Richard Dartnell, Legal Director, Pinsent Masons with Richard Harrison (President, Association of Consultant Architects), Chris Hallam (Partner, Nabarro), Kevin Murray (Deputy Director Complex Transactions, Cabinet Office) and Tim Willis (Consultant, Trowers & Hamlins).

Conference delegates contributed during question and answer sessions, were provided with a draft copy of this Research Report and were invited to submit written comments by 20 May 2016. These comments were taken into account in finalising this Research Report.

The BIM Research Group are very grateful for the written comments provided by the following conference speakers and delegates:

- Mark Bew MBE, Chair, UK Government BIM Working Group
- Richard Saxon CBE, Chairman, JCT
- Professor Angelo Ciribini, University of Brescia
- Marzia Bolpagni, PhD student, Polytechnic University of Milan
- Antje Boldt, Arnecke Sibeth Law Firm, Frankfurt
- Matt Olsen, Allies and Morrison Architects
- Nicholas Deeming, FaulknerBrowns Architects
- Dave Grant, Scitech Engineering
- Charles O'Neil, Contract Dynamics