

CLOSING THE GAP BETWEEN

DESIGN



AS-BUILT
PERFORMANCE

END OF TERM REPORT

July 2014

APPENDIX G





The Zero Carbon Hub was established in 2008, as a non-profit organisation, to take day-to-day operational responsibility for achieving the government's target of delivering zero carbon homes in England from 2016. The Hub reports directly to the 2016 Taskforce.

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APPENDIX G: THE POTENTIAL ROLE OF BIM

This appendix was produced by Lynne Sullivan, a member of the Steering Group and chair of the Design Work Group, to explore the potential role of BIM (Building Information Modelling and Management) in helping to understand and control the Performance Gap.

It should be noted that only relatively minor amendments and edits have been made to the recommendations provided. Many of these have been included in the main report, and additional Work Group recommendations are included here.

The Performance Gap project has identified design continuity, quality control, and feedback as key ingredients for improved quality output in energy efficient buildings, along with improved knowledge and skills. The role that BIM could play in acting as the 'golden thread' on which design and quality management, change control and performance / compliance analysis are based is examined here. At the same time we will consider the potential opportunities and barriers, and the likely implications on cost and timescale, of operating a single source for all relevant information during the housebuilding process, including: design and detail drawings and specifications; cost and programming outputs; and contracts.

As a shared and necessarily up-to-date source of project information, the value of BIM and its data-handling power is best realised when it stretches from inception through design, delivery, handover, operation and eventual demolition, thereby also enabling comparable reusable data and feedback. This is borne out by the Government's commitment to BIM as a key contributor in the drive for its own building estate to be more cost- and energy-efficient, mandating BIM for central government building procurement contracts in the UK from 2016,¹ accompanied by the piloting of Soft Landings - a feedback mechanism enabled by BIM, along with monitoring and user survey methods.

BIM is not new and has been used on key projects around the globe for at least a decade. In housebuilding, BIM "...offers the prospect of improved efficiency and fewer errors, resulting in a better quality product for the home owners".² However, the NHBC review of major housebuilders suggests that only around 11% of them currently use BIM, and generally in a limited way. Across the range of housebuilders, document management is an essential part of the process but currently system protocols and responsibilities vary, and the additional resource / computer capability and skills required to transfer to BIM is perceived as a challenge.

What is BIM and how could it reduce the Performance Gap in new homes?

*"A Building Information Model is a shared (digital) representation and spatial database that records the location and attributes of every component."*³

'BIM' is also synonymous with Building Information Management, a method of packaging and controlling information to support co-operation between team members, where it also encompasses planning, organisation and resourcing (e.g. including the brief and contracts).

The use of BIM requires collaborative exchange of information, through a common structure, and is geared to staged outputs⁴ at an increasing level of accuracy, through appropriate software and core 'documents', with associated conventions and protocols. As detailed in the *Evidence Review Report*,⁵ many of the *Housebuilding Process Reviews* carried out for the Performance Gap project showed how design detailing was incompatible with energy targets and familiar site practices. In these cases, BIM would enable design stage spatial clash detection as well as design stage energy evaluation through the model, at the same time as facilitating cost checking and even procurement programming through numeric data outputs.

1. The Cabinet Office has also established the BIM Task Group, which is working with industry to enable this.

2. 'Building Information Modelling: An Introduction for House Builders', NHBC and BSRIA 2013 NBS and CPA, BIM for the Terrified 2013.

3. NBS and CPA, BIM for the Terrified 2013

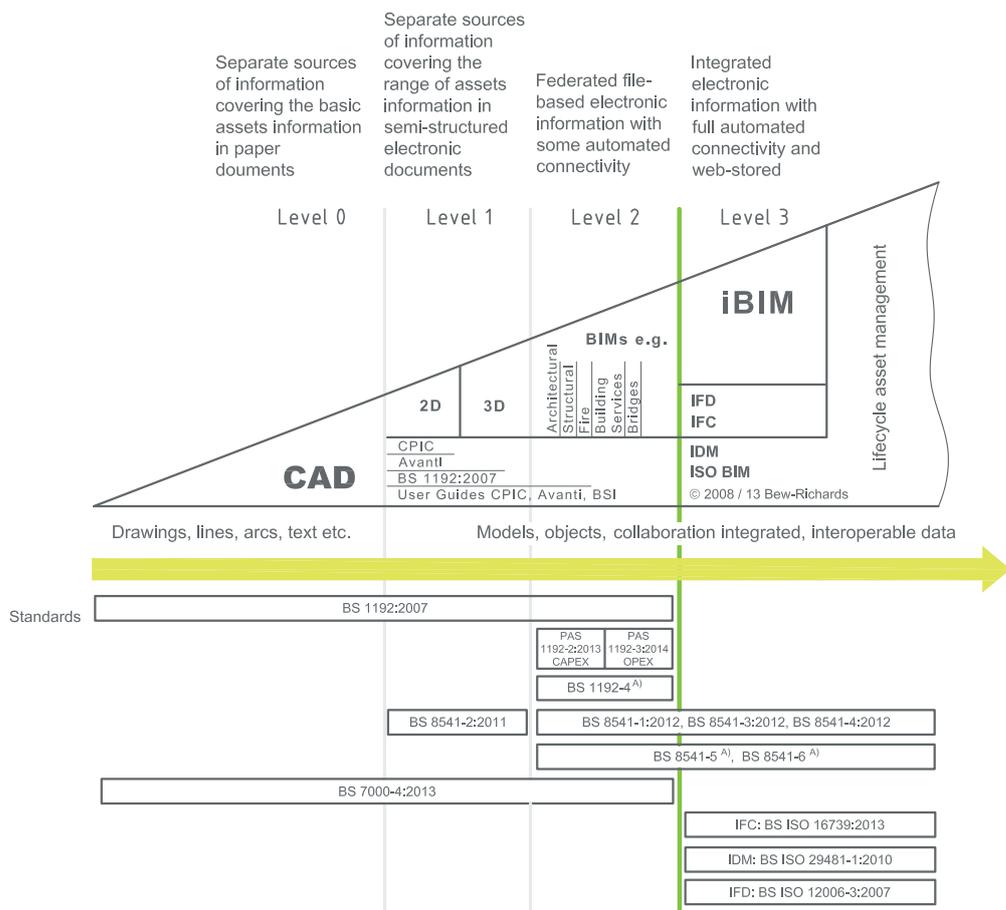
4. Data Drops 1, 2 and 3 are broadly consistent with RIBA Plan of Work Stages 1, 3 and 4 of project delivery (to be confirmed once Plan of Work/BIM definitions are published)

5. To download the Evidence Review Report please visit: www.zerocarbonhub.org/full-lib

For its effectiveness to be maximized, data conformity standards and interoperability between software are required, and the Government's BIM Task Group has prepared templates for a range of products and elements (currently focused on M&E services), which are presented in different formats based on the COBie spreadsheet method, which product manufacturers and others are beginning to adopt. The BIM4Regs⁶ – a specialist BIM task group focused on the interaction between BIM and regulations - is now considering a BIM-enabled compliance procedure which could deliver a streamlined verification process, supporting the iterative compliance checking and accurate as-built SAP outputs identified by the Performance Gap project as key drivers for better performance.

A BIM project needs to have clear requirements enshrined in an Execution Plan from the outset, defining all inputs from all project contributors: including client, consultants, contractors, supply chain and so on. At Level 2 BIM (note that the current stage of maturity is estimated around 1.4), each consultant can work on their own discrete 3D information model (their models 'federated' and brought together for checking) as only at Level 3 is there full interoperability and a single project model⁷. As-built information on a BIM project is encapsulated in a project information model ('PIM') and this can be integrated into an asset information model ('AIM') for operational management and maintenance.

Figure 1. BIM Maturity Model



© Mark Bew & Mervyn Richards, 2008

6. <http://www.bimtaskgroup.org/>

7. Level 3 BIM was originally targeted at 2016 but now generally anticipated sometime before 2020.

BIM's Relevance to Housebuilding

The typical housebuilding process map (as detailed in the *Interim Progress Report*⁸) suggests that in the early stages, projects can be of a stop-start nature and that to some extent the design / project work stages are discrete, possibly as a result of uncertainty in the planning process. This has the potential effect of disconnecting the early stage aims of achieving planning approval in terms of site yield, density, character and the eventual delivery of building regulations compliance. However, the Performance Gap project has identified the lack of consideration of energy targets at the early stages as a potential contributor to creating a gap, so it is relevant to consider how BIM has the potential to provide a 'golden thread' of compliant design and specifications, integrating the range of housebuilding objectives. Indeed it is fair to say that a 'long-hand' version of this exists in the form of standard housetypes which have evolved as a resolution of design objectives from planning through to cost and compliance, with accompanying specifications and known construction sequencing and details resolution.

Arguably, the standardised housetype could be construed as the closest construction gets to the automotive industry (which BIM has transformed) and seems ideally suited for a template to serve a mass market, which could be refined with tested and validated components through BIM. It is also relevant to acknowledge, however, that standard housetypes are not applicable in urban situations and in highly contextual design where they are often rejected by planners.

Barriers and Opportunities

A major perceived barrier is an additional up-front cost.⁹ However, NBS have generated a national free BIM object 'library' to conform with the protocol of their Uniclass products and materials classification system, which establishes a platform for increasing amounts of BIM-ready content, for example generic construction typologies. The increase in available manufacturer-generated BIM library components will also augment a rapidly expanding existing set of information for BIM users, available at no extra cost. As referenced before, once a library of standard housetypes is established, its replicability is enhanced in BIM as, for example, a single change to a plan or a window size is immediately reflected in the 3D drawings (i.e. in section and elevation) and on scheduled outputs. BIM reduces costs of data repetition. Uncertainties around planning may remain, but increasing moves towards zero carbon homes, and digital submission and compliance checking of planning and building regulations, could incentivise wider uptake of BIM information.

8. To download the Interim report please visit: www.zerocarbonhub.org/full-lib

9. As per the 'Macleamy Curve', which shows additional resource at the project outset coming from the necessarily early definition of specifications and components

BIM in the UK is reported to save, on conservative estimates, 8-18% on design fees through improved coordination, and 8-10% of construction cost.¹⁰ These figures are reinforced by the BIS BIM strategy report,¹¹ which estimates the savings at a minimum of 5%.

Another perceived disadvantage is that skills are lacking, compromising existing alliances and optimal competitive procurement. Although it is recognised that experience of BIM in the housebuilding supply chain lags behind that of larger contractors incentivised by the Government's BIM targets, it is likely that a two-tier knowledge and skills system is a purely transitional state. Design management, quality management and compliance have been shown to be improved by convergence on the single BIM process, and the potential feedback loop BIM offers could be of real benefit for skills development and cost optimisation.

The RIBA's BIM overlay to the RIBA Plan of Work is in the process of being updated by the industry to reflect the cross-discipline adoption of the Plan of Work 2013. This identifies a number of challenges to normal practice, including the need for collaborative working, knowledge of databases, information classifications and protocols, contractual responsibilities and software interoperability. However it also highlights the potential value, equally relevant to housebuilding, of the use of BIM data to the analysis of cost, time and post-construction feedback as well as enabling quick sensitivity analyses for cost and compliance impacts.

Timeframes and Costs

The transition timeframe is dependent on how quickly BIM becomes the industry standard; this has already slowed because it was originally thought that Level 3 BIM might be achieved by 2016, which now seems more likely to be the date by which Level 2 is achieved. The NBS 2014 Annual BIM Report showed that of their annual survey of around 1,000 construction professionals across disciplines, the majority of those who took part in the survey had used BIM on at least one project in the last year, and the general expectation was that within three to five years, BIM use will be almost completely universal.¹²

Along with the need for up-skilling project staff, housebuilders may need additional resource in the shape of a BIM manager, although arguably this is subject to the skills levels of existing roles such as design and site managers. For smaller builders, BIM may seem a mountain to climb, but arguably once it is accepted as the industry standard and incorporated regularly in skills training, it will become a default skills requirement, and could provide a ready-made template for quality and process control with default processes and documents. By 2016, the culture associated with Level 2 maturity and government procurement should have established an industry-standard platform at virtually no extra cost other than that of upskilling and training.

10. *Investors Report, British Standards Ltd (see Diagram 2):* : <http://www.bimtaskgroup.org/wp-content/uploads/2012/03/InvestorsReport-BIM.pdf>

11. *A Report for the Government Construction Client Group Building Information Modelling, BIM Working Party, 2011:* <http://www.bimtaskgroup.org/wp-content/uploads/2012/03/BIS-BIM-strategy-Report.pdf>

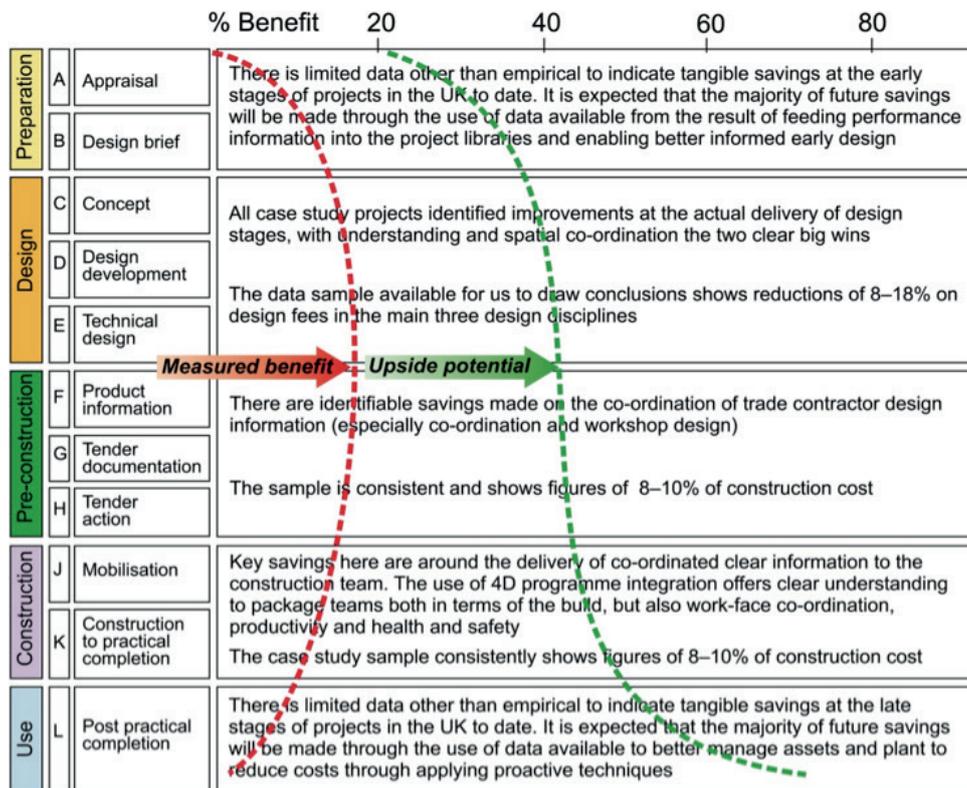
12. *NBS National BIM report, 2014:* <http://www.thenbs.com/pdfs/NBS-National-BIM-Report-2014.pdf>

The current cost of the software varies but could be as little as 10-20% extra over current CAD costs, however computer systems need to be more powerful. Costs and time currently associated with making changes, options appraisals, compliance analysis, integration of standard details and so on could be reduced with the use of BIM, although setting up and training costs will need to be factored in.

The table below illustrates findings of some published commercial research and data gathered from case studies, as part of a BSI supported research project looking at the effect of the implementation of BIM on chosen key projects. The red plot indicates the average saving of projects available for measurement to date, with the green plot indicating potential benefits expected by the early adopter community.

Figure 2. Diagram 2: Potential Benefits of Using BIM

© Mark Bew, 2010. From BIM Task Group Investors Report, published by British Standards Ltd



Note: letters in second column relate to RIBA Plan of Work

Recommendations

Once the industry produces the Plan of Work documents incorporating all the definitions of documents, data drops and other activities associated with each stage,¹³ it will give clarity to the landscape and offer market-led opportunities for BIM-based standard packages of documents, details, components and designs to be marketed, which could be of substantial benefit to quality management in housebuilding.

13. Currently the subject of a BIM TaskGroup / TSB project

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