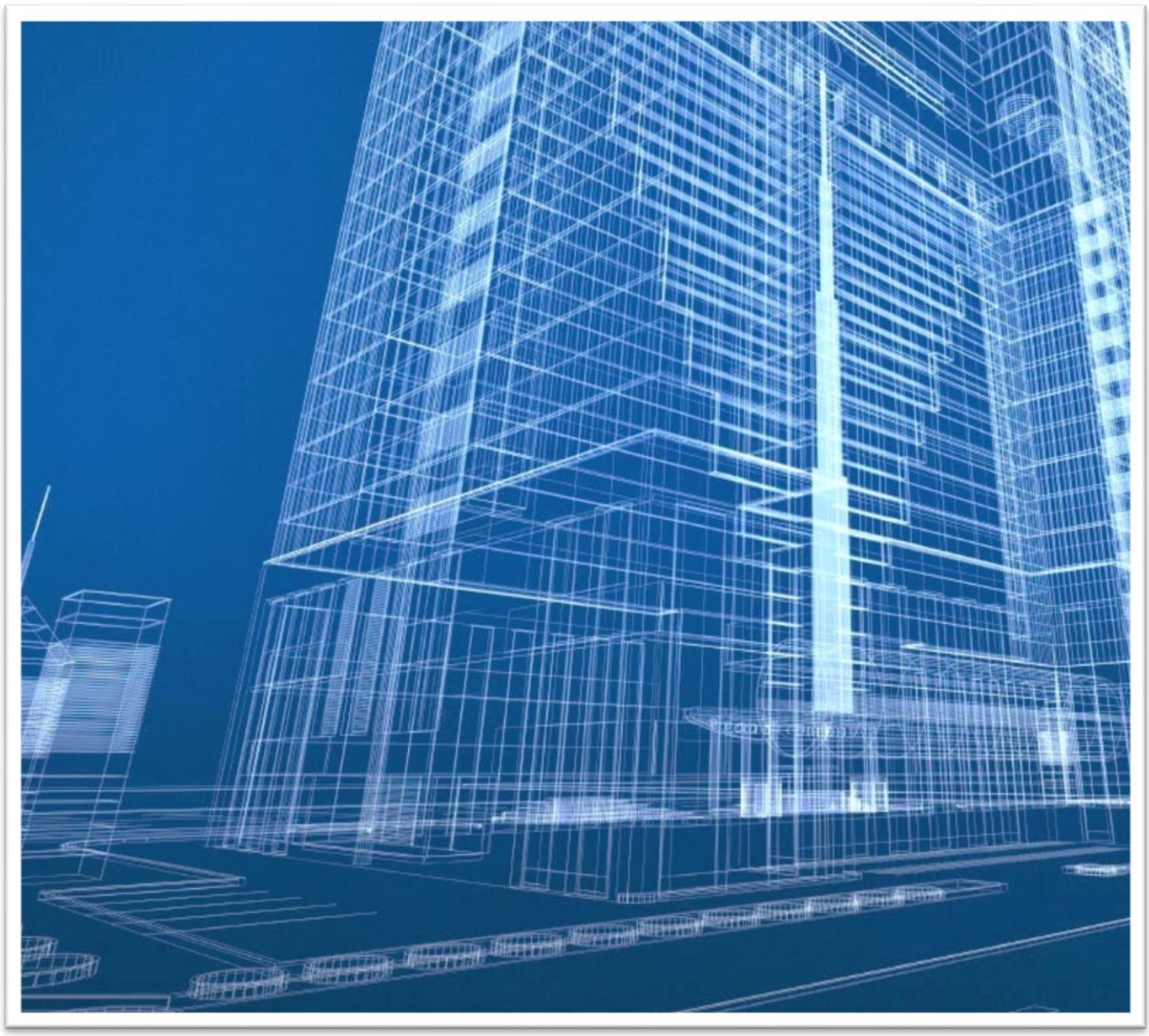

BENEFITING FROM BIM: WHAT ARE THE PRIORITIES FOR DEVELOPMENT?

JUNE 2014

White paper report

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Overview

This white paper report was put together to summarise the CBx breakfast briefing "Benefiting from BIM", held at UCL Energy Institute, London on 05 June 2014.

An open discussion around the role of building information modelling (BIM) in data management and the feedback between design and operations, exploring how the promotion of (BIM) has the potential to dramatically improve the way data is captured during the design phase and handed onto the end user.

With special thanks to our fantastic panel of industry experts; Neil Thompson, Principal BIM Integrator at Balfour Beatty; Jason Clark, Director of UBS; Brent Rees, Senior Architectural Technologist & BIM Coordinator at Ridge and Partners LLP and Brian Coffey, Principle Research Associate at UCL and Head of Research at BuildLab.

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Important Notice

BIM: THE STATUS QUO

Building Information Modelling (BIM) has been a hot topic across the industry for a decade, receiving increasing attention recently due to UK Government mandates for its use across centrally-procured public projects by 2016. The policy was published in the Government Construction Strategy in May 2011 with the aim of delivering projects quicker, cheaper and with lower carbon. It requires fully collaborative 3D BIM, or BIM Level 2 with the range of levels categorised as:

- Level 0: Unmanaged CAD (Computer Aided Design)
- Level 1: Managed CAD in 2D or 3D
- Level 2: Managed 3D environment with data attached, but created in separate discipline models
- Level 3: Single, online, project model with construction sequencing, cost and lifecycle management information

BIM level 2 is the process of creating discipline-specific models which will be populated over the design process and combined into a federated model for on-going use. The Industry Foundation Classes (IFC) data model is a platform-neutral, open file format, and are currently used for around 45% of BIM projects in the UK. It enables models built with assorted software to be shared among the design team and

To ensure projects are properly validated and controlled as they develop, data is extracted from the evolving building information model and submitted to the client at key milestones. This submission of data is described as a 'data drop''and the schedule of data drops will differ from project-to-project. Both the RIBA (BIM Overlay to Plan of Works) and the Government's BIM Task Group have developed guidance in this area.

There is currently no movement towards setting a Government target date for BIM level 3, however benefits from BIM implementation are already being felt across the industry. Design teams are experiencing enhance time-efficiencies and increase profitability on projects through improved collaboration, visualisation, coordination and information retrieval. Manufacturers can provide accurate, information-rich BIM objects which can be thoroughly integrated into the BIM, facilitating optimum placement and utilisation of their product, persistence of specification through the project and correct maintenance across a building's life. For clients, design outcomes can be modelled and confirmed at the briefing and design stages enabling the maximisation of the lifetime performance of a building and greater efficiencies to be delivered.

> ***"61% of users found that BIM brought cost efficiencies, 52% that it increased speed of delivery & 45% agreed that it increased profitability."***
>
> **NBS BIM Report 2014, p9**

The National Building Specification (NBS) produce an annual BIM report on the awareness and uptake of BIM in the industry; the 2014 report shows a 40% rise in these areas on previous year figures. The dataset of approximately 1000 respondents describes a 95% awareness of BIM with more than 50% of those using BIM employing BS 1192:2007 or PAS 1192 - 2:2013; standardised processes for the ownership, review and sign-off of information, before that information is more widely shared. The report also found that BIM adoption in small practices (fewer than 6 people) is delayed, currently sitting at the level seen in the wider industry in 2011. Reported barriers include cost, the absence of an appropriate project and a lack of in-house expertise.

BIM INTERGRATION INTO OPERATIONS

Jason Clark is a director at UBS a Swiss-based global firm of 65,000 people providing financial services in over 50 countries. UBS have recently tried to consolidate the majority of their 8,500 strong UK workforce into a new-build headquarters building in Broadgate in conjunction with their Landlord / Developer British Land. By RIBA Work Stage 3, UBS decided that it was necessary to implement BIM given the new building's projected completion around 2016.

> ***"The industry needs an end-to-end design – constructor – operation tool to realise the full potential of BIM"***
>
> **Jason Clark, UBS**

Although BIM was not stipulated in the key deliverables from the outset, the methodology was embraced by the architects and structural engineers. However, the building services consultants, who commonly work in software such as CAD-Duct, did not feel it was feasible to deliver such a complex, and highly serviced building on unfamiliar software. Stipulating the use of BIM is stipulated in the key deliverables allows organisations time to up-skill for complex projects.

ISG have come on board pre-tender to coordinate the services which will be modelled in Revit-based software to facilitate effective management and coordination with the architecture and structure; trades can then use this as their trace tool if necessary. The ambition was to develop a BIM model that could be used through construction and for the on-going, efficient operation of the building. For this reason, all assets were included; security, structure, cabling and audio visual equipment, although a further level of detail will be necessary for the model to be used for post-completion.

UBS have come up against numerous challenges in their bid to implement whole-life BIM into their project. Firstly, the lack of a single, end-to-end tool for design-constructor-operation creates many software coordination issues that translate into time and cost inefficiencies and prevents the full potential of BIM being realised.

> ***'BIM would benefit from a larger input from the facilities managers as a professional body going forward'***
>
> **Jason Clark, UBS**

Secondly, there is still some guidance needed from the facilities management professional bodies in creating the 'pull factor' when it comes to post-completion BIM. The industry needs their expertise on how to maximize the benefit for BIM in operation so as to facilitate the interoperability between Revit, CAFM (Computer-Aided Facilities Management) and CMMS tools.

UBS see many opportunities in streamlining the BIM process and introducing efficiencies. Operations and Maintenance (O&M) manuals often get left on the shelf our underused as they are lengthy and seldom user friendly – see the CBx white paper 'Making Energy Audits Work for a Resilient Portfolio' for more details on this topic. Operational BIM and information-rich components have the potential to encompass the function of O&Ms into a dynamic and parametric environment with relevant information tagged to appropriate elements and further linked to associated components. A model of this kind would enable any instantaneous alterations to operational set points by facilities managers to be checked against the design parameters of the building for continuous validation of both the model and the building in use. UBS make frequent one-time changes to their facilities and would like to see the changes automatically replicated in the

asset management system and the Computerised Maintenance Management System (CMMS).

Graphical User Interfaces is another area that can be streamlined. Each system illustrates the building with a different set of bitmaps, meaning that users must familiarise themselves with multiple sets of graphics for operation. If the systems were integrated into the building information model, users could concentrate on becoming well-versed on one, interconnected system.

BIM post-completion could also facilitate life cycle planning, allowing designers to check the model for any likely consequences to refurbishment strategies; for example to be able to validate whether or not the extraction of a chiller would have any detrimental effects on building performance.

Lastly, if cable management platforms could be federated into a BIM model, this would enable landlords, owners or operators to understand how the space inside a building is being used, by monitoring the usage of computers and other equipment, leading to some useful insights and information upon which to reduce energy performance.

EFFICIENT BUSINESS FOR EFFICIENT BUILDINGS

Balfour Beatty have put together a roadmap in response to the Government targets set out in their July 2013 industrial strategy document 'Construction 2025'. These targets include; a 33% reduction in the initial cost of construction and the whole life cost of built assets, a 50% reduction in the overall time, from inception to completion, for new build and refurbished assets, a 50% reduction in greenhouse gas emissions in the built environment and a 50% reduction in the trade gap between total exports and total imports for construction products and materials.

Balfour Beatty work on the basis that in order to produce a sustainable building, you must first have a sustainable business and have put together various toolkits in order to realise the ambition. The toolkit has many parts; innovation, zero harm, IT, quality assurance and LEAN – a methodology borrowed from the automotive industry dealing with materials. One of the largest components of the wheel is building information modelling.

For years the industry has operated under an analogue system with paper files and reams of drawings. In more recent times, as digital technology has emerged, the industry has digitising its analogue processes which has hampered progression and innovation. Instead, there needs to be a push for redesign of processes from first principles. Virtual design and construction (VDC) was used alongside BIM during the construction of the Heathrow Terminal 2 Building and Balfour Beatty report a saving in the order of millions of pounds as a result of designing-out paper files and conducting conversations with the correct members of the team present. By employing this method, lengthy Requests for Information (RFIs) were avoided and decisions were made instantaneously with changes made directly to the model.

> ***"The use of BIM and VDC led to large savings on the delivery of the Heathrow Terminal 2 building"***
>
> **Neil Thompson, Balfour Beatty**

There are many overarching systems involved in the delivery of a building and a large amount of equipment that needs to be managed, the operational expenditure, , external impacts of construction work, just-in-time deliveries and on-going impact on surrounding businesses both during construction and following a new influx of local population. Building Information

Modelling allows the connection of these larger economic systems at a level above the coordination of the various building systems and components.

COMBINED BIM & ENERGY SIMULATION

As the industry generates and records more and more BIM and energy monitoring data, these become two very complimentary exercises with energy modelling as the lynchpin. Building information modelling provides many of the data points needed to build an energy model; some at high quality and some at lower quality so it is necessary to augment the data from elsewhere or from in-use.

> ***"There are huge opportunities for creating feedback loops between BIM, energy modelling and energy monitoring"***
>
> **Brian Coffey, BuildLab**

The type of data needed for energy modelling differs from that which is encapsulated by a model for construction or architectural development; it concentrates less on junctions between fabric elements and more about HVAC zoning and thermal performance.

Importing and exporting from BIM presents some challenges. Currently this is much more seamless with geometric data than with an HVAC simulation. Furthermore, when an energy model is built, spaces or zones with the same occupancy and HVAC profiles will be connected however when the data is exported from BIM, each of those zones is exported separately. This presents an issue in terms of increased computational time for rendering as it is often highly dependent on the number of separate zones.

Even so, there are some big opportunities from connecting these processes and creating feedback and analysis loops between BIM, energy modelling and energy monitoring.

Once an energy model has been set up, there will inevitably be a 'performance gap' between the results and what is happening in operation. There are two computational models one could employ at this stage, depending on the desired outcome.

A design-intent version of a model might be utilised for a benchmarking exercise – to understand how the building is performing compared to how it was expected to perform. This may provide insight into what should be further investigated. Similarly, if the model is to be queried in order to establish what needs to be altered on the building in-use, a fault detection and diagnosis process would be run on this type of model.

Energy models can also be utilised to understand what can be done to improve the running of a building in operation. In this instance, the model would be calibrated and then tested with various retrofit analyses and control optimisations. Further studies may be undertaken on complementary software such as Sefaira. Monitoring analyses can also be performed on a calibrated model to tease out where additional monitoring may provide further insights into building performance. Finally, this type of model can be used to identify ways in which to improve the design for the next building.

FURTHER DISCUSSION

By general consensus, BIM presents a plethora of unexploited potential for the industry and further discussion centred on priorities for enhancing BIM capabilities. In the first instance, the biggest inefficiency was seen in taking on multiple sets of information and the need to streamline the interface for this process and minimise latency of decision making. Furthermore, the synchronisation of datasets must be improved to

decrease the resources needed to verify successive alterations through the model.

The operation of a building accounts for the majority of a building's lifetime however BIM is not currently an effective tool post-completion. The running, maintenance and facilities management should be taken into account at design stage and kept in mind as the model is set up and developed.

A building information model developed for use into operation could have the ability to capture in-use data and compare and verify that against expected outcomes. This type of evolution could support performance contracting activities by identifying where a building is diverging from design intent and attributing that to occupants, heating or zoning, for example, there-by imparting some confidence into those taking on the performance contracting risk.

Energy modelling is often used to substantiate declarations made for environmental certification which can divert attention away from its intended, superior use of providing insight across the design and construction of a project. Another area of priority for BIM, therefore, is to develop the interfaces with various energy modelling programmes so as to encourage these types of feedback loops.

CARBONBUZZ

CBx endorses the use of tools such as the CarbonBuzz platform which can record building energy consumption data from any stage of design, through construction to post-completion and year-on-year in operation. The CarbonBuzz platform has many synergies with the process of BIM and can therefore act as the repository for all energy related data. The ability to illustrate multiple energy bars means that, at any stage, additional complexity of information can be added as a new record and the resulting changes to the energy consumption will be displayed. It has the capability of recording contributing factors alongside consumption data under the main headings of; design vs. as-built, building management, special energy uses, appliances and IT, occupancy and operating hours. The excel import and export function facilitates energy consumption data drops that can be aligned with stages outlined by the BIM Task Group, the RIBA Plan of Works Overlay or any bespoke set. Finally, the 'share a project' function promotes single-file working across a project team.

RESOURCES

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