

AR21604

Connect 4 - Geometry, Data, People, and Process

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After attending this class you will understand how change management and communication both internally and within an extended project team can benefit your client and your projects, along with the negative impacts that not embracing change may have on your business.

Learning Objectives

Learning Objective 1

Discover the current and future state of BIM adoption within the UK AEC space.

Learning Objective 2

Understand that it's not just about using BIM tools, but rather how capitalizing on a mandate can open up collaborative workflows and drive process change.

Learning Objective 3

Discover that BIM adoption is a disruptive change to your organization, and learn how to address internal cultural and sociological challenges.

Learning Objective 4

Learn how to effectively track your BIM adoption to benchmark progress internally and use the metrics to win both work and confidence.



Class Description

Historically, the architecture, engineering, and construction industry has operated in information silos. With the creation of the UK BIM mandate, the government has focused on the end product, and has essentially farmed out the workflow for project teams working in a collaborative environment. Never before, has there been such an open and sharing mentality among would-be competitors trying to achieve a common goal. This session is the “warts and all” account of two UK Architecture firms describing how we have tackled changing perspectives, internal office culture, mindsets and deliverables. focusing on examples of where new technology and innovative workflows have assisted with communication, collaboration and coordination to provide a consistent approach for projects in alignment with the UK BIM mandate.



Your AU Experts



David Sewell

Design Applications Manager

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As Design Applications Manager at Perkins+Will London David is part of a global team, whose primary focus is overseeing the strategy and implementation on all things digital practice.

With over 20 years' experience across disciplines and sectors, he has held technology leadership roles connecting IT, Building Information Modeling (BIM), practice management, and project delivery.

He has a firm understanding of the BIM process and is currently aligning the London office with BIM methods and emerging industry standard processes and workflows.



Jon Arnott

Associate Director of
BIM and Digital Design

@jonarnott

Having worked at a number of notable national and international practices, Jon recently joined renowned international practice, Broadway Malyan.

He has over a decade of experience as a registered Chartered Architect working within Architectural practices, setting the strategy for and implementation of BIM processes and tools globally.

He has first-hand practical knowledge and understanding of how modern working methodology's and processes implemented in the lifecycle of building projects can deliver real benefits for AEC businesses, and their extended supply chain, worldwide.



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Overview

Social media, mobile, wearables, Internet of Things, real-time are just some of the technologies that are disrupting markets. Changes in how people communicate, connect, and discover are carrying incredible implications for businesses and just about anything where people are involved. It's not so much that technology is part of our everyday life but that technology is relentless in its barrage on humanity.

This is a time of digital Darwinism — an era where technology and society are evolving faster than businesses can naturally adapt. This sets the stage for a new era of leadership, a new generation of business models, new methods of working, charging behind a mantra of “adapt or die.”

27 years ago a man wanted to re-frame the way we use information and the way we work together. He was frustrated as a software engineer, watching people come from all over the world to the labs he worked in, they brought all sorts of computers with them, they had all sorts of data formats, all kinds of documentation systems; but in all that diversity, if he wanted to figure out how to build something from a bit of this and a bit of that, everything he looked into he



had to connect to a new machine, learn a new program, find the information he needed which would be in some new data format and would all be incompatible.

As he put it, "the frustration was in all this unlocked potential. If you could imagine information all being part of some virtual documentation system in the sky, say on the internet, then life would be so much easier"

Sounds scarily like the issues in the AEC space doesn't it? That's because historically the AEC industry has operated in information silo's.

The problem that the AEC sector have been trying to solve is how to clearly communicate cross discipline, on a global scale, to build projects efficiently, with less risk and cost, both in CAPEX and OPEX phases.



The mandate gave the AEC sector 5 years to get BIM Level 2 ready. It gave an opportunity to introduce concepts such as Supply Chain Management (SCM), Product Lifecycle Management (PLM) and Integrated Project Delivery (IPD) into our respective business.



Because despite there being many reports¹ suggesting better and smarter working practices like other industries (aerospace, manufacturing) the AEC industry has never really embraced change. The Government wanted to reduce waste and cost by improving efficiency in its procurement and running of its estate and so mandated more collaborative workflows that the AEC sector had to adopt these methods or not be able to tender for projects.

Early BIM got confused with 3D Modelling tools but the introduction of the above concepts were never about software. They are about connecting people, process and technology.

¹ There are 6 reports most notable of which are The Latham Report, "Constructing the Team" (1994), The Egan Report, "Rethinking Construction" (1998) and the Government Construction Strategy (2011). More information can be found here, https://www.designingbuildings.co.uk/wiki/Latham_Report

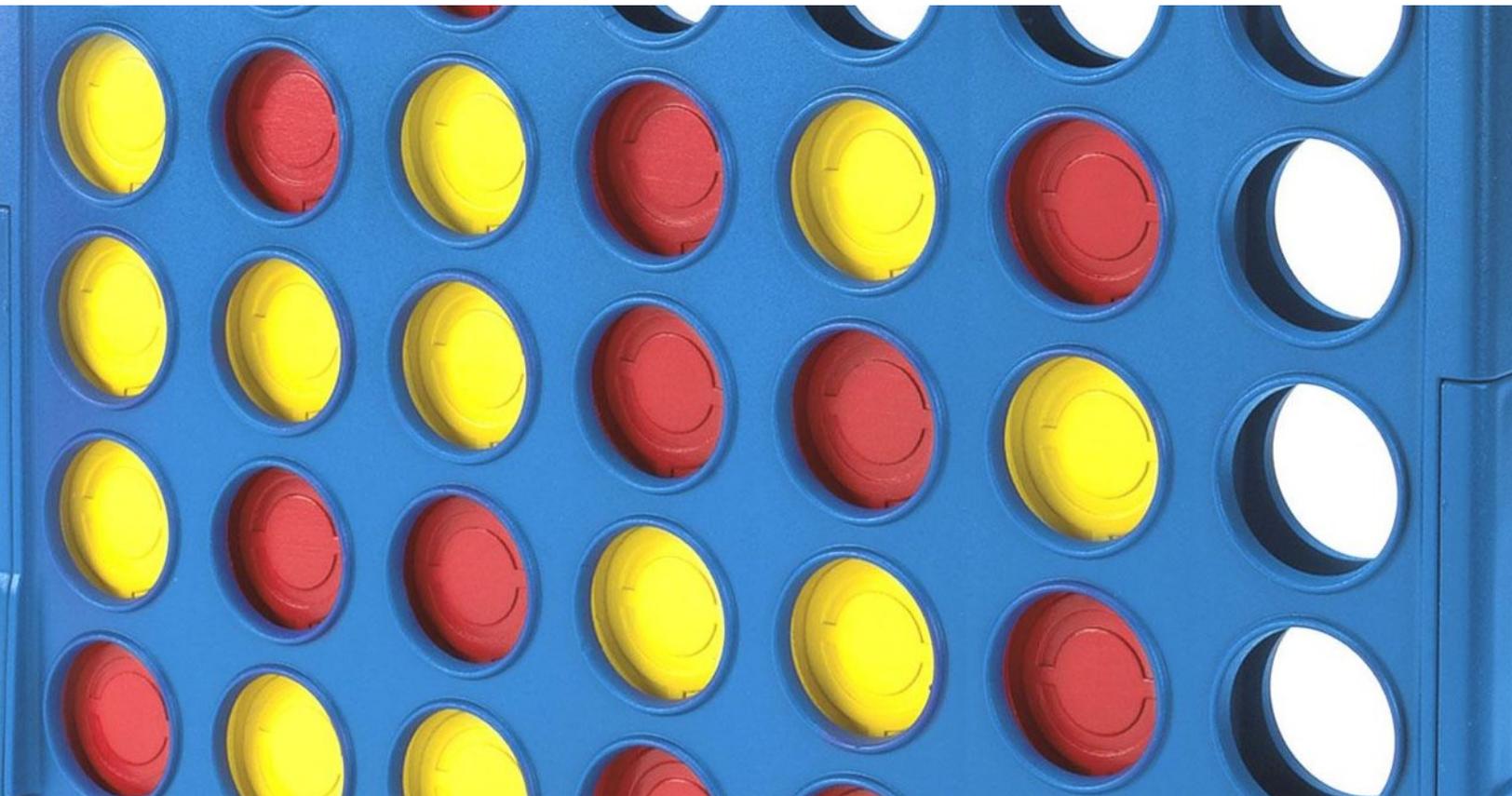


For us, this means the infamous acronym that has become familiar worldwide, should actually mean **Business** Information Management as it extends to all information required for project delivery.

The word "connect" is fundamental into everything we do, hence the title.

The engineer by the way, his name... Sir Tim Berners-Lee, he invented the WWW².

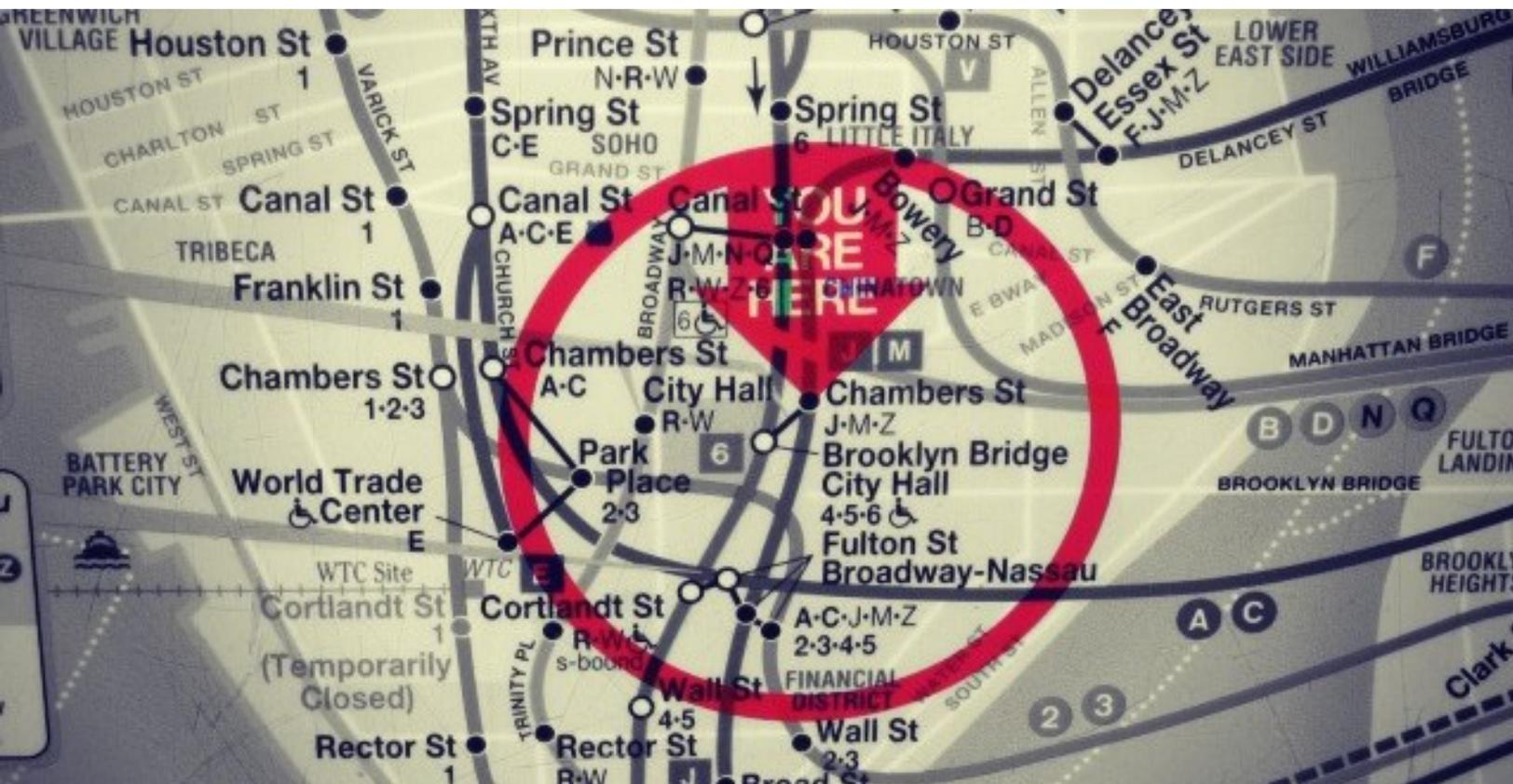
It reflects what we believe are the four factors that enable implementations to succeed. By connecting geometry, data, people and process we can transform businesses into forward thinking, efficient and adaptable outfits that can embrace change enabling them to keep pace with the technology revolution, reducing risk their operations and remain relevant to how new generations of people will want to work.



² Learn more about what Sir Tim Berners-Lee has to say about connecting people in his TED Talk



We have designed the class so that we're not just explaining a standard process. We wanted to show you how we actually went about adopting these new methods and highlight some of the challenges we both faced implementing new ways of working. There may be better ways, we may not have everything fully resolved and we may not be 100% in alignment with the mandate but they are real life examples which we hope you can benefit from and maybe even apply them in your own businesses.



The Current State of BIM Adoption

Since 4 April 2016, in the United Kingdom (UK) publically procured construction projects now need to achieve what is termed BIM Level 2. This is a significant milestone in the UK's BIM journey.

In 2011 BIM Level 2 was announced as part of the UK Government's Construction Strategy, and since that time BIM methods have moved from a niche practice to the norm.

However, concerns remain.

A significant number of people are not clear on what they have to do to comply with the BIM mandate, and only one in ten believes that the construction industry is ready to deliver on it³.

Aligned to this is a broader skills gap in BIM, with a quarter feeling they lack the skills and knowledge that they need.

As a collaborative practice, BIM requires a shared ownership of the design and construction process. Through this shared ownership will come shared learning, as well as the iterative development and implementation of improved practice. This level of collaboration opens up new possibilities to design teams: coming together on a project-by-project basis to collaborate in clearly defined and described ways, with information pooled, rather than hoarded.

The UK has a world-leading design community that contributes very positively to our balance of payments. We are delivering world-class construction projects, such as the 2012 Olympics and Crossrail. BIM is playing a significant role in increasing the efficiency of government construction spending. In 2014 / 15, the Government saved £855m⁴ on existing schemes, allowing for investment in new ones. The UK is leading in providing standards and descriptions of BIM, and other countries are using these as a template for best practice in BIM.

"But there is still much work to do and the journey continues. For BIM to realise its transformative potential, investment and change is needed across the sector."

(RIBA Enterprises Ltd, 2016)

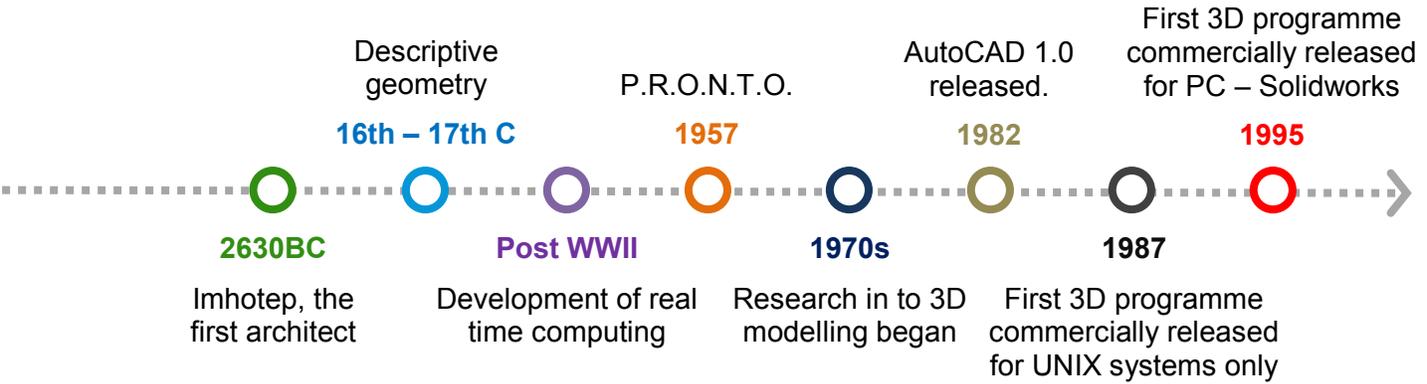
It is worth reflecting on history to show how quickly new developments have come along and the impact it can have on our businesses.

Overleaf is a timeline of the developments of drawing methods from the first Architect through to present day⁵.

³ Figures from the NBS National BIM Report 2016, <https://www.thenbs.com/knowledge/national-bim-report-2016>. Accessed 7 November 2016.

⁴ Extract from Introducing the National BIM Report 2016, <https://www.thenbs.com/knowledge/introducing-the-national-bim-report-2016>

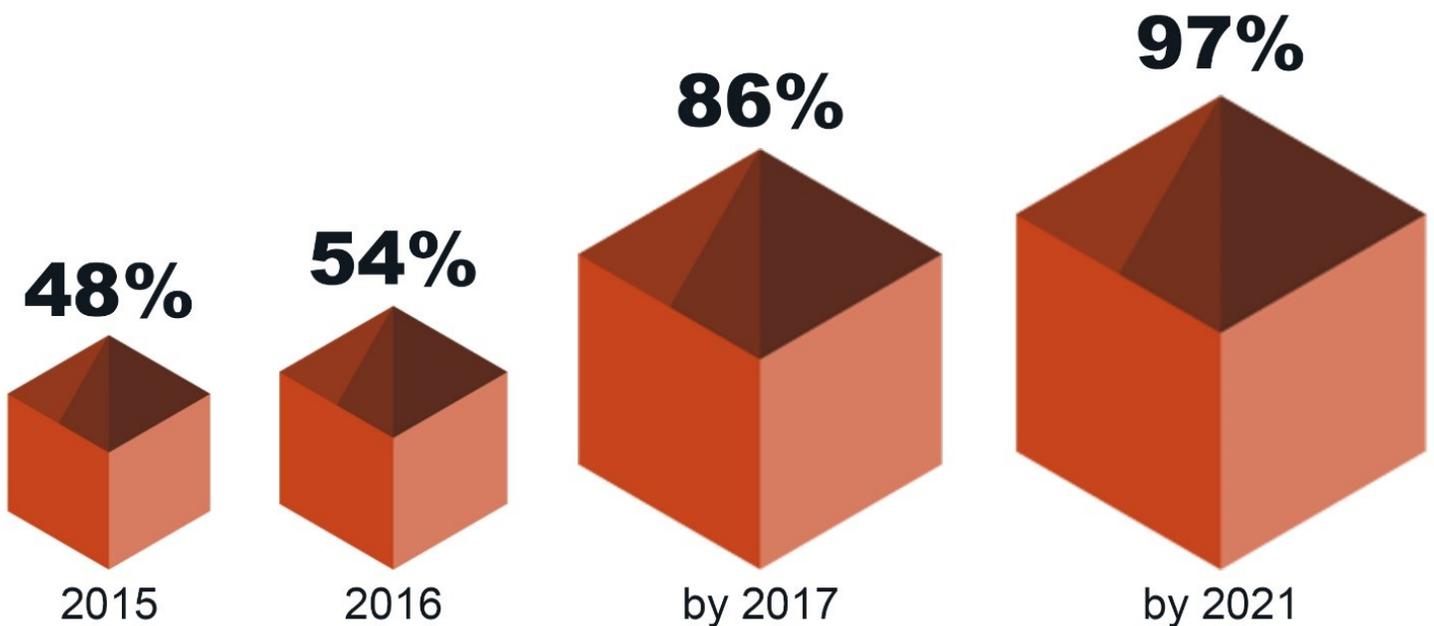
⁵ Dates and detail from Wikipedia. Refer to bibliography for details. Accessed 7 November 2016



It took us 5 centuries to get to real time computing but it has only taken 6 decades to develop BIM related tools.

The pace of change does not look like it is about slow either. This year, 2016, the [NBS National BIM Report](#) states that 53% of UK construction professionals are aware of and using BIM, but that by next year this is expected to rise to 86%, and in 5 years' time to 97%.

Rather than react to change or be disrupted by it, forward-looking companies are investing in digital transformation to adapt and outperform peers.





The UK government along with many other industry leading bodies around the globe recognised that change was required for a number of reasons:

- To reduce cost of designing, constructing and running building projects
- To remove risk, and stop projects being over-time and over-budget

They went on to realise that if this is all done well we can be a cog in much larger machine for example, Internet of Things (IoT), Smart Cities, and the wider connected world.



The concept behind BIM is a series of working methodologies and processes that looks to:

- maximise efficiency
- optimise project outcomes
- increase value to the owner / occupier
- reduce waste

in the design, delivery, construction and occupation of building and infrastructure projects.



As mentioned previously this mandate only applies to Government projects. We understand that in the US there are similar frameworks such as GSA and DoD that also drive private sector process but the UK mandate describes explicit deliverables those of which are being asked to be applied in seemingly all collaborative BIM projects.

Much UK industry talk cites BIM Level 2 but essentially it's just the description given to a defined process of working collaboratively which is the common goal of everyone working on any project across the globe

BIM Level 2 Framework

We hear you ask yourself, - "That's all great, but how do we actually deliver this and it can't all be plain sailing. There have to be some issues..."

With the aforementioned in mind it goes without saying that we should be thinking about the importance of managing all of our information related to the project; document and drawing management, distribution control, version control, audit processes and quality assurance, communication between project team members, while considering the systems that will help us create this common platform to enable the BIM workflows to seamlessly integrate into our everyday project delivery cycle.

This may seem obvious to some, but this is often overlooked or not considered properly. We are often surprised by the amount of people who don't understand the importance of setting out a brief at beginning of a project.

Right now, there are many projects leading the way, but none can claim to have done it all. There are still difficulties in producing, extracting and using information and that's what we want to talk about.

Key documents

There is a framework of reference documents in place to help explain the BIM Level 2 process and how it should work. We are conscious that these may not apply to many outside the UK but

they do help break down a process of collaborative workflows so we have added them into this handout.

Since the first piece of the jigsaw arrived in 2013, there are now 8 key standards with numerous supporting documents, forms, and protocols.



Below we outline the main guidance standards for reference and give you a little information on what each deals with and when they should be used.

In reality for most people these can be a tough read but it is important to be at least familiar with their wider purpose and terminology and how they may affect your individual deliverables.

It has been argued that in order to be BIM Level 2 compliant the following Standards and guidance documents must be incorporated into the project. We disagree. Simply because there is an element of interpretation and often project requirements will determine which of the standards need to be incorporated.



100% of our “BIM Level 2” projects are not fully compliant projects as defined by mandate.

But we would still argue that we can deliver BIM Level 2, leading people to quickly question BIM Level 2 validity.

Typically, projects are addressing some but not all of the following guidelines, but, this is still a great step forward towards a UK industry standard. It has also been identified that there is contradiction between documents and that they are also open to interpretation but they do still provide a solid framework to work from.

BS1192:2007 – Collaborative production of AEC information – Code of Practice

This is seen as the foundation of collaborative working. It is the British Standard (BS) that is a common thread throughout the accompanying framework of documents.

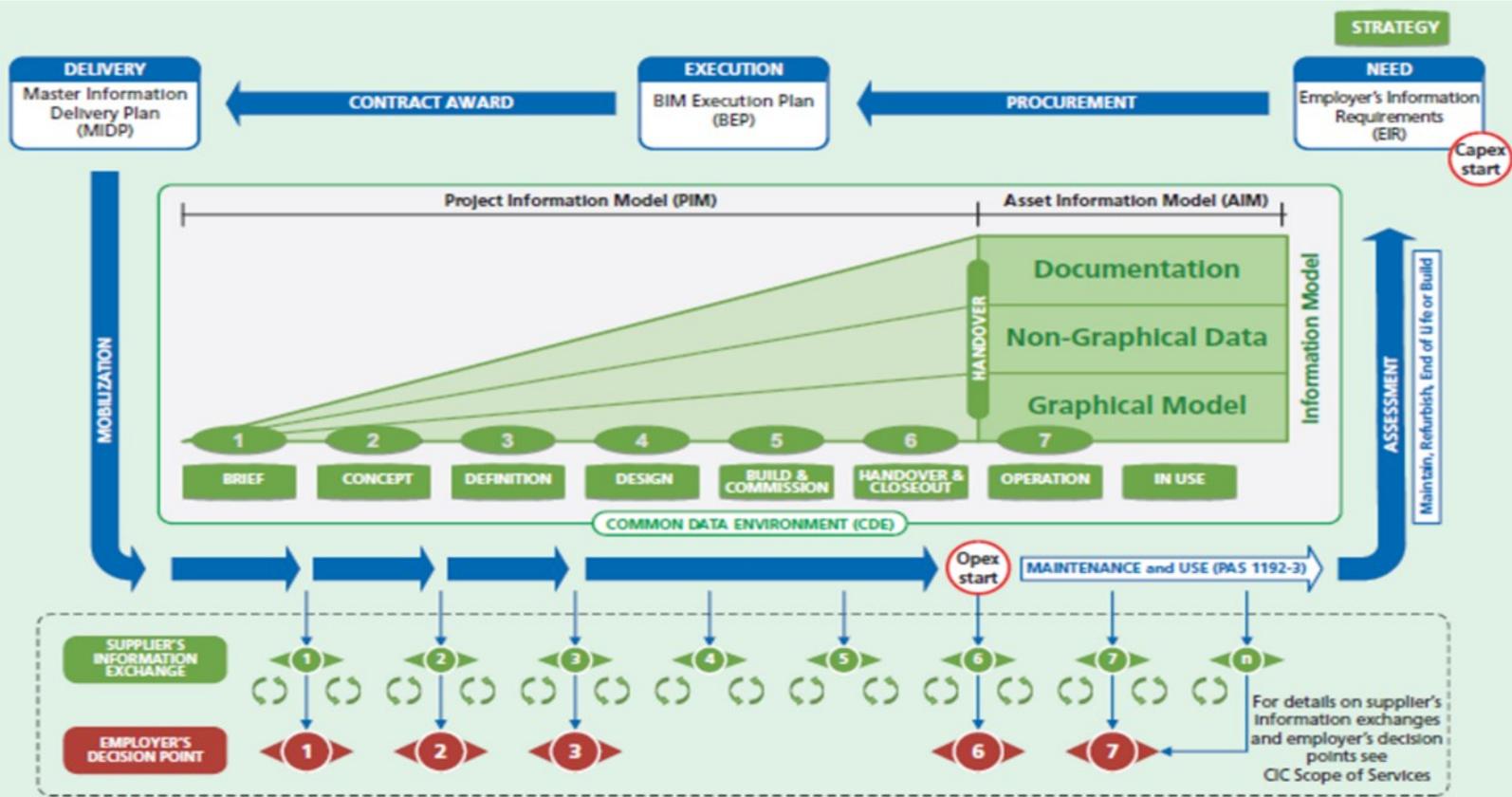
It primarily addresses the idea of working collaboratively in a digital format and introduces the key concepts to standard naming conventions, managing version control / suitability status and how to work collaboratively via a Common Data Environment (CDE),.

PAS1192-2:2013 – Specification for information management for the capital/delivery phase of construction projects using building information modelling

This is seen as the primary document that underlines BIM Level 2 delivery during the design and construction stages.

This PAS builds on the 1192 standard in respect of collaborative working within a common data environment, mandates the requirement of BIM docs such as EIR's and BEP's, defines the requirement for data delivery should the project require it, details specific roles within a project and defines requirements and guidance for coordination.

A cyclic process (as seen overleaf) that details the delivery of an asset from inception through to operation with identified information exchanges (data drops) which inform key client decision points.



PAS1192-3:2014 – Specification for information management for the operational phase of assets using building information management

This is used during the assets operational stages. It details the information management process for full asset lifecycle to support building maintenance in operation. This PAS considers the relationship between the Project Information Model (PIM) derived from capital delivery and the Asset Information Model (AIM). Used correctly it enables the production of a clearly defined EIR.

BS1192-4:2014 – Collaborative Production of Information

In short, details COBie requirements based on real project examples. COBie-UK guidance document showing examples of outputs at various project stages.



BS1192-5:2015 – Specification for security minded building information modelling, digital built environments and smart asset management

Gives guidance on the processes for digital security as we exchange BIM information in a cloud based world.

The BIM Protocol (CIC BIM/Pro)

There has been lots of talk internally about what BIM Level 2 means contractually to us. The CIC BIM protocol is a standardised supplementary legal agreement that is added to existing contracts to encompass BIM. This then forms a direct contractual agreement between individual supplier and employer. It is not a project wide agreement and is used to identify key obligations, liabilities and limitations between a named individual supplier and employer. If an Architect employs a sub-consultant, then the CIC BIM Protocol also needs to be appended to their agreement contract. There are two appendices that are listed in the BIM Protocol that need to be completed to enable the production of information models at various projects stages along with identifying collaborative workflows, common standards and identifying roles. This document was first published in 2013 and the Appendices are a little outdated so it is common practice for the Appendices to reference other guidelines such as the information detailed in the EIR / BEP. Ensuring that everyone producing information has the BIM Protocol appended to their contract means that BIM deliverables and standards are clear.

We certainly do not claim to have enough legal knowledge but a key factor to this way of working is that of IPD. Where the success and failure of the project is shared collectively. We guess at the moment that contracts currently do not allow for this fully and simply that nobody trusts each other enough.

Government Soft Landings (GSL)

A GSL process bridges the gap between those that design and construct an asset and those that use and manage it. GSL works with the idea of a 'golden thread' from initial brief, through design/construct and handover and into an extended evaluation period during operation. GSL focuses particularly on end user training, setting targets and outcomes from the outset, aftercare and post occupancy evaluation.

Designers and contractors become involved with the building beyond its completion ensuring that handover is smooth and operators are well trained.



Digital Plan of Work (dPoW) / BIM Toolkit

The BIM toolkit is an online resource managed by NBS that allows project information requirements, responsibilities and deliverables to be defined at each project delivery stage in a standard, robust and open way from inception through to operation. The content from the plan of work develops over as more information is known about the project. It should be made available to all participants on the project so that they know who must deliver what information and when

Classification (Uniclass 2015)

A 'digital-first approach' where the classification is in a central database and accessible through an intuitive user interface or web services⁷.

Key Roles

Within these documents there are also references to a variety of project roles. One key role is that of the Information Manager.

There are different views as to how this role is best implemented and it is fair to say that information management is part of everyone's job.

The [CIC BIM Protocol](#) document mandates that the client appoint/request the Information Manager.

It may be that the role is provided by an existing member of the project team (design or construction lead) or is provided independently. The key is to remember that this is a role, not an individual and will be carried out by an organisation that has the relevant in house skills to understand all inputs on the project, or may in fact involve a group of people from different design disciplines for example the lead designer or lead consultant may be the information manager during the early stages but then the contractor during construction.

Recently this role is becoming more commonly requested. It was a tick box exercise a year or so ago on the projects we worked on but now it is being clearly defined in EIR's and external

⁷ Extract from <http://bim-level2.org/en/standards/>



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companies are providing it as a full service. We see this now internally as an added service with an associated cost to cover the tasks associated with the role..

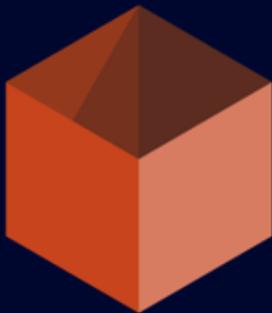
More information on the role and FAQ's can be [found online on the BIM Task Group's website](#).

BIM Level 2 Deliverables

There are many parts that make up a successful BIM Level 2 project, but the real question is, what are the key outputs or deliverables for a compliant BIM Level 2 project?

From a UK perspective to achieve BIM Level 2 at the key project stages you need to be able to deliver 3 things as a minimum⁸:

- 3D models in native format
- 2D drawings in digital format taken directly from the model. Typically, this is produced .pdf format
- COBie spreadsheets - defined as structured data from a number of construction professionals who collaborate to complete this documentation⁹. Typically, this is supplied in .xls / .xlsx format.



3D Models

in native format



2D Deliverables

“cut” from models



COBie Data

Excel spreadsheet

⁸ As stated in PAS 1192-2:2013, clause 9.1.4

⁹ Project team members only enter the data for which they are responsible. Designers provide spaces and equipment locations. Contractors provide manufacturer information and installed product data. Commissioning agents provide warranties, parts, maintenance information



Collectively these are the primary building blocks of the Project Information Model (PIM). A PIM is not a physical model. It is all of the data that makes up the information that is required to design and construct the project.

An Asset Information Model (AIM) can be derived from the PIM once the project moves into operational stage.

Getting the Deliverables Right

Have you ever bought a new car but weren't informed of all the optional extras you could have had? Maybe you've bought an airline ticket for a low-cost carrier, it all looks good until you progress past choosing the destination and time and realise that if you want to take your bags with you that's extra money?



All of the above are examples of when you don't have the full picture and costs suddenly go up or risks are added because you assume certain things will be done or included.



So the question is, how to iron out these issues? Quite simply in our minds it's a case of defining the deliverables, expectations and goals at the outset of the project.

How?

By setting the above out clearly in the following key documents:

- Employer's Information Requirements (EIR)
- BIM Execution Plan (BEP)

The Employer's Information Requirements (EIR) document¹⁰, commonly referred to as The BIM Brief, is a pre-tender document created by the Client and / or End User setting out the information to be delivered, and the standards and processes to be adopted by the supplier as part of the project delivery process.

EIRs are produced as part of a wider set of documentation for use during procurement of consultants for a project and should typically be issued as part of the employer's requirements or tender documentation. The development of the EIR starts either with the assessment of an existing asset, leading to the development of the employers need, or directly with the employers need if no existing asset or asset information model is to be considered.

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

It should be submitted firstly, **pre-contract** award, to address the issues raised in the EIR and then with more detail **post-contract** award to explain the design team's (supply chain's) methodology for delivering the project using BIM.

The BEP is designed to enable the client to determine if the requirements within the EIR are achievable, allowing for adjustment or negotiation of the supply chain's capabilities if necessary.

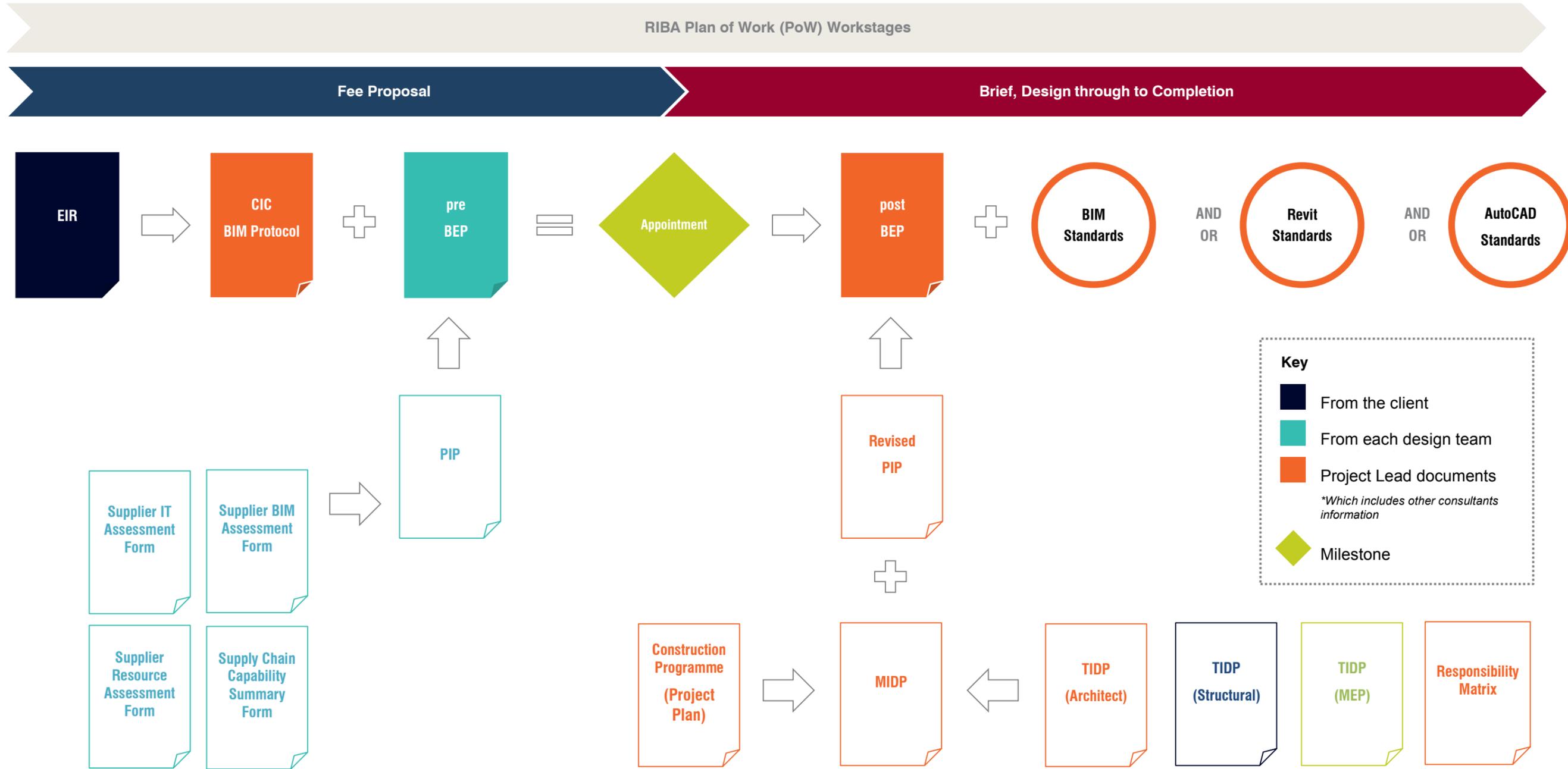
¹⁰ More information on [EIR's can be found here](#) along with guidance on questions that should be included.



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The BEP is submitted by the project lead on behalf of the whole supply chain.

The BIM Document Workflow



In conjunction with the documents, we need to ensure that the project includes the important role of the Information Manager¹¹.



Real World or Hollywood BIM ?

So, does this idealist or “Hollywood BIM” actually happen?

This is where we want to throw some light on the reality of working in this new way to show that it isn't all straightforward just because some documents were written. It's engaging people that makes the difference.

Typically, we receive requests from clients for new projects that go something along the lines of,

“Can we have a BIM Level 2 project?”

We'd respond,

¹¹ More information on these roles can be obtained at the following links:
[Information Manager](#)



“Yes, but what are your requirements? Do you have an EIR?”

“What’s an EIR? What do you mean by ‘requirements’?”, they’d say.

This sort of request is not dissimilar to that of a child,

“Dad, I want sweets.”

“First of all, it’s may I have, and second what kind of sweets would you like? There are many different types.”, he’d reply.

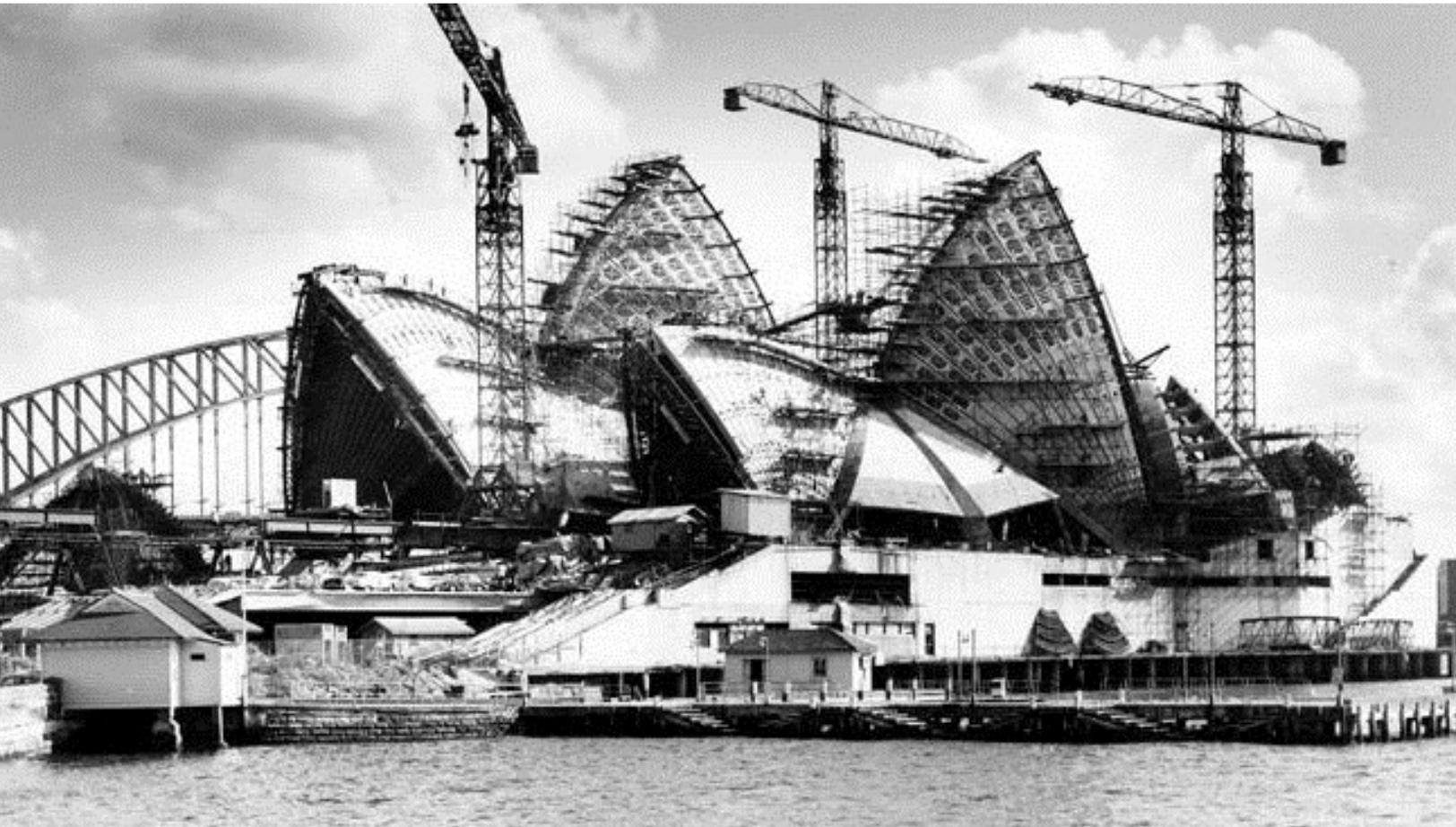
Importantly, this is no different from obtaining a design brief. We are all familiar with landmark buildings around the world that have suffered from not being clearly defined and briefed at the outset and the consequences of this.

Case Study: Sydney Opera House over budget and time

In March 1959 construction commenced on the Sydney Opera House, due to the fact that the government had pushed for work to begin early, fearing that funding, or public opinion, might turn against them. However, the Architect, Jørn Utzon, had still not completed the final designs. Major structural issues still remained unresolved.

By 23 January 1961, work was running 47 weeks behind, mainly because of unexpected difficulties (inclement weather, unexpected difficulty diverting stormwater, construction beginning before proper construction drawings had been prepared, changes of original contract documents). Work on the podium was finally completed in February 1963. The forced early start led to significant later problems, not least of which was the fact that the podium columns were not strong enough to support the roof structure, and had to be re-built.

Other significant design changes included the major hall, which was originally to be a multipurpose opera / concert hall, became solely a concert hall, called the Concert Hall. The minor hall, originally for stage productions only, incorporated opera and ballet functions and was called the Opera Theatre, later renamed the Joan Sutherland Theatre. As a result, the Joan Sutherland Theatre is inadequate to stage large-scale opera and ballet. A theatre, a cinema and



a library were also added. These were later changed to two live drama theatres and a smaller theatre "in the round". These now comprise the Drama Theatre, the Playhouse and the Studio respectively. These changes were primarily because of inadequacies in the original competition brief, which did not make it adequately clear how the Opera House was to be used. The layout of the interiors was changed, and the stage machinery, already designed and fitted inside the major hall, was pulled out and largely thrown away, as detailed in the 1968 BBC TV documentary *Autopsy on a Dream*, which "chronicles the full spectrum of controversy surrounding the construction of the Sydney Opera House"

All in all the Opera House was formally completed in 1973, having cost \$102 million. The original cost and scheduling estimates in 1957 projected a cost of £3,500,000 (\$7 million) and completion date of January 1963 (Australia Day).



In actuality, the project was completed ten years late and 1,457% over budget in real terms.

The Importance of Briefing

It is imperative therefore that an EIR or “BIM Brief”, as we like to refer to it, be created as this is part of a wider set of documents that aim to clarify the project's aims, and aid the delivery team in producing the correct information to the correct people at the correct time. Without it, we can never hope to “change the dynamics and behaviours of the construction supply chain, unlocking new, more efficient and collaborative ways of working¹²”

Ultimately with this kind of vague "BIM Level 2" client request we often have to sit down with the client and run through a series of plain language questions or a blank EIR document to get the answers we require to start formulating a plan.

We have examples from our own personal experience where we can highlight the importance of this work. We have noted two of these below for your information and to show the benefit of sitting with your client and educating them in these new ways of working, so that they can understand what may or may not be important to them. It is also apparent that not every single part of a BIM Level 2 project might be appropriate for that particular organisation.

Example 1: UK wide construction firm appointed to education projects

A well-known, major contracting firm, won the bid to build a group of schools under the Priority School Building Programme (PSBP). The details of the batch are unimportant other than to say there a handful of schools to be delivered within the contract.

It would make sense that efficiencies are realised when designing and constructing the schools, which may include off-site pre-fabrication and digital prototyping to get the most efficient design for all schools, or indeed use of the information created for asset management. However, it is highly unlikely the latter is something deemed important due to the way these buildings are managed after occupation.

¹² <http://www.bimtaskgroup.org/> 26/10/2016



It was therefore a surprise to find myself engaged in the following conversation with the project Architect;

“We’ve been asked to deliver these to BIM Level 2, can we do that?”, said the Architect
“What does the client require from us? Have they defined their requirements and goals?”
“Yes, they want BIM Level 2...”

Skip forward a few days, where I was invited to attend a meeting with the whole design team and the contractor (our client). A very similar conversation as I had with the Architect occurred. But what transpired was that the client hadn’t actually asked for BIM Level 2 per-se, but that contractor, to win the project, offered it without fully understanding whether the client would need a full BIM Level 2 project or not.

Now it is clear that actually they might well benefit from a full BIM Level 2 project, but this hadn’t been ascertained and therefore our costs may have been too low, adding unnecessary risk in terms of whether we could resource the project correctly along with the fact that we could be handing over insufficient or incomplete information at key stages of the project, therefore failing to meet the end-clients expectations.

Example 2: “Dave, this new project is a Revit project”

“...Great stuff, but just before we start modelling can I have a look at the contract or scope of services? Oh it says BIM Level 2 here that’s not Revit.”

"Oh....well that’s what the client has asked for; a Revit project"

So similar to the above you are now trying to gauge just how much the client is expecting before you go back and mention a set of deliverables and processes that have not been considered. We had this situation in the early days, I guess many have, as everyone is trying to learn, it’s why clear scope is king. Without clarity the expectation on both sides can then be at opposite ends of the spectrum simply because of a one-line statement.

As it turned out the poker like conversation about client requirement went something like this -

"...so you do want coordination? , Right. I'll raise you some attached data"



"No, we don't need that we just need it coordinated, why would we need anything else?"

We made an office wide policy that any BIM speak in agreements gets passed to myself. We then go back with caveats to RFP / PQQ's BIM requirements asking for clear EIR's and the office awareness is much greater now, most people know their BIM Level 2 from their LOD200's.

The latest request has been for a BIM Level 3, 3D model,

"I don't want BIM Level 2, I want a BIM Level 3 3d model..."

So we smile at these anecdotes just as others smiled at us when we were trying to figure it all out and getting it wrong but with all the jargon, acronyms, lack of standards, industry learning and terminology it is confusing. We deal with this stuff. It's not straightforward, look at any Twitter feed, those in the know discussing the interpretation of this and that often not agreeing so what chance has the lay person got? It's no wonder there is confusion.

The government mandate focuses only on publicly procured projects but we have seen the private sector rapidly adopting this methodology. We are finding RFP's and PQQ's asking a typical set of questions related to standard BIM documentation and requesting proof of being able to deliver this way rather than previously vague and all-encompassing single line BIM deliverable statements of,

"...this project will be BIM Level 2..."

Our Approach to Implementation

It goes without saying there are a number of keys ingredients to achieving a successful BIM project / implementation.

In this section we are going to discuss what these are along with providing evidence from our respective experience that will help give weight to why they should be done, and sometimes what happens when they are not done.

The title of the talk gives an insight into the 4 things that we believe need to be connected or aligned to enable successful change; geometry, data, people and process. What we expect you'll find is that the lynch pin to all of this is people.





Change Management

Change can be the foundation of competitive advantage but, to be effective, a change management programme must identify areas of potential conflict, address the needs of everyone in the organisation and, crucially, bridge the gap between the aspirations of executives, technical project teams and the people affected by the change.

Case Study: Shell transforms its process amid oil reserve crisis¹³

In 2004 Shell was facing an oil reserves crisis that hammered its share price. The situation was compounded by the abrupt departure of the oil group's chairman, Sir Philip Watts. The new group chairman, Jeroen van der Veer, believed that in order to survive, the corporation had to transform its structure and processes.

A series of global, standardised processes were identified. These, if introduced, would impact more than 80 Shell operating units. While the changes were vital to survival, they proved unpopular in the short term as some countries stood to lose market share.

However, for a change programme of this scale to be successful, everyone had to adhere to the new systems and processes. The leadership of Shell Downstream-One, as the transformation was known, needed unflinching determination and to focus on gaining adoption from everyone involved.

Those leading the change had to ensure that the major players in all their markets knew what was required and why. They needed to be aligned with the change requirement. From the start, it was recognised that mandating the changes was the only way for them to drive the transformational growth they aimed for. This wasn't an opt-in situation.

The main message of the change team, led by van der Veer, was that simpler, standard processes across all countries and regions that benefited Shell globally trumped local, individual needs. That meant everything from common invoicing and finance systems to bigger more centralised distribution networks. By identifying and rapidly addressing the many areas of

¹³ Extract from the 5 greatest examples of change management in business history article, Chartered Management Institute



resistance that emerged – such as that some influential stakeholders stood to lose control or market share – adoption was accelerated.

The team of experts – made up of senior leaders, in-house subject matter experts, implementation consultants and external change experts – who delivered the change programme were crucial in this phase. They'd been picked because they had both technical understanding and could provide change leadership. They both modelled and drove the new behaviours needed for the change to succeed. They briefed the people who would be impacted by the change; risks and potential problem areas were discussed and mitigated – before any real change was even delivered.

In all major change programmes, there's always the danger that change management gets delegated; leaders distance themselves from the challenge of implementing the priorities they once championed. That can cause the initiatives to fail. In Shell's case, however, the change leadership started and finished with Jeroen van der Veer, who never drew back from emphasising how important full implementation of Downstream-One would be.

Shell is in a significantly healthier position than when the transformation started, and by that measure the programme has been deemed a success. And the ramifications of Downstream-One continue to result in ongoing change...

For us this demonstrates the importance of having senior management buy in. It seems obvious to say it, but without this key piece of the jigsaw any change to working practices will more than likely fail.

We have experienced this to a degree previously and know all too well the pains of struggling to connect with the right people in the organisation.

What we've learned is that engaging senior management at any given opportunity is the best way, whether that's at the coffee van, at a staff event or via more formal routes such as email or a meeting, always be prepared to give a snippet of what you are working on, or need help with. Little and often is the best route. It means you have a chance of saying something of worth to a



time poor person. You'll be surprised how responsive people can be even if they only give you two minutes of their time.

Organisational change initiatives fail at an alarming rate. To successfully implement change initiatives, leaders must identify the need for it and communicate this throughout the business.

It is imperative that those leading change engage people at all levels of the organization by involving them in the design of the implementation strategy. By actively do so the people most affected by the change will help ensure employees at all levels embrace the proposed changes.

It goes without saying whenever an organisation imposes new things on people there will be difficulties. Participation, involvement and open, early, full communication are the important factors.

Management need to be able to tell a compelling change story that motivate employees. Before you get buy-in, people need to feel the problem. People aren't going to consider anything until they are convinced there is a problem that truly needs to be addressed.¹⁴

If there is one thing that we have learnt it is that forcing change is not economical, viable, or productive. You should ensure that you create working groups and pilot projects to test new ideas and encourage the team delivering the project to give feedback on the new process or policy so that they feel they have "designed it". This way not only will they want to use it in the future, but they will become your supporters when others "question" the new way of working.

Case Study: Perkins+Will London, Change Management Plan (December 2014)

Position

- Rapidly expanding office following acquisition.
- Historically a Corporate Interior and Architectural Design office but expansion to Healthcare, City&Sites, Hospitality and Workplace over recent years
- Designers used 3D tools like Rhino / SketchUP for design but for project delivery they were predominantly a 2D Architectural AutoCAD office.
- Clients quoting requests for BIM Level 2 deliverables

¹⁴ Successful change management involves the employees — <http://www.torbenrick.eu/t/r/xc>



The initial aim was to convert to model based project delivery methods.

Approach

Create and present implementation plan to Leadership. This was high level and included really only why & how.

Why

- To allow us to collaborate with our partner P+W offices and our extended design teams.
- A an ever increasing percentage of PQQ's will request BIM.
- Not being able to work this way may mean we cannot tender for certain projects both internally and externally.

But... Not just because we have to. Because we want to.

Solve client's problems and work more as a team - collaborate with models. Work faster, giving, more time for design = better design

However, it's a fundamental change; one, everyone reading this will be aware of.

How

- Identify key individuals.
- Train - keep it consistent, make it accessible, have it in a variety of formats.
- Plan ongoing project support.
- Review how project will be resourced. Consistent Teams / Resourcing
- Set Targets, Benchmark progress. Monitoring staff progress against industry standard measures and seeing improvement
- Constantly search for new ways to engage people.
- Get others to help spread your message
- Have many hats... Policeman/Counsellor/Teacher/Cheerleader/Firefighter
- Bribe people



I will expand on some of key “How” aspects from above that creating this change involved.

Identify Key Individuals (Design Tech Leaders – DTL’s)

As go to people and local subject matter experts in the tools being promoted. It quickly became apparent that the absolute best user does not always make to be this person. Personality and enthusiasm are key factors along with having patience and being approachable. These guys are great asset and I try to include and promote them as much as I can. Part of their job is also to identify the next go-to’s that they train up. These guys have a recognized title within the office but they are 90% project chargeable. It can be difficult getting agreement from project leaders to allow them to invest time into streamlining process. They are supposed to be 90% chargeable, in reality they are over resourced. We overcome this by physically meeting each week. Away from the view of project leaders. The meeting takes place regardless of workload. We have a running agenda that is generally project focussed and we often cover the same stuff that wasn’t resolved the week before but we aspire to achieve things. Identifying tasks and assigning them is paramount. It is human nature that people will have more time for the things they find interesting.

Project Leader Training

We ran this after the software training. In hindsight it should have run in parallel so that the project runners were not left thinking they are no longer in control of their projects as they didn’t quite know how long things would take, how information is produced, how it is shared and how much less productive their team will be.

Fundamental Training

P+W have a number of training resources and mediums across the firm and adopt a train the trainer approach. Locally we have a consistent syllabus of fundamentals training where staff are given a solid portion of time to attend classroom like sessions to understand the fundamentals of the workflows and tools required to work on their projects. These are run on a just in time basis so that attendees go straight from training into live project work. The classes are run for three days monthly.



Ongoing Training

Each project is assigned a go to person that helps assist with day to day issues. For any non-emergency problems we ask project teams to attend a weekly workshop where questions are brought along, models are opened and collectively the whole team learns by resolving these problems. These workshop are not about design and not about complaining. These have proved valuable by the teams that have used them. Some teams do not want to engage which is a shame but most welcome it. As knowledge grows the meeting can become less frequent. All employees also have access to the full downloadable content from Lynda access to CAD Learning and also a pool of resource via the office company intranet

Project start up training

Projects still seem to somehow slip under the radar, sometimes you bump into somebody ask what they are up to and they complain to say they are working in a 2D environment as their project leader told them to. I am now on the notification list of all new projects so can go armed with a list of questions before any authoring platform is opened. I try to do this by coincidentally bumping into people and asking what they are up to. “any new projects coming up ? oh really ? are you planning on modelling ?”. This has been useful to also monitor what projects we are simply modelling in and those which we call BIM. For those that are collaborative an external project start up meeting is also arranged, to run through a similar process of agreeing the strategy detailed in the BEP. We try hard to be honest so that they expectation is real. At a recent meeting one project partner accepted that their working model involves a design and drafting workflow so there would be a delay in responding via the model. It was good for everyone to understand this as it allowed us to deploy a system of major and minor issues that could be categorised by priority

Resource

Resourcing projects consistently or at least trying to. This has been a big challenge for one sector in particular who like to work with an element of cross project resource. We have proved though that the success or failure working within a BIM environment is not a software issue as initially assumed by some. It's a people issue. Ensuring consistent people are working on projects so that they see the holistic picture and understand how . the project is designed and modelled.



Benchmark and Measure Progress

We are trying to measure our progress to show that we are achieving the goals we are setting and where we aren't we are trying to identify why. We are doing this in a number of ways but the most effective is by talking. Talking to project leaders, project teams and leadership. We use industry wide assessment tools to generate tangible metrics which are great but you cannot solely rely on these. There is also a stigma attached to any assessment with a negative view that it will be associated to a performance review. We have also seen people score very low simply because they couldn't be bothered or were disturbed and ran out of time but we can use this data as proof of our progress and it has been utilised when presenting back to leadership at 6 monthly intervals.

Get others to spread the word.

I found that in the early days I was the one that had to sell the change; "these are the reasons, this is why, look what you can do". . You need to get others to help you. We run a Show+Tell each week where people showcase projects and designs. We have gained a regular slot from a technology perspective where we showcase projects that have used BIM methods or different technology solutions and talk about where the savings came from what the challenges were and how things could have improved. This is not me talking, this is others, working on real projects. These are the advocates you need. It's just more support for your cause but it's now coming from different sources.

New ways to engage people

Trying to engage people is a constant undertaking. At Perkins+Will there is so much happening through Digital Practice firmwide that it is difficult to keep up but I try to pick the applicable topics that fit more with our office requirements. We try to engage people by showing a new workflow, circulating newsletters, meeting with teams, testing some new software, requesting visits from US Digital Practice managers, getting marketing to try a VR headset, running internal tech clubs or computational design sessions, anything that gets people thinking but most importantly gets them talking. All new joiners are welcomed by a Digital practice induction where they are told about the BIM aspirations, where we are looking to head next, what is available to them, how to use various tools and who to contact.



Different Hats

Having a clear understanding of where we need to go is one thing, getting there is quite something else. I was known as the Revit guy or the IT guy even ! As we have said before its more than that. Training people to use a software that authors models is the tip of the iceberg. This is not about working on Revit projects or “Revitting” up cad files. This is about changing process. And you need to put on many different hats when doing so. I wear the teacher hat, the enforcer hat to implement standards, the cheerleader hat , the negotiator hat , the mentor hat, the firefighter hat (that’s always on) and even the counsellor hat (far too many times) to try to keep the momentum going. Its many hats and of course every problem that you face is the most important. Who ever said my problem is less important than the next persons. It can be a balancing act and I have often felt like throwing all the hats out of the window but you must build in your own support structure to help with your own frustrations.

Cultural Change

I did underestimate the scale of the culture change, coupled with other acquisition challenges, rapid staff changes, emerging sectors, I had forgotten the amount of convincing required and you need different approaches for different “tiers” of people.



Leadership are relatively happy with somebody telling them that a new way of working will mean more work and richer outputs. Although it is really important to get approval it is actually quite hard to get leadership support unless somebody at leadership level either makes it their personal mission, has worked this way before or a project goes well, money is made and people are happy. Search out this person buy them lunch they can be your voice at a high level.

The guys on the ground forming the project teams are usually happy with working in a new and exciting way, they are learning they are demanding training, they mostly don't need convincing.



So you end up with a top down and ground up push but in the middle is where you need to work hardest and maybe with good reason. These guys are responsible for hitting targets, they know the process inside out they have delivered job after job in the same way to the same standards, they know their profit margins, they know the timeframes and you are telling them to change all that and go into the unknown. These are the guys to focus your time on, help and support because when they convert they blow the horn and become your biggest advocates.

Support / Help.

I am in a fortunate position to work for a company that has a dedicated Digital Practice team, being part of this is a privilege, what I learn from them is phenomenal and I connect as much with people 5,000 miles away as I do 5 desks away because that's just how they do stuff. What helped me with implementation was having access to tools, content, processes and knowledge that maybe isn't available to everyone. Much info/news can be found online and although I am not a frantic tweeter, the info posted and shared is super valuable. Thanks to #ukbimcrew especially. There are also lots of seminars / conferences / events and groups full of likeminded people trying to find answers to problems that haven't even been solved yet.

It's been frantic, we have had to incorporate different deliverables, we have learnt on projects we have had success and failure, elation and fury but we are getting there we just need to get better at it and make it the common standard.

Finally Bribery.

Yes, plain old bribery. I've found the cost can differ. I needed a budget to get more people attending some workshops or training sessions a deal with operations was negotiated.!

The following is for guidance only - .

- Full time fundamentals training – no cost they are happy to be there.
- You need to run a session at lunchtime on an exciting workflow in say dynamo and want people to show up - some biscuits and decent drinks.
- You need to run a session at on drawing numbering and document control offer - lunch..
- You need to run an after hours “club” with cool topics but want people to meet and engage ? - pizza and beer!

Progress: So what happened (November 2016)



We are well into our implementation, things are going well, like most of you here we have had minor hiccups, major cock ups but we are mostly on track, we have pretty much reached the expected targets but to me, most importantly, we reached tipping point. The point where you only have the luddites in small pockets left reminiscing about 2D drawing tools and everyone else is talking about project collaboration. This was **my** target.

Targets / Benchmarking / ROI's / Assess Skills

Change in any business is difficult, and proving that the change(s) have made a difference can be even harder to quantify. However, it is essential to inform whether your company is achieving the desired results and can highlight when things are not going in the right direction, so you can intervene and put things on the correct trajectory again.

For us, there are a number of areas where targets, benchmarking and ROI's can be implemented to help give feedback to senior management.

Case Study: Scott Brownrigg Training and Assessments

One of the key areas, we have measured what we are doing is around training.

While at Scott Brownrigg, during a typical 12-month period I would have spent around 450 hours dedicated to training and support via workshops by visiting each of the 5 UK offices for one day a month as well as additional ad-hoc workshops by myself and subject matter experts and external consultants.

The workshops would fill knowledge gaps, as well as provide direct support for project teams regarding issues in their Revit files or project management aspects.

An e-learning platform, which has the aim of training new starters in the foundation of using our primary cad tools, alongside our 3 stage induction process compliment the above.

All of this investment needs to prove its worth, and to do so we did two things:

- At commencement of employment, the new starter undertakes a skills gap assessment online.
- This assessment is then repeated / undertaken on an annual basis as part of their Personal Development Review (PDR)



This allows the individual to understand their skills gaps and set goals for personal training for the upcoming 12-month period, but for me as the BIM Lead and the business we can clearly identify within each business unit (studio / office) what the collective skills gaps are and what courses / workshops we need to deliver to assist our staff.

The metrics from the feedback then are able to demonstrate whether we have improved in the year or not.

At a project level we also benchmarked what we did as a business. Again, on an annual basis, I asked Project Directors and other client facing people to feedback on our projects and clients. The main area of questioning revolved around the services we were delivering and what "BIM Level" we were achieving on projects.

Both data streams were used in a number of ways, e.g. understanding if investment was required in new technology or people, but primarily it gave me a way to report to senior management what our capability was and prove that all the hard work behind the scenes was enabling us to meet and in many instances exceed client expectations, where we could add value to our service delivery.

Case Study - Broadway Malyan Resourcing

At my current company they have learned their lesson by getting their fingers burnt on one of their first BIM projects. As this occurred before I joined I cannot be 100% accurate with the exact figures, but we estimate that the team for this project has seen around 80 people come and go. Needless to say the project did not go well, and while nearing completion, has given many opportunities to reflect and learn from our mistakes

How we Aligned with the Requirements ?

Integrating with project team to understand BIM requirements

As we are discovering there are many things that will lead to successful delivery of a BIM project, however one of the biggest factors is having an adequately completed EIR and BEP.

In our experience these items are in the main either never completed, done after the project has been given the green light or often drafted, issued and ignored.

For us, the only way to overcome these issues is to ensure that the EIR and BEP are complete at the correct stages in the project lifecycle.

We do recognise that some clients do not understand the intricacies of BIM or indeed the way Architects and other professionals work, and therefore struggle to grasp the idea that completing a BIM brief early doors is actually beneficial.

We would always try to setup a meeting in these instances with the person in charge of the project in our office, the client, and any other people who have an interested in delivering the building / structure.

By doing so we can explain, in laymen's terms, what needs to be understood and get the answers to some of the most important questions (outlined above). All of which helps manage expectations and engages the extended supply chain, who then feel empowered and deliver the desired results.

Project Setup

BIM Kick of Meetings (KoM) should be set-up at the start of a project and relevant representatives of external project team consultants should be invited to attend. There will be two of these, one internal the other external but the primary purposes of both are as follows:

- Define and communicate BEP and agree protocols for sharing drawings and models
- Discuss and review the chosen technology for the project e.g. Revit?



- Discuss the strategy for the creation and management of information as the project develops and add detail to the BEP

Regular strategy review meetings should be conducted throughout the project, preferably prior to each stage of work.

In reality the external meetings do not happen regularly enough but we are finding that we are able to get the internal meetings to take place regularly with the project team as they often give the team an opportunity to ask questions and share ideas.

Standard Methods and Procedures: Common Data Environment (CDE)

“The Common Data Environment (CDE) is a digital place in which the information comes together. With vast amounts of digital data being created and shared during a project’s lifecycle, the CDE becomes an ideal environment in which to promote a collaborative working culture.

It should be the foundation from which you facilitate, manage and disseminate data and project information between multi-disciplined teams in a managed process throughout the project lifecycle.

The CDE is not just a place to share geometric information. Other information such as registers, schedules, contracts, reports and model information is all shared, building on the concept of a “federated” model by bringing everyone’s information together in a virtual space.

Establishing a digital tool to manage the CDE should be a priority within your organisation. It could take the form of a project server, an extranet or a file-based retrieval system, but the thing to note is that it is digital.

Document and data management systems solutions range in price and functionality. While some file management systems such as DropBox offer a “freemium” service, they may not be PAS 1192:2 and BS 1192 compliant. Other CDE solutions may include features such as document control, instant messaging and the ability to mark up and review model files directly within the CDE.” (Mordue, n.d.)



Between us, we have encountered and used numerous software that can be used in part or wholly as the CDE, with the main requirement being to provide as many of the features and functions as possible under one roof, and then supplementing it with additional platforms that pick up the remaining pieces.

Previously we have used systems such as Newforma, Union Square, Oasys Columbus, Archetype and Rapport. Each have their benefits and disadvantages, but the best of them helped us store all documents, models, drawings, images, emails in one central repository against the relevant projects, contacts & organisations as well as capturing all fees, invoices, time, expenses and disbursements, alongside forecast and budget information to give clear visibility of how individual projects are performing. They make it easy to capture, store and retrieve business information with a clear audit trail and help embed our standard methods and procedures by setting standard data storage structures, and policing drawing numbering standards.

It is worth noting that while there should be a CDE for internal management of project information, there will also be an external one.

As defined in PAS 1192-2:2013 the CDE should be a single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multi-disciplinary teams. Essentially a place where all project stakeholders can publish and view relevant models or other files / documents which pertain to the project and its current stage.

This can add complication as many software vendors do not have open dialog enabling them to “connect” the information silos (internal and external). Therefore, we find that there can be duplication of process / information when issuing information.

It would be great to think that by using a product that is “open” to other team members this would solve some of the above, however there is a nervousness that individual companies do not want to take contractual responsibility for the safety and accuracy of the information stored. This is a real stumbling block and one we feel can only be resolved over time, and using the ideas laid out in the Latham, Egan and GCS reports; move away from an adversarial structure,



adopting a more integrated approach with greater partnering and teamwork, where risk allocation to the party best able to manage, estimate and carry it

But even with all these tools in place it's still quite hard to get project teams to follow the standards that have been set out. Teams are happy to create a WIP folder and use as a dumping ground that from dawn till dusk.

Fields	Directories (see 5.4.2)	Files (see 5.4.3)	Containers within files including layers (see 5.4.4)	Clause
Project	PR1	PR1		6
Originator		XYZ		7
$\langle A_1 \rangle$ Volume or system $\langle A_1 \rangle$		$\langle A_2 \rangle$ 01 $\langle A_2 \rangle$		8.1.2
Levels and locations		01		8.1.3
Type		M3		9
Role		A	A	10
Classification		$\langle A_1 \rangle$ Uniclass $\langle A_1 \rangle$ (optional)	$\langle A_1 \rangle$ Uniclass $\langle A_1 \rangle$	11
Presentation			M	12
Number		0001		13
Description (optional)			Doors	14
Suitability (optional)	S1	S1		15.2.2
Revision (optional)	$\langle A_1 \rangle$ P02 $\langle A_1 \rangle$	$\langle A_1 \rangle$ P02 $\langle A_1 \rangle$		15.2.3
Name	PR1-S1-P2		A- $\langle A_1 \rangle$ Uniclass $\langle A_1 \rangle$ -M_Doors	

Naming Standards

Question; who went to design school to worry about file naming and folder structure?

Nobody right.

However, many people do worry about it and the fight for who's standard is better is one that has long raged in many a design office.



BS1192 introduces the key concepts to standard naming conventions, managing version control / suitability status and how to work collaboratively.

It provides a consistent container naming convention that can be used by all project partners across a project.

The following briefly describes how this system works¹⁵.

We will break it down to further describe how this beast of a number is put together.

Document and Model Naming Convention

Project (3)	Author (3)	Zone (2)	Level (2)	Type (2)	Role (1)	Number (4)
PRJ	PWA	Z1	ZZ	M3	A	0001

Project Code

This field indicates the Project Code (3 Characters)

Originator

This field is defined by the name of the organisation authoring the document (3 Characters)

Zone

This field is defined by the building zone (2 Characters)

Level

This field is defined by the building level (floor) (2 Characters)

¹⁵ Images are all extracts from the BS 1192:2007+A2:2016.



Document Type

This field is defined by type of document to aid recognition (2 Characters)

<i>Code</i>	<i>File Type</i>
AF	Animation file (of a model)
CM	Combined model (combined multidiscipline model)
CR	Specific for the clash process
DR	2D drawing
M2	2D model file
M3	3D model file
MR	Model rendition file for other renditions, e.g thermal analysis etc.
VS	Visualization file (of a model)

<i>Code</i>	<i>File Type</i>
BQ	Bill of quantities
CA	Calculations
CO	Correspondence
CP	Cost plan
DB	Database
FN	File note
HS	Health and safety
IE	Information exchange file
MI	Minutes / action notes
MS	Method statement
PP	Presentation
PR	Programme
RD	Room data sheet
RI	Request for information
RP	Report
SA	Schedule of accommodation
SH	Schedule
SN	Snagging list
SP	Specification
SU	Survey 



Role

This field is defined by role of the originator/author responsible for creating the document (1 Character)

Number

This field is defined by a four-digit number managed in your organisation's own policy. This number shall be unique regardless of subsequent identifiers.

Revision

Revising must also be in accordance with BS1192:2007+A2:2016. The revision field is in the form of Xnn.nn where n represents a number.

When the information is identified as WIP as defined in the CDE the number on the right of the decimal point is increased by 1 after each revision.

Eg - P01.01, P01.02, P01.03, P01.04 etc

When the information is ready to be shared, published or archived, the number on the left-hand side of the decimal point is increased by 1 and the number on the right-hand side (representing the WIP status) returns to .00 again.

For example, the above revision code of P01.04 which becomes suitable as "Shared" information via the CDE would then have a revision of P02.00

Status Code

BS1192:2007+A2:2016. Identifies the use of a suitability field to indicate to all project stakeholders with clarity what the information is suitable for.



Status	Description	Revision	Graphical Data	Non-Graphical Data	Documents
Work in Progress					
S0	Initial status or WIP Master document index of file identifiers uploaded into the extranet.	P01.01 etc to P0n.01 etc	✓	✓	✓
Shared (Non-Contractual)					
S1	Suitable for Co-ordination The file is available to be 'shared' and used by other disciplines as a background for their information.	P01.01 to P0n.01	✓	✗	✗
S2	Suitable for Information	P01 to Pn ∞	✗	✓	✓
S3	Suitable for Review & Comment	P01 to Pn ∞	As required	✓	✓
S4	Suitable for Stage Approval	P01 to Pn ∞	✗	✗	✓
S5	Suitable for Manufacture	P01 to Pn ∞	✓	✓	✓
S6	Suitable for PIM Authorization (Information Exchanges 1-3)	P01 to Pn ∞	✗	✗	✓
S7	Suitable for AIM Authorization (Information Exchange 6)	P01 to Pn ∞	✗	✗	✓
WIP to Published Unauthorized and (Non-contractual) use at risk.					
D1	Suitable for Costing	P01.1 etc to Pn.1 etc	✓	✓	✓
D2	Suitable for Tender	P01.1 etc to Pn.1 etc	✗	✓	✓
D3	Suitable for Contractor Design	P01.1 etc to Pn.1 etc	✓	✓	✓
D4	Suitable for Manufacture/Procurement	P01.1 etc to Pn.1 etc	✗	✓	✓
Published Documentation (Contractual)					
A1, A2, A3, An etc	Approved and accepted as stage complete (C= Contractual/Complete)	C01 to C0n	✓	✓	✓
B1, B2, B3, Bn etc	Partially signed-off: with minor comments from the Client. All minor comments should be indicated by the insertion of a cloud and a statement of 'in abeyance' until the comment is resolved, then resubmitted for full authorization.	P01.01 etc to P0n.0n etc	✓	✓	✓
Published for AIM Acceptance					
CR	As Construction Record documentation, PDF, Models etc	C01 to C0n	✓	✓	✓

The table below gives an example the document and model naming conventions that may be used

Document

Project (3)	Author (3)	Zone (2)	Level (2)	Type (2)	Role (1)	Number (4)
PRJ	PWA	Z1	04	DR	A	1101



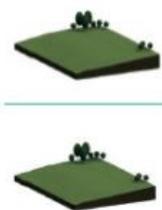
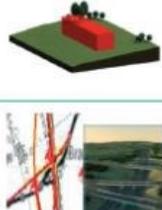
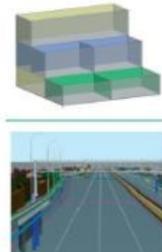
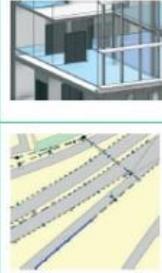
Model

Project (3)	Author (3)	Zone (2)	Level (2)	Type (2)	Role (1)	Number (4)
PRJ	PWA	Z1	ZZ	M3	A	0001

Are you still there? As you can see this is a long Revit sheet number. It's complex and not very intuitive and causes problems with authoring tools and EDMS that are not yet able to accommodate this format.

Colleagues look at you in disgust when you say
“you know drawing A101, its now XXX-PWA-ZZ-04-DR-A-1101... is that ok?”,

but it passes, people get used to it. The key really, in our experience, is to implement a DMS that can police the standards. That way there is no argument about how we name things, it just gets done.

Model Name : Generic	1 Brief	2 Concept	3 Definition	4 Design	5 Build & Commission	6 Handover & Closeout	7 Operation & End of Life
System(s) to be covered	N/A	All	All	All	All	All	All
Graphical illustration							
Certainty / Purpose	Project brief and procurement strategy	Refined project brief and concept approval. Design contingency of 20-25%	Approval of coordinated developed design. Design contingency of 10-15%	Integrated production information. Complete fabrication and manufacturing details, systems and element verification, including commissioning, operation and maintenance information Design contingency of 5-10%	Construction progress and integrated production information updated as appropriate Commissioning and performance data	As constructed systems, operation and maintenance information. Building Log Book. Information gathered as key elements are completed to feed installation information for the later packages.	Agreed final account in use performance compared against Project Brief Project process feedback: Risk, procurement, information, management, soft landings.

LoD, LomD and Lol Explained

Level of Definition (LoD) is the collective term used for and including, Level of model Detail (LomD) and the Level of Information detail (Lol). LomD is the description of graphical content of models at each of the stages; the Lol is the description of non-graphical content of models at each of the stages defined in the CIC Scope of Services.

The level of detail of a building information model increases as the project proceeds, often based in the first instance on existing information, then developing from a simple model through to a detailed virtual construction model, then an as-constructed asset information model (AIM). Different aspects of the model may develop at different rates, may originate with different members of the project team, and their development may pass from the employer, to consultants, to the contractor and suppliers and ultimately back to the employer.



It is important therefore that the employer defines the level of detail that is required at each stage of development of the project. This not only ensures that the design is developing in sufficient detail, but also that the information required by the client to make decisions about the project development and then to operate the completed project efficiently, is actually provided. It also gives an indication of the reliance that can be placed on information.

The employer should define the level of detail that is required in the Employer's Information Requirements (EIR).

The levels of model detail and model information are generally defined for key stages of the project, allowing the employer to verify that project information is consistent with their requirements and enabling them to decide whether to proceed to the next stage. This is analogous to a stage report on a conventional project.

As present, there is no standardised definition for the timing of data drops or for levels of model detail and model information, other than the suggestion that they should be aligned to employer decision points:

- Brief: If a graphical model exists it is likely to have been developed from an existing asset information model. Other information might relate to existing buildings and structures (there may also be schedules of requirements).
- Concept: The graphical design may show massing diagrams and 2D symbols to represent generic elements.
- Definition: Objects are based on generic representations, and specifications and attributes allow the selection of products.
- Design: Objects are represented in 3D with the specification attached along with information about space allocation for operation, access, maintenance, installation and replacement.
- Build and commission: Generic objects are replaced with manufacturers objects, with essential information re-linked to the replacement objects and manufacturer information added.
- Handover and close-out: The model represents the as-constructed project and all necessary information is included in handover documentation, including maintenance and operation documentation, commissioning records, health and safety requirements and so on.



- Operation and in-use: Performance is verified against the Employer's Information Requirements and the project brief and if changes are necessary, the model is updated. Information about maintenance, replacement dates, and so on may be added.

The **NBS BIM toolkit**, developed following a government competition can be used to help define information requirements for projects aligned to specific project stages.

The American Institute of Architects (AIA) has also published a LOD framework for the AIA G202-2013 Building Information Modelling Protocol Form.

The biggest issue we have seen here is mainly two fold. One is that people seem to like to interchange the UK standard for the US and vice-versa with no real explanation. This is even more confusing as neither LOD references actually align. (AIA LOD 300 is actually the equivalent LOD 4). It is important to remain consistent with the standard chosen. Two, is that not all elements will be developed at the same rate s each other, or indeed with the same level of detail as there is information. Therefore, it is imperative in our eyes that any MPDT should outline what will be delivered and when to a component level. Thus clarifying exactly what the client, and other design team members, can expect to receive at key stages throughout the project.



Classification of work

Not the most riveting of subjects and often quite confusing.

Classification systems are tiered systems that attempt to provide a unique number for everything that needs to be described in the building process.

Stateside there is Omniclass and in the UK there is Uniclass. There is unfortunately no International Standard yet.

As part of the BIM Level 2 mandate the government procured a new classification system (Uniclass2015) developed by the NBS as part of the BIM Toolkit.

Uniclass 2015 provides:

- A unified classification system for the construction industry. For the first time, buildings, landscape and infrastructure can be classified under one unified scheme.
- A hierarchical suite of tables that support classification from a university campus or road network to a floor tile or kerb unit.
- A numbering system that is flexible enough to accommodate future classification requirements.
- A system compliant with ISO 12006-2 that is mapped to NRM1 and supports mapping to other classification systems in the future.
- A classification system that will be maintained and updated by NBS.

A 'digital-first approach' where the classification is in a central database and accessible through an intuitive user interface or web services.

The Uniclass tables are broken down as follows:

- Complexes – the overall project such as a university campus.
- Entities/Facilities – such as a building.
- Spaces / locations – such as a space in a building where an activity takes place.
- Activities - the activities to be carried out in the complex, entity or space.
- Elements - the main components of a structure or a building such as walls or roof.
- Systems – a collection of components that make an element, such as the components of a roof.



- Products – the products that are used to construct a system.

Codes within the classification system consists of four or five pairs of characters.

- Table.
- Group.
- Sub-group.
- Section.
- (Object)

SS_25_10_30_35 – Gypsum board partition systems

BIM Interoperability Tools

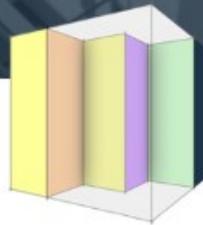
Free add-ins for Autodesk Revit® to help architects, engineers, contractors and owners with their Building Information Modeling (BIM) workflows.



Autodesk
**Model
Checker**
for Revit



Autodesk
**Model
Checker
Configurator**
for Revit



Autodesk
**COBie
Extension**
for Revit



Autodesk
**Classification
Manager**
for Revit



Autodesk have provided a suite of BIM Interoperability tools that aim to align with BIM Level 2 requirements¹⁶.

One of these is the classification manager Add In. This allows us to quickly assign multiple classifications to model elements collectively to help organize and manage project data.

As we move our teams over to this classification system we found a super handy search tool that NBS have available on their website. This has stopped the issue of having to look up Uniclass Tables.

<https://toolkit.thenbs.com/articles/classification/>

VIEW AND DOWNLOAD THE CLASSIFICATION TABLES

Search Uniclass2015: Filter by:

Results 1 to 10 of 41

Code	Title
Ss_25_20	Wall cladding systems
Ss_25_20_08	Board cladding systems
Ss_25_20_14	Composite panel cladding systems
Ss_25_20_14_52	Metal composite panel cladding systems
Ss_25_20_14_55	Metal semi-composite panel cladding systems
Ss_25_20_15	Concrete cladding systems
Ss_25_20_15_16	Concrete panel cladding systems

Digital Coordination

¹⁶ <http://www.biminteroperabilitytools.com/>



Introducing digital coordination workflows into our London office were pivotal in our move to becoming a model based office. One particular project team were struggling when they first began working this way, so much so that a meeting was called to discuss the “move back to AutoCAD”. Fortunately it did not happen the project is the most complex in the office and through blood sweat and tears has become a showcase to others. The same reluctance came from our design team partners but having presented to the client the basic benefits of BIM they were naturally interested in coordinated information but we needed to engage design leaders.

This is how we went about this engagement.

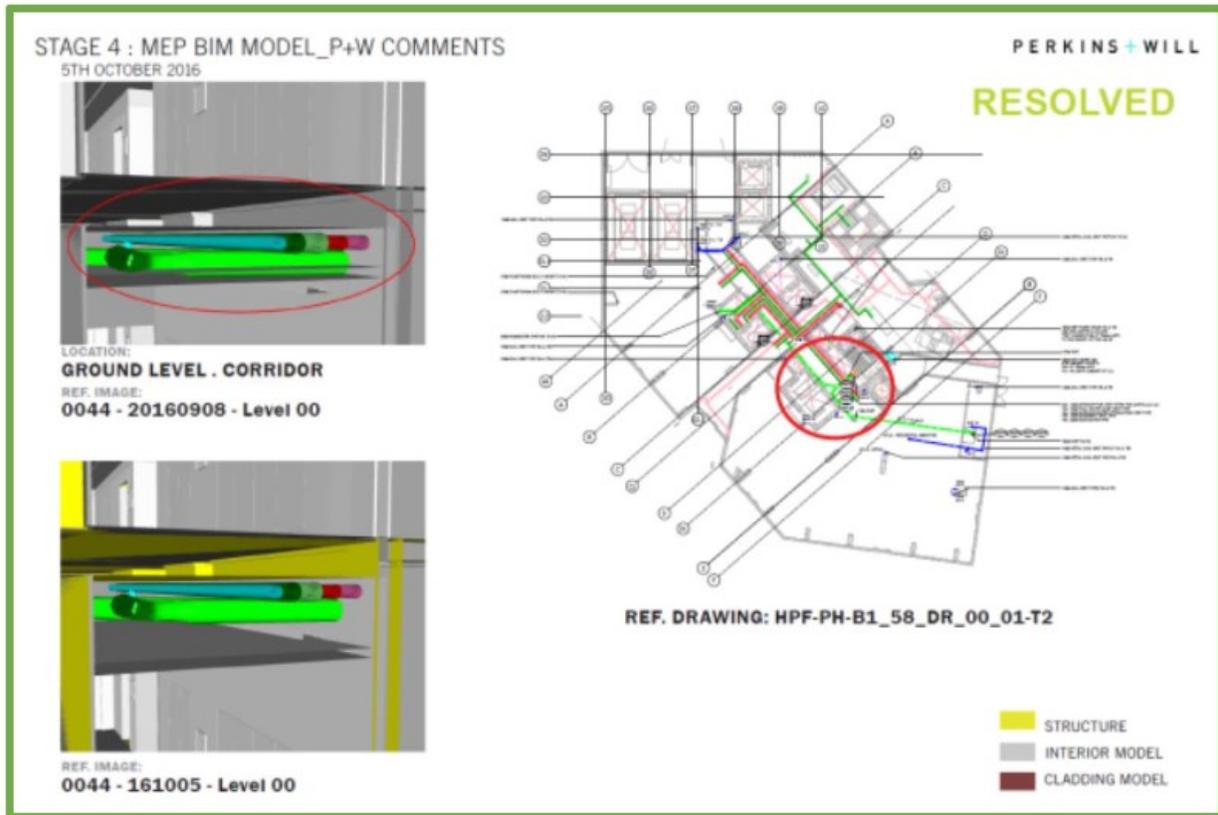
We arranged the first early Stage 3 workshop in accordance with our BEP , there was an instant air of defensiveness between the design partners and we spent the first 20 minutes assuring everybody that this was anything but a finger pointing exercise.

- We are in this together
- the client is not here
- we don't care who's fault it is.

Initially all we were trying to do was get the team engaged in looking at a 3D model rather than pieces of paper.

The first few meeting were continued this way while trying to encourage the design Arch's to begin navigating the models, highlighting the issues and suggesting resolutions.

We worked on the premise of informal reports being simply generated from the models and actions/resolution responsibilities recorded. These would be reviewed at the start of the preceding meeting.



Quickly it just became the norm and the same project used these workflows through Stage 3, bi-weekly then weekly during Stage 4 to help drive the coordination. Towards the end of Stage 4 the client also became involved and decisions were made instantly within the room.

The collective team say this process has been invaluable,

IFC

IFC is an industry-wide open and neutral data format that is fast becoming the de-facto standard for rich data exchange. Essentially speaking, IFC provides the 'guidelines' or 'rules' to determine what information is exchanged. Although it may include geometry, it is not limited to this; it presents tangible building components such as walls and doors and also enables the linking of alphanumeric information (properties, quantities, classification, etc.) to building objects and maintaining these relationships.

Although IFC is known as the Open format for information exchange we have both experienced difficulties when receiving IFC files from outside parties. We have had issues with missing



geometry, incorrect coordinates , non changeable materials and triangulation of surfaces. We have worked hard to resolve these with our design partners but we feel that the process needs to be made simpler. We still don't see this open platform as fully open because it would seem that the vendors continue to not communicate or have minimal investment added into the development of IFC.

COBie

As we mentioned previously the only additional deliverable to full BIM Level 2 is the introduction of a Construction (to) Operations Building information exchange format (COBie) or data exchange.

This means taking information that has been used for construction purposes, formatting it in a consistent way and then using (or exchanging) it for operations purposes.

Bill East the inventor of COBie clarifies further,

"The sole focus of COBie is the capture of assets that need to be managed following construction."

"COBie should include 'Managed' assets. Managed assets are those assets which;

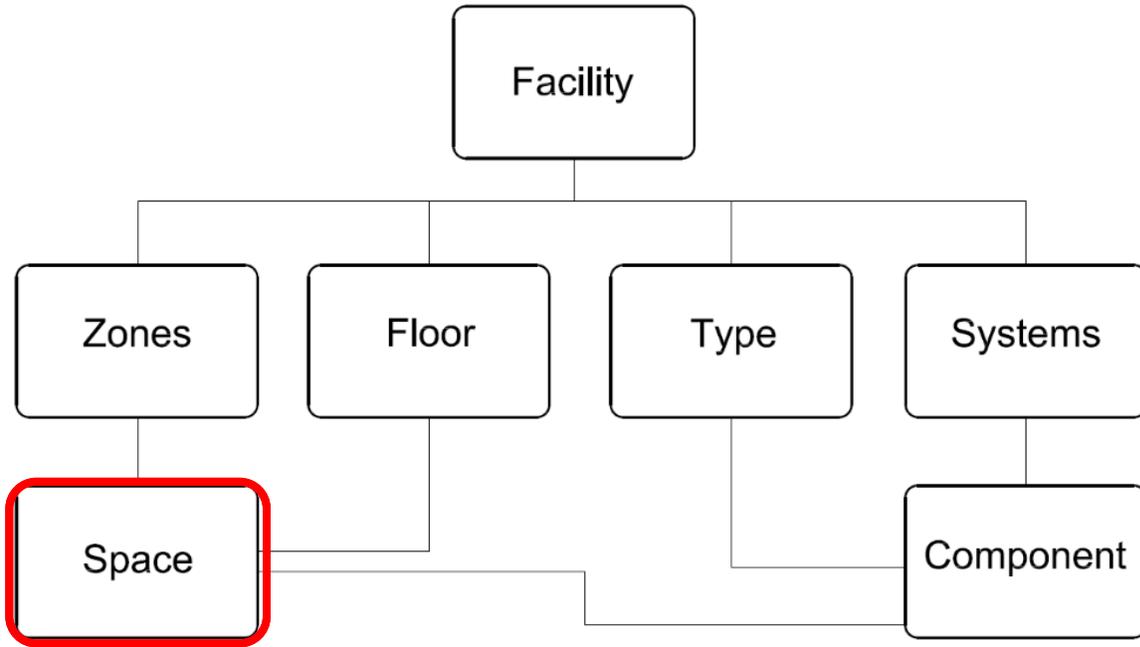
- requires management
- requires (considerable) on-going maintenance
- has consumable parts requires regular periodic inspections"

In short COBie allows us to provide the part of "with information attached" from the BIM Level 2 deliverable.

COBie UK 2012 has become the recognised method of achieving this.

In essence COBie is delivered via an Excel spreadsheet broken down into Worksheets based around the extract diagram taken from BS1192-4:2014 (Table 4)

Building View of COBie using generic terms.



COBie “space” output example.



	A	B	C	D	E	F	G	H	I	J	K	L	M
	Name	CreatedBy	CreatedOn	Category	FloorName	Description	ExtSystem	ExtObject	ExtIdentifier	RoomTag	UsableHeight	GrossArea	NetArea
2	CORRIDOR_LB-192	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	B1 C-FFL	CORRIDOR	Autodesk Revit	Rooms	ac611781	LB-192	2940	217.4581	217.4581
3	MTG ROOM_04-024	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-024	2715	31.4573	31.4573
4	MTG ROOM_04-025	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-025	2715	15.51	15.51
5	MTG ROOM_04-022	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-022	2715	15.7042	15.7042
6	MTG ROOM_04-026	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-026	2715	15.789	15.789
7	OPEN MTG_04-164	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	OPEN MTG	Autodesk Revit	Rooms	bb8291c1	04-164	2715	8.1344	8.1344
8	BREAKOUT_04-163	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-163	2715	8.4682	8.4682
9	BREAKOUT_04-161	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-161	2715	8.4345	8.4345
10	OPEN MTG_04-160	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	OPEN MTG	Autodesk Revit	Rooms	bb8291c1	04-160	2715	8.0937	8.0937
11	BREAKOUT_04-165	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-165	2715	5.3382	5.3382
12	BREAKOUT_04-159	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-159	2715	5.34	5.34
13	MTG ROOM_04-158	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-158	2715	8.2118	8.2118
14	MTG ROOM_04-177	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-177	2715	8.2862	8.2862
15	MTG ROOM_04-176	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-176	2715	8.126	8.126
16	OPEN MTG_04-174	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	OPEN MTG	Autodesk Revit	Rooms	bb8291c1	04-174	2715	8.0779	8.0779
17	BREAKOUT_04-173	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-173	2715	8.4846	8.4846
18	BREAKOUT_04-171	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-171	2715	8.4632	8.4632
19	OPEN MTG_04-170	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	OPEN MTG	Autodesk Revit	Rooms	bb8291c1	04-170	2715	8.1312	8.1312
20	BREAKOUT_04-175	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-175	2715	5.2469	5.2469
21	BREAKOUT_04-169	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	BREAKOUT	Autodesk Revit	Rooms	bb8291c1	04-169	2715	5.1999	5.1999
22	MTG ROOM_04-168	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-168	2715	8.2979	8.2979
23	MTG ROOM_04-167	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-167	2715	8.3608	8.3608
24	MTG ROOM_04-166	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-166	2715	8.3094	8.3094
25	OFFICE_04-044	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	OFFICE	Autodesk Revit	Rooms	bb8291c1	04-044	2715	15.7039	15.7039
26	MTG ROOM_04-045	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-045	2715	31.4564	31.4564
27	MTG ROOM_04-047	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	MTG ROOM	Autodesk Revit	Rooms	bb8291c1	04-047	2715	15.5203	15.5203
28	OFFICE_04-048	david.sewell@perkinsw	2016-10-24T05:30:4	n/a	04 C-FFL	OFFICE	Autodesk Revit	Rooms	bb8291c1	04-048	2715	16.9924	16.9924

Again we can look at <http://www.biminteroperabilitytools.com/> to enable us to extract COBie-2012 UK compliant information directly from our authoring models. There are also other methods of creating COBie via IFC subsets. If you refer back to the EIR requirements of a typical project it will be the contractor responsibility to ensure that the bulk of COBie information exists.

BIM Interoperability Tools

Free add-ins for Autodesk Revit® to help architects, engineers, contractors and owners with their Building Information Modeling (BIM) workflows.

- Autodesk **Model Checker** for Revit
- Autodesk **Model Checker Configurator** for Revit
- Autodesk **COBie Extension** for Revit
- Autodesk **Classification Manager** for Revit



Nobody likes the idea of producing COBie. It is seen as a painful process and its validity is always questioned. Although its delivery is in the form of an excel spreadsheet, COBie should not be populated manually. Using the tools to export to COBie is really the first step, actually verifying and validating that the information a) appears and b) is correct is the part that may need time investment, but in actual fact it is really another process of displaying possible errors and omissions in models that would previously be ignored.

Again “you want me to do what?” is the question fired at you when you explain that the downloaded LOD 5(500) chair that is in the model doesn't actually comply with the information requirements so needs replacing and that's why standard libraries are so important.

It is important to remember that one individual is responsible for collating the COBie outputs, and that it is a team effort to create this data. Contractors, and their sub-contractors may start with the design team COBie extracts and then add additional information that is particular to their line of work and knowledge. The contractor would then pass this asset information on as part of the digital Operations and Maintenance (O&M) manuals to the client, end-user and / or facilities management team to be utilised in operations to enable managing the facility as efficiently as possible. It is also worth mentioning that while this information initially exists in Excel format (the lowest common denominator) it is highly likely to re-purposed / pushed into a fit-for-purpose database driven FM system for example, Autodesk [BIM360 Ops](#).

Reference material

Anthony McPhee writes a fantastic blog on all subjects of BIM. Here is a link to his COBie post <http://practicalbim.blogspot.co.uk/2016/03/cobie-is-not-what-you-think-it-is.html>

Validation aka Quality Assurance (QA) and Control (QC)

October also saw the passing of the BIM Level 2 stretch target mandating the need to have “the capability to electronically validate BIM information delivered from the supply chain” and will also need to be “making progressively more use of supply chain data for key business activities” by this date. As the focus on data becomes ever more important ensuring it is both reliable and of the expected quality is key. We are seeing requests from Information managers and PQQ's asking for validation processes.



Case Study: Singapore local authority requires models submission

Singapore's Building and Construction Authority (BCA) is working towards mandating BIM e-submissions in Native BIM format in the second half of 2017 (for architectural plans) and second half of 2018 (for C&S and MEP Engineering Plans).

With effect from 19 October 2016 (for architectural plans) and 01 October 2017 (for C&S/MEP Engineering plans), BCA will accept voluntary BIM e-submissions in Native BIM format. The voluntary submission phase is a good opportunity for Industry to practise submissions in Native BIM in preparation for the proposed mandatory submission requirements.

Currently, plans for new developments with Gross Floor Area (GFA) larger than 5,000 m² are to be submitted in BIM format, though this may change in the future.

For this to work the BCA have designed a Code of Practice (CoP)¹⁸ which outlines minimum modelling standards and regulatory information required to be provided in the BIM model.

Its contents include modelling standards, schedule layouts, data requirements and information many other things, for example data security.

Building proposals were submitted as a combination of existing 2D drawings with additional information provided in supplementary IFC-based files.

The aim was to improve performance, increase coverage and check compliance of building data in an IFC format. However, while the implementation of the IFC by CAD vendors remained focused on geometry many of the requirements for compliance checking were not available.

Despite ongoing attempts to implement performance based checking, e-PlanCheck in Singapore is still the only system that is currently operational.

¹⁸ [http://www.corenet.gov.sg/general/buildinginformation-modeling-\(bim\)-e-submission.aspx](http://www.corenet.gov.sg/general/buildinginformation-modeling-(bim)-e-submission.aspx).



We have investigated the use of systems such as Solibri and others which have rules based validation checking built in, to look at a number of areas of our models including, parameter inclusion, information missing, and to a limited extent, special planning issues both in terms of planning and building control.

Case Study: Scott Brownrigg Data Validation for Construction

From first-hand experience, I have actively worked on a project at Scott Brownrigg where we were asked to use BIMXtra. This software has a number of benefits, particularly for the contractor where the design consultants and sub-contractors can all upload their models and associated data from direct¹⁹ from Revit. This means multiple sources of data can be referenced together in one place, giving visibility across the entire project for all stakeholder, particularly the client, contractor, FM and end-users. It also cuts out the need for a COBie export.

We validated the required scheduling data by creating schedules in Revit which mirror the ones generated on BIMXtra first, enabling us to check whether or not all the data was available for all the objects. What this exposed was the fact that people were creating shared parameters or their own or using the “wrong” parameters to host the required data e.g. the door number was inserted in the description parameter instead of the Instance Mark parameter.

The above allowed our technical team to check what was going on with the data prior to uploading.

What we found was that we needed to create quite a few shared parameters to complete the process; a very messy and time consuming job indeed; some of those parameters need to be in each door family for example so the script opens each family it finds in a project and loads the parameters in to ensure consistency.

Subsequently our application developer has written an addin to assist with the process.

All in all, this is very early days, and something which we both hope to expand on in the near future for our respective practices.

¹⁹ The process to be followed means you export a Navisworks file from Revit, then using the add-in for BIMXtra in Navisworks, upload the geometry and data from there.

As mentioned in the case study, we have used a schedule to QA our work. Both our practices have QA schedules we keep out-with the main Revit template that are extend this checking capability to look for a number of errors or omissions. An example of this would be a schedule that is pre-sorted and filtered to find all unplaced rooms in the model to quickly remove them.

AEC (UK) checklist

Validation of the model provides a guide for certifying the model file for issue, the intention being that the recipients of the model know that the file is fit for use.

AEC (UK) BIM Protocol for Autodesk Revit Model Validation Checklist

Revit File Details	
Model Name	
Date	
Prepared By	
Approved By	

Model Preparation provides a guide for preparing the model prior to validation. The list can also be referred to for continued model management.

Model Preparation	
Check model file name conforms to Standards	<input type="checkbox"/>
All users to "Save to Central" relinquishing all editing rights	<input type="checkbox"/>
Review and fix all warning messages where possible	<input type="checkbox"/>
Check that all families conform to Standard naming conventions	<input type="checkbox"/>
Check Line Styles conform to Standard naming conventions	<input type="checkbox"/>
Check that all content is in the correct Workset and conforms to Standards	<input type="checkbox"/>
Check model is correctly assembled through visual inspection	<input type="checkbox"/>
Document Phasing / Design Options if used	<input type="checkbox"/>
Update Model Matrix if required	<input type="checkbox"/>
Update revision on Splash Sheet	<input type="checkbox"/>

Update Project Information	
----------------------------	--

Validation of the model provides a guide for certifying the model file for issue, the intention being that the recipients of the model know that the file is fit for use and will not require additional work to fit within the project framework.

Validation of Model	
Open Central file with Detached from Central and Audit selected	<input type="checkbox"/>
Remove non transmittal linked-in files	<input type="checkbox"/>
Remove all non-required Views / Legends / Schedules / Sheets / Images	<input type="checkbox"/>
Remove unwanted Design Options	<input type="checkbox"/>
Purge model (repeat process three times as materials are only removed after the parent object has been removed)	<input type="checkbox"/>
Update Save to Central view with any relevant model notes	<input type="checkbox"/>
Save file to publish folder with same name	<input type="checkbox"/>

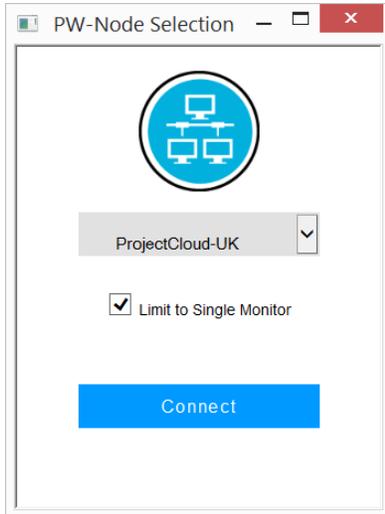
Unexpected Benefits / Innovative workflows

Project Cloud Collaboration

As a global firm Perkins+Will have a fully connected infrastructure that allows us to interact seamlessly within the P+W framework of offices. Our fully mobile solution not only means our live data is available anywhere and everywhere, avoiding data duplication, coordination issues



and rework, but also enables us to resource projects globally, leveraging experience and expertise from across the firm. This solution can be extended beyond our internal infrastructure and into a “project cloud” or “virtual project office” where dedicated project stakeholders can gain access to live and secure information from any location ensuring a single source of truth for all project data



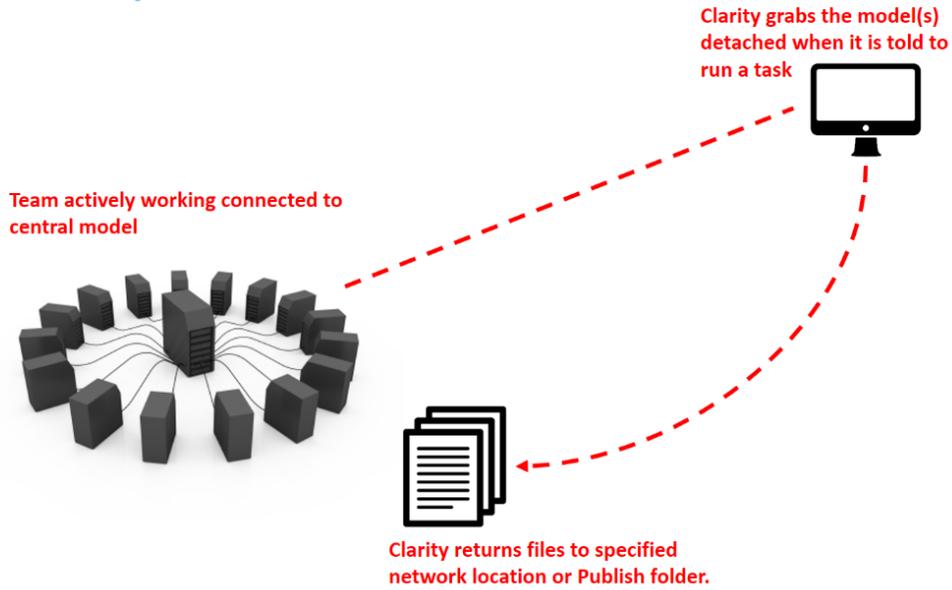
Ideate Clarity

Perkins+Will leverage a tool called Clarity for automation of printing and exporting our 2D project BIM deliverables.

Tasks can be run remotely by project teams via a web interface meaning that the inconvenience of performing these repetitive tasks has all but vanished from our Revit workflows.

Clarity works by acting as a “dummy” user taking a copy of the Central model running the assigned task then moving the outputs to a specified folder with the option to rename the output files.

Batch Print/Export Automation



Tasks are set up depending on project requirements and there are many options of export but mainly PDF printing and DWG export are required.

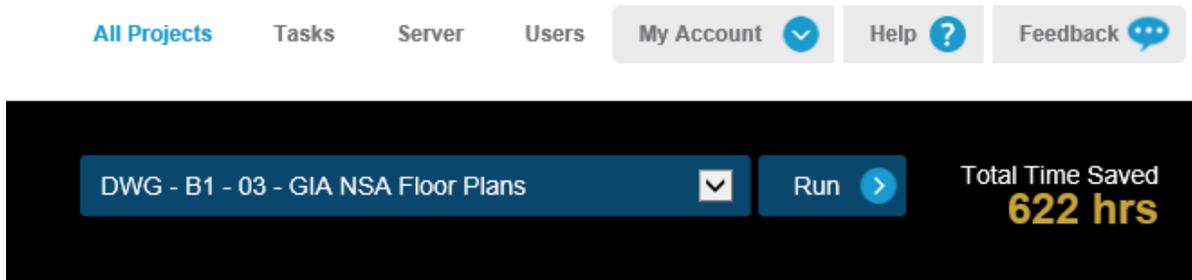
-  **Project Home**
-  **Activity Stream**
-  **Tasks**
-  **Reports**
-  **Data Sheets**
-  **Files**
-  **Model Map**
-  **Model Metrics**

Tasks

- Current Tasks
- Completed Tasks
- Setup Tasks
- Task Servers
- Task Timeline

Actions	Name
Delete Copy Edit Run	PDF - B1 - 13 - 01 - Curtain Wall Unit Types
Delete Copy Edit Run	PDF - B1 - 13 - 02 - EWS Configurations
Delete Copy Edit Run	PDF - B1 - 13 - 03 - External Wall System
Delete Copy Edit Run	PDF - B1 - 13 - 04 - External Wall Schedules
Delete Copy Edit Run	DWG - B1 - 13 - 01 - Curtain Wall Unit Types
Delete Copy Edit Run	DWG - B1 - 13 - 02 - EWS Configurations
Delete Copy Edit Run	DWG - B1 - 13 - 03 - External Wall System
Delete Copy Edit Run	DWG - B1 - 13 - 04 - External Wall Schedules
Delete Copy Edit Run	PDF - B1 - 11 - Elevations

These tasks can be both launched by users or automated, meaning that we can request a set of prints to run at 4:00am each morning to ensure a current drawing set is always available to the team.



This is how much time has been saved on one project by not having to do the exporting tasks manually.

Virtual Reality

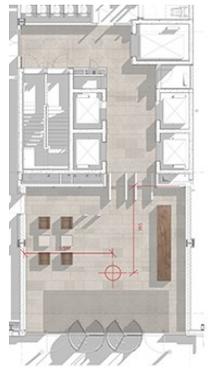
It is the unexpected and unforeseen benefits of new workflows that often really help support change. Working with models opens up different possibilities one of which was our ability to utilise VR in a very simple way. Bringing a Revit model into VR or creating a stereo panorama (360 image) from any Revit camera using Autodesk Cloud Services was a wow factor. Being able to then attach that image via a link to an email meant that we could very quickly immerse people in extremely portable VR using cardboards and portable headsets.

Internally this helped actually push the change into working in a model based environment as some staff saw the benefits of VR more important than collaborative working. This excited them more so they wanted to adapt. What it did mean though that we had base models to work from that could then be developed along with the design workflow rather than being remodelled from traditional tools such as SketchUP and CAD. People had inadvertently switched to BIM tools. Some things you just can't predict.

Perkins+Will London Case Study

A team used VR to gain client sign off for the reception materiality on a project that was under construction. The reception space on site was dark due to the scaffolding and therefore made

the client nervous of the current material choice. Being able to stand in the space and visualize it gained sign off there and then.





Managed Libraries

To enable Scott Brownrigg to win work, drive efficiency and ensure consistency through the use of BIM and its related toolsets I provided every member of the practice access to our content management database, Content Studio our 2D and 3D central library, and developed our Revit Family Creation Standards document which aligned with best practice outlined in various high level British Standards documents, helping us in our goal of working smarter.

It is the company's element, family and block management solution for Revit and AutoCAD helping them share approved content across the practice for the benefit of all. By saving the elements, families and blocks here technical staff were able to access approved content submitted by others as well as submitting their own thus reducing the need to create new items for use on individual projects and increasing their productivity.

It was a managed system which was administered by myself, and few content champions around the business who validated the content against our internal Content Standards documentation. This enabled us to ensure we had a consistent approach to the geometry and data thus giving us lightweight, usable objects that didn't drive down performance of the models / files.

Conclusion

This talk came about because we discussed at length the challenges we both faced. Our individual roles within a firm can be quite isolated, we are spread thin and we act as a conduit between all of the key departments. We are often “selling” our ideas to the entire business from top to bottom. We suppose in a way it was mutual counselling along with a sanity check.

When we spoke about the subject of BIM we realised that very often, almost to the letter, we had similar hurdles to overcome; the solutions we were proposing and the ways in which we implemented these solutions within our organisations. We thought that others may also be facing the same challenges and hoped that by writing this class we could share some of our experiences along with our interpretation of the standards, workflows and methods.

As we've demonstrated the multitude of parts to delivering a BIM Level 2 project can be overwhelming to say the least and hopefully we have also shown that because of this no-one, certainly not us, has been able to achieve 100% of the requirements in any one project. We also hope that we have explained that BIM Level 2 compliancy is project wide and not an individual responsibility. This is mainly due to the fact that our clients are still in their infancy of understanding BIM, it's processes and procedures, along with the supply chain not always having the capability to deliver.

The title reflects our belief that connecting geometry, data, people and process is key to making your BIM journey a success; it is really important to remember that changing people way's of working will be the biggest challenge. However, being successful at this will reap rewards downstream and you will start to see your hard work pay off. It's important to try to benchmark to show progress towards the business goals, proving that the training, software and processes you put in place actually are making things better.

We tried to make it a little different from other seminar talks that we have attended; to show how we have attempted to tackle key aspects of the workflows and explain, in real terms, whether or not these were successful.



We do not claim to know all of the answers. We learn something new every day, like the rest of the industry, and our roles internally are widespread. What we are finding though is that each project gets delivered just that little bit better with a clearer understanding of what we are trying to achieve along with our design partners and internal team members growing their skill sets.

Throughout the handout and the presentation, we hope you have been able to get at least one piece of take away advice or knowledge that you can implement in your business, to either kick-start or continue your journey to BIM nirvana. Not that we believe in such a thing.

“BIM is just doing your job properly with [the help of] technology as an enabler, not an outcome”
Ref - @biminstitute

We reference BIM Level 2 all the way through this handout, it's the given name and number; somebody had to call it something... right?.

We look forward to the day when BIM is no more and it's just what we do. This day will come.

For us we eventually hope it ends up like learning to riding a bike. At the start you wobble everywhere, you then get more confident, you may fall off a few times and hurt yourself but get back on, and after a bit, you never even realised you found it difficult.

Thank you for reading and we genuinely hope that it has been of benefit.



Appendix A The Information Manager

Mandated by the **CIC Building Information Model (BIM) Protocol (CIC/BIM Pro 2013)** which states that the employer must appoint a party to undertake this role, it can be carried out by one of the following:

- Design lead
- Project lead
- Independent / Third party consultant

The key aspects of which are:

- They have no design related duties.
- Clash detection and model coordination activities remain the responsibility of the design lead.

Principle responsibilities

- Managing processes and procedures for information exchange on projects.
- Initiating and implementing the Project Implementation Plan (PIP) and Asset Information Plan.
- Assisting in the preparation of project outputs for example data drops.
- Implementation of the BIM Protocol including updating the Model Production and Delivery Table.
- Manage and establish a Common Data Environment (CDE) including processes to enable reliable information exchange between project team members. Advise on non-compliance.
- Establish, agree and implement the information structure and maintenance standards for the model(s).
- Receive and validate compliance with information requirements and advise on non-compliance.
- Liaise and co-operate with project team members and the employer to support collaborative working.
- Agree formats for project outputs and assist project team members in assembling information in these formats.



Appendix B BIM Co-ordinator Role

The key aspects of which are:

- Wider set of responsibilities than the Information Manager.
- More closely bound to design and the design lead.

Principle responsibilities

- Develop, implement, maintain and ensure all stakeholders are in alignment with the BIM Protocol.
- Create and maintain a BIM coordination programme that aligns with the project programme.
- Establish BIM coordination workshops and report progress at the design team meetings.
- Record the BIM models, their status and transfer of element ownership between parties for example columns transferring from Architect to Structural Engineer.
- Establish quality control procedures to check all models are accurate and the level of detail is fit for purpose.
- BIM project setup: Setting up goals for the projects BIM workflow and management.
- Model co-ordination including coordinating the process and ensuring the models can be federated (linked together), are interoperable and up to date.
- Clash detection.
- Quality checkups
- Quantity takeoffs (if required)
- Data conversion and extraction from one format to another, where multiple CAD packages are being utilised in the workflow