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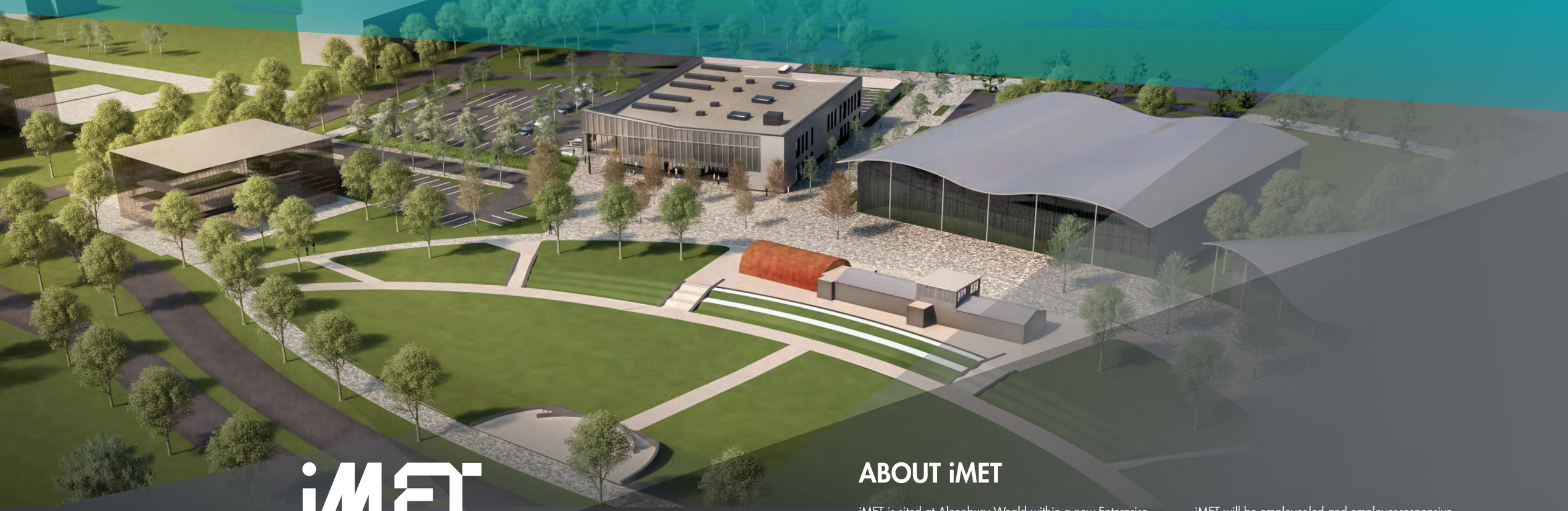
The BIM Journey

A case study in the practical application of BIM Level 2



iMET

Cambridge Regional College
first for training & skills

Peterborough Regional College

Urban&Civic

Alconbury Weald Make|Grow

HM Government

PROCUREMENT PARTNER

Scape Procure

PROJECT TEAM

WILLMOTT DIXON
SINCE 1852

thornton-firkin
Project Managers ~ Cost Consultants

Bond Bryan Architects

BSD
Building Services Design
Consulting Engineers

MLM. Group

ABOUT iMET

iMET is sited at Alconbury Weald within a new Enterprise Zone, which is part of an extensive residential and commercial development delivered by Urban & Civic plc and supported by local authorities and the Cambridgeshire and Peterborough Combined Authority (CPCA). The CPCA covers a region that is a highly diverse economic area which has seen rapid employment growth over recent years and which is set to continue. Market research has indicated that there are a number of factors which could limit this growth including, significantly, a lack of a highly skilled workforce in major growth sectors and skills gaps in sectors key to growth.

iMET is a new advanced technical academy providing innovative training to the construction, manufacturing, digital and science sectors. A joint venture between Cambridge Regional College and Peterborough Regional College, iMET aims to address the identified skills gaps in these sectors, by training both the existing workforce and providing a pipeline of future talent, through a range of apprenticeships and short training courses tailored to the individual needs of business throughout both Alconbury Weald, and across the East of England.

The primary focus of iMET will be development of specialised skills, and the product offer will include a focus on higher level training and qualifications at levels 3 to 6. iMET will deliver apprenticeships, specialist commercial courses and contextualised and industry specific leadership and management courses. In addition, iMET will explore opportunities for business support, consultancy and research and development (R&D) services.

iMET will be employer-led and employer-responsive. The academy has already engaged many of the key businesses in the region and has support from a number of these including Willmott Dixon, Breheny, Codem and Envigo. Further engagement across all target sectors is underway and will remain a key focus as the iMET business develops.

The iMET facility is 100% capital funded by the CPCA through HM Government Growth Funds with the land provided by Urban & Civic plc. The total funding granted is £10.5m, of which some £8.5m relates to the build cost, with £1.5m allocated to fittings and equipment, and the balance covering start-up consultancy costs.

The building was specified to deliver the objectives above, but to meet the caveat that it also had to deliver a flexible training environment, given the rate of technological change in the economy. The challenge was also to deliver a building that could be operated efficiently, and cost effectively yet be aspirational to encourage learners in an environment conducive to independent learning.

This clearly presented a challenge and the selected procurement route through the Scape National Major Works framework led to the appointment of Willmott Dixon as the major contractor which enabled the utilisation of BIM Level 2 within the framework. The perceived advantages were both operational and financial combined with the opportunity to use the experience to deliver this case study and the developed BIM model to deliver practical training courses on BIM in the future.

CONTENTS

PROJECT SUMMARY

This report is a case study of the use of Building Information Modelling (BIM) technology in the development of the iMET training facility in Alconbury Weald, Cambridgeshire. It sets out the challenges faced by the project team, lessons learned during the design and build of the new facility, and some key recommendations for the industry on the use of BIM.

Building Information Modelling has already begun to revolutionise the way buildings are designed and built. In 2016 the Government sought to embed BIM in all centrally funded public sector procurement by mandating that all construction projects must be delivered to BIM Level 2, marking a step change in requirements for the supply chain. Yet while some larger SMEs in the supply chain have embraced this change, there is still much further to go to ensure that BIM is fully adopted, and the benefits maximised.

Engagement with the main contractors, supply chain education, and collaboration will be essential in ensuring that the UK supply chain embraces digitalisation, and delivers a high quality product and better data, to unlock more efficient buildings for the public sector.

The decision by Cambridge Regional College (CRC) to utilise the Scape National Major Works framework (with Willmott Dixon as the main contractor) enabled the use of BIM Level 2 under the terms of the framework. This case study attempts to describe the BIM journey experienced by the participants and to serve as a learning tool for future potential projects. It reflects upon the opportunities and gaps in current practices and makes some recommendations which may assist others in the future. In addition, iMET will go some way to plugging these gaps by providing courses which incorporate BIM for the built environment at all levels of experience. Crucially iMET will provide high quality training for those already working in the industry, helping to ensure the existing workforce is able to understand and maximise the potential of BIM.

The design and construction of the iMET training facility, and the practical application of BIM on the project, will also serve as a best practice case study for iMET students. They will be able to engage with data and 3D models of their training facility as they study in iMET's state of the art digital suite.

Moreover, iMET serves as a case study for customers and SMEs within the supply chain. This document sets out some of the practical examples of BIM's application on a real-world project, the lessons learned and the project team's recommendations for the industry. The project teams hope these will be used by customers and SMEs in the built environment sector to enhance their understanding and use of BIM.

"The opportunity to use BIM Level 2 as part of the Scape framework was an additional opportunity to gain precious experience in this new, evolving, technology which aligns with the ethos and ambition of iMET going forward. It always sets a good example to practice what you preach!"

Mark Robertson, Principal, Cambridge Regional College

"The opportunity to deliver through to BIM Level 2 has been a great success and has delivered many benefits to the iMET project. It has allowed Scape and Willmott Dixon to offer our customer enhanced visualisation, better quality design and better collaboration."

Garry Fannon, Head of Digital, Willmott Dixon

"A fundamental change in approach to the way we design and build is not easy to achieve, but it is essential that collectively we all strive for change. iMET will pioneer the training required to make this leap in capacity and deliver full utilisation of BIM."

Mark Robinson, Scape Group Chief Executive

WHY BIM?

The potential long-term savings for the public sector and the industry from the use of BIM are very significant. The adoption of BIM is already creating efficiencies through information-sharing, identifying waste and offering the ability to systematically 'design out' common problems.

The utilisation of 3D modelling and virtual prototypes in other sectors of industry demonstrate this.

BIM has a long-term impact too, as the more data on a building that can be integrated digitally, the greater the opportunity for savings and improvement of whole life costs on these projects in future.

The construction sector is all too aware of the claims as to the benefits of BIM and only a proportion of those benefits have been evidenced currently. The key to harnessing future efficiencies and savings is the early engagement of customers and their facilities management teams to translate BIM construction methodology into 'soft landings' and long-term facilities management giving 'whole-life' cost reductions in maintenance and ancillary costs.

An additional consequence is that the collaborative nature of BIM also has a very positive impact upon team building and generates a holistic approach to project delivery and problem solving.

It is clear that a majority of customers, contractors and other stakeholders identify with the potential benefits of BIM; it now requires more confidence in its application to deliver these benefits.

The effective adoption of BIM at Level 2 is not easy and demands early and continued commitment and this case study has been written to assist others in this journey.

FOREWORD

The iMET building project was completed successfully, on time and within budget.

There have been challenges along the way, as in all such projects, however one of the key achievements has been the adoption of BIM Level 2. An opportunity driven by the terms of the Scape framework, which enabled the team to demonstrate the use of digital technology, its scope, practicalities and application in this new advanced technical training academy.

The construction sector has embraced the use of BIM in recent years and is beginning to unlock the opportunities to maximise design and construction efficiencies that it can bring. This alternative method of working is about sharing and collaboration; a move to a more holistic approach to a project where the whole is greater than the sum of its parts. The next step is to realise the full potential of BIM throughout the life of a building, its management and modification, until its ultimate de-construction.

The case study, along with the BIM model, will provide a valuable teaching tool at iMET assisting the sector in utilising digital technology.

iMET, of course, will be more than that – it will deliver much-needed advanced skills to the construction, manufacturing and science sectors in the region. The use of BIM during the design and construction of iMET demonstrates our commitment to promoting development and use of digital technology within the construction industry and beyond.

Jo Sainsbury, Managing Director, iMET

iMET – PROJECT OVERVIEW

iMET, the Innovation, Manufacturing, Engineering and Technology centre, is due to open at Alconbury Weald in 2018 and will focus on technical training for both the existing workforce and new apprentices in the key areas where increased skills have been identified as essential for growth in the region.

Funded by Growth Funds through the Cambridgeshire and Peterborough Combined Authority (CPCA), supported by Cambridgeshire County Council, Huntingdonshire District Council and Urban & Civic plc, iMET demonstrates that innovative local initiatives can meet the national agenda on skills, delivering positive results for the UK plc.

iMET was conceived in 2012 from an identified need to deliver advanced technical skills training in Manufacturing, Engineering and Technology. Most importantly, iMET defines the need to meet employers' demands with specialist, advanced courses created in collaboration with those employers as partners.

iMET is different and new. Crucially, the training facility is employer-led, with businesses in the region helping to shape the offer, sitting on iMET's board and sponsoring the facilities. The training academy does not replace or duplicate existing further education and higher education institutions, but supplements them by developing individuals to meet business requirements in the key technical sectors and the need for industry specialist roles.

Training courses will focus on Engineering, IT, Life Sciences, Construction and Advanced Manufacturing – all identified as key areas where more high-level skills training is needed.

iMET, a joint venture between Cambridge Regional College and Peterborough Regional College, aims to address the identified skills gaps in these sectors, by training both the existing workforce and providing a pipeline of future talent, through a range of apprenticeships and short training courses tailored to the individual needs of business throughout both Alconbury Weald, and across the East of England.

Training will focus on technical skills for the Construction, Manufacturing, Digital and Science sectors, delivering apprenticeships and short course master-classes to suit industry requirements.

Cambridge has been identified as a key economic driver for the wider region, and an asset for the UK as a whole, while Peterborough is focussing on becoming the national capital for green technology industries. Growth at Alconbury Weald is a strategic policy priority for Central Government and for regional stakeholders. The GCGP LEP Strategic Economic Plan for the region highlights the need for business-focussed higher-level skills provision in its area.

"Together we can directly influence the future of the construction, manufacturing, digital and science industries, whilst also providing a career path for young people in the region."

Jo Sainsbury, Managing Director, iMET

"This is a very exciting development for skills in the region, and we are delighted to welcome Joanne as the new Managing Director of iMET. Cambridgeshire is the fastest growing economic region outside London, but skills shortages are reported as a major barrier to sustaining that growth. iMET will be employer-led and employer-responsive, ensuring the provision of the high-level skills the region needs to continue its growth."

Mark Robertson, Principal, Cambridge Regional College

"The system must work for adults as well as young people… Adults already in skilled employment who want to pursue a new career or progress higher in their chosen career will want to ensure that they can join a technical education route at the highest possible point."

Independent Panel on Technical Education (Sainsbury Report)

iMET: A CASE STUDY IN BIM LEVEL 2 BEST PRACTICE

BIM AT iMET

In October 2015 a design team was selected to work with the college to develop the iMET concept into a workable design.

From the outset the college were keen to pursue a BIM Level 2 approach, however like so many potential customers before and after, they had a lack of awareness as to the importance of their role in the BIM process; hence the initial reason for this case study. The stage 2 concept design, for example, was developed without Employers Information Requirements and Asset Information Requirements.

Prior to commencing RIBA stage 3 (which is very late in the process), Willmott Dixon held a series of workshops with the customer and design team and collectively agreed a set of employer documents, which would generate the BIM Level 2 deliverables that have recently been handed over to the customer on completion of their new building.

This is a fundamental learning from the project and the potential use of BIM Level 2; client awareness of their own requirements, in detail, require a commitment of time and resources that is not currently identified or applied at the feasibility stage of a project. The benefits are accrued and released at the pre-construction and construction phases and form the on going benefits in facilities management through the life of the building.

PROCUREMENT AND SOCIAL VALUE

Construction services for the iMET project, delivered by Willmott Dixon, were procured through the Scape Major Works framework. Scape Group is a public sector organisation, dedicated to creating ongoing efficiency and social value via the built environment. Scape's suite of OJEU-compliant frameworks has been designed to meet the specific needs of the public sector, providing reliable and cost effective procurement, but also prioritising social value delivery on every project.

Scape's public sector procurement process selects the best delivery partners, supported by an extensive local supply chain, to deliver projects such as iMET. Subject to a rigorous performance management regime, Scape's frameworks require the highest standards of customer satisfaction, local labour and local spend. Projects also operate with strict minimum standards of fair payment, waste diversion, community engagement, training and apprenticeships.

The Scape Major Works framework was chosen as the procurement route for the iMET project because supporting the local economy and construction supply chain were key priorities for the iMET project team, Cambridge Regional College and the Greater Cambridge Greater Peterborough Enterprise Partnership. The procurement was therefore able to support the goals of the Alconbury Weald Enterprise Zone, helping to upskill and strengthen the local supply chain.

Through the Scape framework, Willmott Dixon ensured that over 40% of all subcontractor spend was within 20 miles of the iMET site and that 88% of suppliers were SMEs. The iMET supply chain also benefited from fast payment of invoices, with 100% of tier two suppliers paid within 19 days and tier three suppliers within 23 days of the client certifying payment.

In 2017 Scape launched the Scape National Construction framework, valued at £7bn over four years, which supersedes the Scape Major Works framework.

iMET PROJECT TIMELINE

2013 – 2014
The GCGP initiated their Skills and Economic Strategic Reviews for the region

2014 – 2015
Initial discussions taking place surrounding the provision of an advanced manufacturing training centre

September 2015
Funding agreed for initial feasibility study

October 2015
Funding agreed for project definition to design stage

October 2015
Design Competition (consultants engaged and commencement of RIBA Stage 2)

February 2016
iMET funding confirmed

January – March 2016
Stage 3 design (agreement of BIM deliverables)

March – July 2016
RIBA Stage 4A design and costing (excluding subcontractor design)

September 2016
Willmott Dixon and Cambridge Regional College sign 'Memorandum of Agreement' for project delivery

October 2016
Start on-site (works paused following merger between Huntington and Cambridge Colleges and commenced in January, 2017)

January 2018
Completion

February 2018
Project handover

KEY THEMES COVERED IN THIS CASE STUDY:

1. Co-ordination
2. Customer Roles and Responsibilities
3. Contractual Requirements and Appointments
4. Programme
5. The 3D Model
6. Clash Detection
7. Utilisation of BIM Level 2 Methodology
8. Construction Stage
9. Common Data Environment (CDE)
10. Handover Documents

CO-ORDINATION

Project co-ordination and collaboration is a key requirement for success in any circumstances, but the adoption of BIM as a tool requires project team collaboration and commitment at an early stage. In order to work effectively, the customer, lead contractor and consultants must invest time upfront in making it work. A key factor in the success of BIM at iMET was the time spent in setting out the framework for collaboration. This included the Employers Information Requirements (EIRs) including Asset Information Requirements (AIRs).

A federated BIM model (with all the consultants' models included) was a priority to aid co-ordination throughout the project. Early involvement of the contractor in a project enables them to seek information and data for elements of the model from suppliers, manufacturers and installers to feed into the overall BIM model.

Bond Bryan Architects (BBA) found that the early exchange of models with simple forms between consultants, prior to the exchange of the whole building, can allow consultants to check settings and position before completing their initial model. Completing this saved time later when full models were exchanged.

The project team must also consider how long it can take for consultants to adapt their models prior to model exchange, and a plan must be created to ensure models are prepared, adjusted and exchanged in a timely way that supports the overall project programme. The iMET team created a model exchange schedule to aid co-ordination and this was very useful in ensuring co-ordination on BIM at the very outset of the project.

LESSONS LEARNED:

- Early model exchange between consultants and subcontractors with simple forms, prior to exchanging the whole building, allows details like settings and position to be checked before the full design is handed over. This will ensure minor issues are addressed before the whole design is handed over, creating efficiencies when it is.
- A key lesson learned by BBA was in allowing sufficient time within the programme for consultants to adapt their models prior to exchange and create a plan accordingly. A plan provides certainty and clarity on timescales, but this also allows enough time to make changes.
- Initially there was concern expressed by many participants over the retrospective adoption of BIM Level 2:
  - The design team thought it would add work and cost to that already completed, including an additional time commitment.
  - The delivery team, because of their lack of practical experience of BIM, were a little sceptical as to the benefits on-site. In reality, the adoption of BIM appeared to drive team cohesiveness with a recognition of shared benefits from a common data environment and members of the delivery team became advocates for BIM.

RECOMMENDATIONS:

- Planning a model exchange schedule from the outset will aid co-ordination and collaboration during the design stages, ensuring a smoother process throughout.
- Undertake a BIM launch meeting as soon as possible with all stakeholders (including design team members) to fully ensure all processes and procedures are being followed and a route map for effective collaboration for the project lifecycle is discussed and agreed.

CUSTOMER ROLES AND RESPONSIBILITIES

Customers are clearly the main beneficiaries from the utilisation of BIM throughout the design, construction and life of the asset. It has the potential to save time over the lifecycle of the project. BIM reduces waste and also creates long-term efficiencies throughout the lifetime of the building through streamlined facilities management.

Whilst customers are often keen to see the benefits from BIM, it is important for them to understand the process from the outset and the responsibilities they have in delivering BIM level 2. The Employers Information Requirements (EIRs) and Asset Information Requirements (AIRs) are key documents initiated by the customer and require early input from the facilities management team if the 'building with the end in mind' philosophy is to be fully utilised.

Timescales in the early stages of the programme need to be considered for the preparation of these documents and ideally considerably more time is required at the design stage to design and co-ordinate a virtual prototype. This creates efficiencies during the construction stage of the project but is a different approach to a traditional design and build programme, which would see the design adapted on an ongoing basis after construction on-site has started.

Customers may not understand the amount of time required at the beginning of the programme to ensure the project team is able to fully utilise BIM, until the main contractor is appointed. They must, therefore, understand the key RIBA work stages prior to the main contractor's appointment:

RIBA – KEY PROJECT STAGES AND CUSTOMER RESPONSIBILITIES

STAGE 0 – STRATEGIC DEFINITION

- Write Organisational Information Requirements (OIRs)
- Write Employers Information Requirements (EIRs)
- Define Asset Information Requirements (AIRs)

STAGE 1 – PREPARATION AND BRIEF

- Prepare and issue Employers Information Requirements and Asset Information Requirements (EIRs and AIRs)
- Check capability of design team to deliver EIRs and AIRs
- Appoint design team

STAGE 2 – CONCEPT DESIGN

- Review content of EIRs and AIRs with design team
- Design team prepare / issue Pre-Contract BIM Execution Plan
- Issue EIR to bidding contractors with design teams Pre-Contract BIM Execution Plan

STAGE 3 – DEVELOPED DESIGN

- Appoint main contractor

Clearly this presents a challenge to the customer, as in reality, they must plan for the operation of a building two to three years in advance. In the case of iMET, the former Huntingdonshire Regional College merged with Cambridge Regional College prior to commencement on-site and therefore during the construction stage a series of re-engagement meetings were held and end user requirements changed as a result.

BIM Level 2 requires the customer to familiarise themselves with certain BIM related roles such as Employers Representative, Project Delivery Manager, Project Information Manager and Task Information Manager so it is advisable to appoint a Project Manager with an understanding of these key roles, processes and procedures who can guide the customer through the early BIM process.

BIM can offer many opportunities depending on the type of project, the skillset of the client project team and the intended asset management strategy after handover, therefore it is important to establish as early as possible what you want to use BIM for, make key appointments and engage early with key stakeholders.

The implementation of BIM allows the client team to consider and utilise many potential uses to aid the design and management process of a project, however it is recommended that a practical approach is taken when determining what a model should be used for, to avoid unnecessary additional works and costs.

LESSONS LEARNED:

- From an early stage of the project the customer must take an objective and strategic view of the actual long-term requirements of the asset (OIR, EIR and AIR) and not the current requirements of current maintenance personnel, as they may not be running the building once complete, or in years to come.
- The customer may not be fully aware of the RIBA stages of design and where BIM fits into the timescales of the project. They must become aware of these in order to appoint consultants early enough to fully utilise BIM.
- Early engagement and preparation allows developers to take full advantage of the benefits of BIM.
- End user requirements will change, and so the process of designing the building will change. The design team will have to account for this and how these changes can be managed in a timely way through BIM.

RECOMMENDATIONS:

- A long-term strategy for facilities management of the asset is essential in making long-term efficiency savings over the lifespan of the building.
- Appoint the project team as early as possible.
- Engage with the project team to ensure they understand BIM requirements and how they fit into the 'bigger picture'.
- The customer and lead contractor should provide support and encourage collaboration to ensure the entire project team understand the requirements and is collaborating fully.

CONTRACTUAL REQUIREMENTS AND APPOINTMENTS

As well as understanding their role and time requirements for BIM at the outset of the project, customers must be firm in ensuring BIM is a contractual requirement for all relevant consultants as well as the main contractor. BIM can only be a contractual requirement for consultants if the EIRs and AIRs are set out from the outset. Customers may be nervous about making BIM a contractual requirement given their own and often the wider supply chain's relative lack of experience on delivering projects through BIM.

It is essential that they do so, however, in order to ensure BIM compliance across the entire project team and to take full advantage of its benefits. Customers need to be brave and understand their role and how they themselves can drive efficiencies – not just leaving this to the lead contractor and their supply chain partners.

One way that customers can help to ensure that all parties within the project team meet the customer requirements, is to set out a clear set of deliverables and a roles and responsibilities matrix in the EIR and use the CIC (Construction Industry Council) BIM Protocol within the contract. They must ensure that all members of the team (including the customer themselves) understand the Asset Information Requirements (AIR) and who will be producing each element of the model.

A key finding on the iMET project was that later adoption of BIM can undermine its utilisation and the potential benefits throughout the project. There was further reluctance to make BIM a contractual requirement because of BIM's late introduction. The EIRs and AIRs were not defined from the outset, but Willmott Dixon and the design team supported the customer to develop the EIRs and AIRs at RIBA Stage 2.

"To fully utilise the BIM Level 2 processes, the preconstruction stage will likely be prolonged, however the construction period should be more efficient."

Steven Smyth, Willmott Dixon

LESSONS LEARNED:

- Customers remain nervous about stipulating BIM as a contractual requirement and are reluctant to do this. However, this is essential to ensure BIM is fully utilised, and customers must therefore be braver in making BIM a contractual requirement. (In the case of iMET, this decision was made easier by use of the Scape framework.)
- The later into the project that BIM Level 2 is incorporated, the more difficult it is to realise the full benefits of BIM later in the project.
- A clear set of deliverables and a matrix of roles and responsibilities helps to ensure that all members of the project team understand what is required of them.
- The design team need more time to design and co-ordinate the virtual prototype, therefore alternative methods of procurement could assist such as alliance contracting.

RECOMMENDATIONS:

- Customers and lead contractors must provide clarity on deliverables, roles and responsibilities for the project team in relation to BIM.
- The CIC BIM Protocol should be included with all design, subcontractor and main contractor appointments and contracts.
- All parties must understand the Asset Information Requirements (AIRs) for the project and who has responsibility for each piece of information.
- The customer has a place for the data to go i.e. a common data environment. The data will instantly start to decay (i.e. get outdated) if left on a CD or hard drive.

PROGRAMME

There is often a tendency to target an early start on-site (for a variety of reasons) on the assumption that this will facilitate an earlier handover however in reality a robust design period should make the construction period more efficient.

On a BIM Level 2 project it is important to undertake as much detailed design as early as possible (including those from key subcontractors with design responsibility) to ensure the design is co-ordinated.

Willmott Dixon and the project team helped to ensure a robust design programme was developed in collaboration with the design team and key supply chain partners. This is a good example for the industry on how engagement with the supply chain on BIM can deliver better outcomes. Similarly, a programme review workshop was held with the customer's team to ensure they understood the processes for BIM and the steps required during the programme.

A specific example of BIM creating efficiencies within the programme was the use of a pre-fabricated temporary handrail system on the iMET site. This was modelled and co-ordinated prior to commencement on-site, and pre-drilled before arriving on-site. This made on-site co-ordination much easier and saved time.

LESSONS LEARNED:

- Parties within the project team may not fully understand how long key processes take or the deliverables and outcomes for each stage.
- Investment in BIM upfront pays dividends over the lifetime of the programme, as the construction stage will be more streamlined and often shorter.
- Using visualisations at the outset of the project can help the project team, including the customer and Town Planning teams, to better understand the building and make design and operations quicker.
- 3D visualisations can help to create efficiencies, while 4D BIM can help the customer and project team to identify sequencing issues and establish a detailed programme early on.
- An additional benefit of 3D visualisations is to assist in stakeholder engagement.
- The customer must allow sufficient time for the new RIBA Stage 0 for engagement with the end user and understanding how the building will be operated and maintained.
- Ensure all subcontractor design is included within the programme and milestones for any early orders required to facilitate this ahead of the main contract.

RECOMMENDATIONS:

- Greater education of the supply chain on requirements and time commitment, as well as greater customer engagement on BIM, will help them to understand the requirements from the outset. Crucially this will also help them to understand the time needed at the earlier stages of the project to maximise efficiencies later.
- A detailed programme review workshop will help the customer to understand the BIM process and requirements for the whole programme.
- The customer's team should allow several weeks, if not months, to develop the asset requirements for facilities management and a long-term security strategy.

THE 3D MODEL

The main contractor (Willmott Dixon) noticed that some sub contractors despite being contracted to provide BIM Level 2 initially, defaulted back to producing traditional 2D outputs and, where they had the capability, they then produced a BIM model to meet the team's requirements. Clearly greater engagement with suppliers and more education within the supply chain is required to ensure BIM compliance and realise the full benefits of digitalisation at an early stage.

Both the customers and lead contractor must also do more to ensure they are working with supply chain partners who have good experience and understanding of BIM to deliver projects fully, while suppliers themselves must also ensure that they are doing everything possible to train their teams to fully understand and embrace BIM. They must understand not just what the project team needs from them, but the benefits for the end user.

It is important that the momentum of BIM is carried through from preconstruction to the construction stage where infrastructure and facilities (projection screens etc.) need be in place on-site in order to utilise the model not only for design-related tasks but also general project awareness amongst workers, health and safety planning and site inductions.

A key finding from the project was that although BIM creates significant efficiencies, it is still reliant upon people using it and people's willingness to change the way they would traditionally work. Practical applications, including hardware, are still very much important and we need to remember that BIM is ultimately a tool that relies on people.

LESSONS LEARNED:

- Establishing supply chain capability is key to what they can deliver today and where they need help and experience to deliver tomorrow.
- SME engagement and preparation ahead of time helps to ensure full adoption of BIM.
- Collaboration is the key to realising the benefits of BIM, especially where there is imperfect understanding or limited experience.
- The federated 3D model is very useful for both customer and design team meetings.
- Design team meetings are most effective when all consultants are present. BIM is a tool for collaboration, but communication and face-to-face meetings remain essential.
- Customer engagement throughout the design process is essential. 3D visualisations help them to better understand the design and give feedback.

RECOMMENDATIONS:

- The supply chain must understand BIM, and this should increasingly be a key consideration in choosing suppliers. SME engagement and education are vital to ensure the supply chain adapts and prepares for this.
- Don't forget the hardware – meeting rooms need to have the right equipment for BIM to be used, including 3D and 4D visualisations.

"There was definitely a learning curve, but the core consultant team worked collaboratively."

Steven Smyth, Willmott Dixon

"Using the 3D model in client meetings allows the client to 'visit' every part of the building at every stage and provide comments."

Zubin Masters, Bond Bryan Architects

"The design of mechanical, electrical and plumbing services to fit the new training facility was ultimately accomplished by a collaborative design working process. But it was the utilisation of BIM on the iMET which facilitated this."

Mark Dyer, Building Services Design

CLASH DETECTION

Early clash detection improves efficiency and reduces cost in construction. Clash detection is a core component of design through BIM and a key finding of the iMET team was the importance of managing the process of identifying and managing clashes to save time.

One of the key concepts of BIM is to digitally construct the asset prior to its physical construction, in order to understand and resolve issues in advance. More traditional methods on the other hand would mean supply chain partners design is ongoing through the construction stage. However, BIM can only work if the majority of the model is completed during the design stage, and that sufficient time is allocated for this. This requires a change in mindset and approach as the supply chain moves from traditional 2D methods to digital 3D methods, however the result will be a reduction in time and cost during construction. Inevitably not all building components will be provided in 3D by the manufacturers and installers, and a clear understanding of what will and will not be modelled in 3D from the outset is important.

BBA, in particular, cited the importance of keeping records of clashes and their resolution throughout the project, and that this was improved over the duration of the project. Further to clash detection, clash management and resolution as well as prompt updates of the models are critical to ensure model co-ordination is in synch with the design and build programme.

Models were produced by some supply chain partners such as M&E, pre-cast concrete, drainage and steel frame. However, the team found that these models were often only being utilised to assist in resolving on-site issues, rather than pre-empting them and avoiding them. Supply chain partners with design responsibility should utilise the models from other disciplines to produce their models, develop their design, check it for clashes and issue it for approval to the lead designer. This relies on the timely production and issue of the models by the supply chain, allowing them to be co-ordinated prior to the issue of construction information.

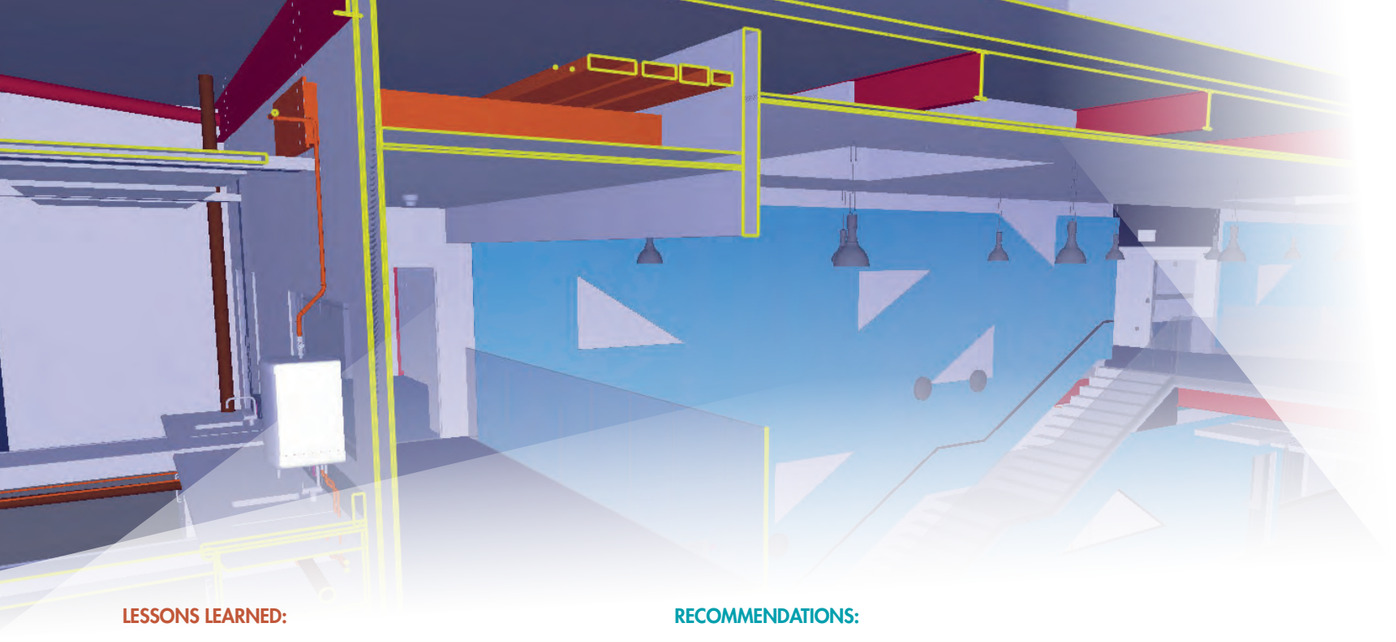
The whole project team has to be engaged and 'BIM ready' in order for BIM to work across the project. Otherwise the process can be too reactive rather than pre-emptive on issues, and this can prevent the project from maximising the value of digitalisation across the programme.

A good example of the importance of clash detection and enforcing the use of agreed processes came from Willmott Dixon. On some key interfaces, Willmott Dixon received 2D outputs on the understanding that they were co-ordinated, and so cross-discipline checking (auditing) was not undertaken. The team later discovered after fabrication and delivery to site that the model hadn't been utilised in the first instance, creating delays and additional costs.

The whole team must embrace BIM fully for it to work effectively. If one supplier fails, it can have implications for other suppliers and the project as a whole. This again underlines why engagement with the supply chain on BIM requirements is so important.

"Often models were utilised to assist in resolving on-site issues rather than actually pre-empting issues and avoiding them. The whole project team must make every effort to identify and resolve issues at the design stage. There can be a misconception that pressing a button means all issues will get resolved but this is not the case. The BIM process is an addition to traditional co-ordination techniques and not a replacement."

Steven Smyth, Willmott Dixon



LESSONS LEARNED:

- The project team must keep a record of clashes and their resolution.
- If the use of a Build Collaboration Format (BCF) Manager is suggested, it should be included in the BIM Execution Plan (BEP) early in the programme, with clashes then only detected and managed through the BCF Manager.
- Upskilling the workforce is critical to utilising BIM's full potential.
- BIM alone does not solve problems. People still need to collaborate to solve the problems, with BIM as a tool to make the process more efficient.
- The definition of BIM can only be met if all of the preparatory work is completed on time.
- The whole team must embrace BIM fully for it to work effectively. If one supplier fails it can have an adverse impact on the whole project.
- Fully define each team member's role in relation to clash detection relating to their discipline and any subcontractor's design from the outset.
- The timing of procuring the packages and consequent 3D model production from the supply chain is crucial to the model co-ordination process and the overall programme. Delays in procurement can have significant detrimental impact resulting in an inefficient co-ordination process.

RECOMMENDATIONS:

- Ensure clash detection reports are produced regularly, typically before design team meetings so that consultants can discuss these in person and understand the issues before the meeting. Crucially, clash detection is not an end in itself, the team's focus should be clash resolution (co-ordination) and updating the model promptly.
- There should be clarity across the team on which supply chain packages will be produced in BIM. This is likely to improve with higher adoption rates of BIM. More packages in BIM will mean better co-ordination and ultimately provide more benefit.
- Streamline supply chain procurement processes to align with the BIM programme.
- Design Managers to be made aware which design packages have been co-ordinated and which have not been included in the Clash Detection Process.
- Minor clashes should be resolved before design team meetings wherever possible, so that these are solved quickly and time at meetings is focussed on more significant issues.
- Project teams must enhance co-ordination and communication to resolve a maximum of issues prior to construction as a team.
- It is useful to produce a simple guide to go with supply chain orders instead of just requesting compliance with BIM Level 2.
- Suppliers with design responsibility should produce their model and pass on to the next supplier to review and resolve any clashes, before then passing on to the next supplier.

"In order to invoke change, people need to see where BIM can benefit them personally in their day to day roles and see past the initial steep learning curve and setbacks."

Steven Smyth, Willmott Dixon

UTILISATION OF BIM LEVEL 2 METHODOLOGY

To ensure that the supply chain embraces change, and BIM is fully utilised across the project, members of the project team must change their existing mindset on methodology and embrace a new set of procedures. The customer and lead contractor must also create a culture of collaboration, where suppliers can be open about issues that arise and have their work reviewed. It is important to ensure a free flow of shared learning and to avoid a 'blame culture,' as being too critical can be counterproductive. This is where Alliance Contracting in the future can change stakeholders' attitudes to mistakes and blame.

There is an important balance for the customer and lead contractor to strike as the supply chain adapts to BIM. From the perspective of the supply chain, BIM capability assessments are often viewed by those receiving them as an attempt to 'catch them out' and 'eliminate' them from a potential opportunity to work on a project. However, it is better for an organisation to know if it is 'lacking' in a certain area, so they can be upskilled. Collaboration will inevitably lead to some contradiction, which needs to be managed openly.

LESSONS LEARNED:

- A change of mindset and approach is often required for SMEs when first using BIM, but this takes time to be fully realised.

For BIM to become embedded across the supply chain, members of the project team need to see where BIM can benefit them personally in their day to day roles and see past the initial steep learning curve and setbacks. Education and a practical understanding of the day to day difference BIM can make is vital if digitalisation is to be embraced fully. Engagement with the supply chain, removing technicality or complication where it isn't required, can help to ensure suppliers see the value in BIM.

The iMET team also cited other practical measures to help ensure full utilisation of BIM, such as appointing BIM Champions, developing a BIM Execution Plan, creating a Task Information Delivery Plan and devising BIM protocols. Again, the earlier suppliers and consultants are appointed, the easier it is to embed a different approach.

RECOMMENDATIONS:

- Early supply chain engagement is essential and being open and collaborative on BIM is important as it solves problems later down the line.

CONSTRUCTION STAGE

A key objective for the project team was a well-coordinated and BIM-compliant model during the construction stage of the iMET project. Full utilisation of BIM enables site teams to see issues in advance of construction so that they can amend details, adjust sequencing and ensure good co-ordination between different teams.

Full immersion in BIM at both the design and construction stages should therefore be a key objective. As well as creating efficiencies throughout the programme, an accurate post-construction BIM model and clear deliverables also aid the long-term facilities management and maintenance of the asset.

BIM is the most efficient way to get from the design stage to construction and completion, it actually creates efficiencies which are then realised during the construction stage. When fully utilised, BIM also helps to ensure what is designed is actually constructed.

Clashes can occur due to supply chain partner design development. Therefore, to help to address these issues and clarify processes for resolving clashes on the iMET project, Willmott Dixon and BBA held clash detection workshops with key supply chain partners. Engagement with suppliers is essential, but the lead contractor must emphasise the importance of these or make attendance compulsory, in order to avoid issues later in the programme.

The iMET team found that during the construction phase it was important to create a 'BIM friendly' environment, where the use of 3D models was actively encouraged. In particular, they found that it is important to ensure that the construction site has the infrastructure in on-site meeting rooms, such as large monitors, equipment and suitable connections, to facilitate 3D visualisation and collaboration on design. Hardware and practical considerations are still important, and BIM can only be successful when used as a tool for collaboration.

Collaboration and ongoing engagement help to move the whole team towards full utilisation. BIM and 3D outputs may never fully replace 2D drawings, however as more subcontractors continue to utilise digital technologies (tablets) on construction sites for snagging and even viewing drawings, the BIM model now has the platform to reach and be utilised by the workforce out in the field.

Traditional 2D drawings (which are currently used) lack that 3rd dimension which can easily be taken from a 3D model. The upskilling and changing of mindsets amongst subcontractors and their people to utilise the 3D model will provide more exposure with regards to the original design intent and help to reduce unnecessary queries and incorrect installations. However, it all depends on the quality of the model and the information inputted by project teams.

On the iMET project as an example, the design team utilised the BIM model during the preconstruction stage to co-ordinate and locate a hole through a steel beam to avoid a clash with a pipe and curtain walling below the beam. When the pipe was initially installed by the M&E subcontractor, it was hard to tell on the 2D drawing what the intent actually was and it was installed below the beam instead of through it before being rectified.

As the utilisation of BIM becomes more commonplace, there is still a long way to go to ensure that BIM is used comprehensively and is the first consideration at every stage. Supply chain engagement, collaboration and education are crucial in ensuring this happens.

The iMET team agreed that customers and contractors should encourage or even make it mandatory for the supply chain to have access to the Common Data Environment (CDE), including the BIM model, remotely. This helps to ensure (as noted above) that the supply chain embraces BIM fully, and use on-site visualisation as a practical way in which they can make day to day efficiencies.

There is no reason why the model cannot be used on-site by the supervisor, however this does not always happen on-site – suggesting full immersion is still required amongst suppliers.

LESSONS LEARNED:

- Sub contractors need to be made aware of BIM protocols and standards.
- BIM workshops with the design team, supply chain and customers are a good way to foster collaboration and understanding between all parties.
- BIM models must be updated regularly and all specified and installed equipment must be tagged.
- BIM is the most efficient way to get from design to construction and completion, as it creates efficiencies which are then realised during the construction stage.
- Remote access to the 3D model improves quality and reduces errors.
- If the installer is involved from the very beginning this delivers a better result.

RECOMMENDATIONS:

- Appoint supply chain as early as possible and issue EIRs and AIRs.
- A good set of BIM deliverables for post-construction will help to deliver long-term value for the customer.
- All sub contractors should be requested to attend meetings to keep them aware of clashes and any co-ordination issues.
- Create a working environment to encourage use of BIM in every day activity. This includes having the right facilities and hardware on-site.
- Encourage, or even make it mandatory, on such sites for the supply chain Package Supervisors to have access to the common data environment (including the BIM model) remotely.
- Model is used as a visualisation tool at every opportunity. Inductions, progress meetings and out in the field.

COMMON DATA ENVIRONMENT (CDE)

Information management is a vital component of BIM and a strategy must be in place from the outset to ensure the Common Data Environment (CDE) processes data effectively and the team delivers structured information.

For iMET, workshops were carried out at the design stages by Willmott Dixon to provide training to use Viewpoint (4Projects), their corporate project management system. These workshops were a good example of the iMET project team engaging suppliers and collaborating to realise the benefits of using BIM software.

A dedicated Information Manager was also appointed for the iMET project, and this helped to ensure consistency and good management of information across the project team. This is particularly useful where there is mixed expertise within the supply chain on information management to support BIM.

Early team agreement on the file naming convention, and the process and responsibilities for signing off information, helped to ensure consistency and a smooth process. Simplified and specific project workflows on iMET also helped to ensure suppliers followed the agreed protocols. Furthermore, supply chain partners on the iMET project were guided by both the Design Manager and the Information Manager to use the correct status codes set out in BEP. The file naming convention etiquettes for information was identified in the BEP.

A good example of the importance of information management on the project was that Willmott Dixon produced and issued their own CDE user guide as part of their response to the EIRs. Production of information had already commenced, at this stage, and so there was a time-consuming process of renaming information to align with the file naming convention and setting up a compliant (BS1192) file structure. The project team migrated to a compliant filing structure midway through the project, which caused some logistical issues.

Willmott Dixon and consultants had the opportunity to comment on other consultants' drawings using Viewpoint. It was noted that some consultants still felt that commenting via 4Projects is more time consuming than manual mark-ups, however the immediate accessibility of current data to all was recognised as a benefit.

The team was successful in creating a clear strategy and protocol to manage the flow of information. Putting resource into this process and providing a dedicated Information Manager also helped to ensure the process was followed. It is also important for sufficient time to be allocated for suppliers to adopt BIM and change their approach, when they may be used to more traditional methods of working.

LESSONS LEARNED:

- Information management was vital, but time had to be spent ensuring supply chain partners were following protocols.
- Consultants may be reluctant to embrace a software which may be new to them, or may have preferences for other systems. Training where required is essential to ensure consistency and full utilisation of the chosen software.

RECOMMENDATIONS:

- A dedicated Information Manager can help to ensure information across the project team is policed, and managed effectively and consistently.
- A simple, clear strategy and protocol for information management is necessary across the project.
- Suppliers should be provided with specific training on software where needed, and sufficient time allocated for this, to ensure the whole team understands how to use them so that the efficiencies of BIM can be achieved.

HANDOVER DOCUMENTS

As there were no EIRs documents in place at the start of the project, Willmott Dixon assisted the customer in producing these to assist with the design lifecycle and handover of the project. The two main BIM-related outputs at handover were the 3D model and COBie Data.

COBie Data outputs are in Excel spreadsheets using a format that can be read by a Facilities Management System. This data includes key information relating to the main elements of the building, such as a light fitting or door (as an example) and provides details on things such as their location, type, quantities, warranties and the like which aid in the ongoing management of the building.

The Employers Information Requirements and Asset Information Requirements are the key documents which act as a BIM road map through the duration of the project and determine what the customer team expect to see at handover. This is why it is very important that this initial process is done correctly and the facilities management team are fully engaged from the onset and are realistic as to what elements of the building they need to utilise COBie for.

COBie data does not currently replace the old traditional O&M manuals, although it may well do so in the future. Due to a lack of understanding on this topic, there is a tendency for the customer to ask for 'everything' in their AIRs, which can be a waste of time and money for no real benefit to the project.

As part of the Asset Information offerings for iMET, Willmott Dixon worked in collaboration with Bond Bryan Architects and the customer to determine how the building would be managed by the college and what key data was actually needed.

As with BIM generally, there is a lack of understanding with regards to COBie roles, responsibilities and outputs. As this became apparent at key milestones, Willmott Dixon engaged a 3rd party to audit the models and COBie and present the latter in a more user-friendly format for use by the college as a learning tool and also by their facilities management team.

It is critical to ensure that the correct information is handed over and, therefore, it is important to identify the customer's BIM lead very early in the project and ensure they are fully engaged with the design and contractor teams at key data drops (particularly pre-handover) is critical to ensure the right information is handed over. On iMET, we put a strategy in place over the three-four months prior to handover to ensure the team was engaged and knew what needed to be submitted.

LESSONS LEARNED:

- Customer engagement is important as they need to be able check the final outputs.
- Liaison with the customer's facilities management and building management team is vital for the accuracy of the data provided.
- Ensure a strategy is in place for the project team in the lead-up to handover and everyone is fully aware of their handover deliverables and upskill as required.

RECOMMENDATIONS:

- The lead contractor must support the customer, as well as the supply chain, at every stage to understand what they need to do to understand and evaluate the project.
- The Project Information Model handed over to the customer ideally should be hosted on a CDE. Customers must place some value on the data provided by the main contractor.

UTILISING BIM: LESSONS IN THE CONSTRUCTION OF iMET

Key findings from the iMET case study:

- BIM must be wholly embraced by the customer and the entire project team from the outset to maximise the potential benefits.
- Customers and their lead contractors must engage Small and Medium-size Enterprises (SMEs) and the supply chain with strict requirements and expectations as to the adherence to an agreed BIM protocol to deliver fully and to ensure the entire team is 'BIM ready'.
- Although BIM is more prevalent within the industry and now a requirement on some public sector projects, SMEs and the supply chain require support and clear guidelines to ensure they are fully engaged from the outset of a project.
- Problems and clashes will inevitably arise on projects, and these need to be resolved through collaboration. Meetings and discussion are still essential.
- BIM will help to reduce the long-term running costs of a building by considering facilities management and the lifetime of the asset from the outset.

COMMENTS FROM THE iMET PROJECT TEAM

"Although defined in the Scape Access Agreement the adoption of BIM Level 2 was a great challenge to all parties (including us, the customer). The main contractor and architects were very keen to support the application and, very early, we all realised the change in methodology that would be required. Collaboration and teamwork was the route through and was demonstrated in many instances, with resulting benefits driven from an holistic approach. Interestingly, this developed into a strong project loyalty combined with an advocacy for the use of BIM."

Richard Baggaley, Project Manager, iMET

"Our experience working with our customer on the iMET building has been a positive one and reflects our current market place. We have many customers who need support and education on the value of the BIM process and the data we provide for the future running of the asset. Plus we have a supply chain with varying levels of knowledge, capability and expertise. It would have been easier to not to commit on iMET, but we chose the difficult path as we knew it would ultimately assist in delivering a better product. The team have been fantastic at dealing with the challenges of change and inspiring our customer to deliver digitally in the future.

The collaboration facet of the BIM process adds real value, something you cannot quantify. I believe we are cost neutral currently on a BIM Level 2 projects. We are spending more on resource to manage the process as well as paying for third parties (Co Builder) to collect the data. However, we are having less issues, less RFI's and less errors on-site in comparison to non-BIM projects. The BIM process is adding huge value to our customer and exceeding their expectations. In the future, as the whole industry gets better at delivering through a BIM process and we build more elements offsite the cost will start to come down."

Garry Fannon, Head of Digital, Willmott Dixon

"Both the industry and the public sector stand to benefit enormously from the unprecedented efficiencies that could come from digitalisation and full utilisation of BIM. However, to get there we must all recognise the need for greater collaboration across teams, and allow time for this to take place, as well as the broader requirement for greater engagement with the supply chain and better education on BIM. A fundamental change in approach to the way we design and build is not easy to achieve, but it is essential than collectively we all strive for change. iMET will pioneer the training required to make this leap in capacity and deliver full utilisation of BIM."

Mark Robinson, Scape Group Chief Executive

"Working in a collaborative process with the customer, lead contractor, design team and members of the supply chain enabled us to design and deliver a fantastic building, both virtually and in the flesh. Clearly, the definition and the management of the information is the key to maximising the benefits of BIM to all involved in the design, construction and maintenance of the built asset. We hope that both the building and the Building Information Model will be an asset to iMET in the years to come."

Zubin Masters, Bond Bryan Architects

"Clearly, we now have a fantastic building, fit for purpose, with a Building Information Model that reflects the concept and strategic aims of iMET. The outcome reflects particularly well upon Scape and our major contractors, Willmott Dixon, and further supports the confidence and support given to us by the Cambridgeshire and Peterborough Combined Authority."

Mark Robertson, Principal at Cambridge Regional College