

BIMScotland

Modelling our built environment



BIM Scotland

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Searching for a single source of truth

Europe's biggest infrastructure project relies on data to reduce risk and minimise waste

BY WILLIAM PEAKIN

Malcolm Taylor joined London's Crossrail project in 2009, a year before the iPad was launched. "Technology has changed a great deal since then," he told the BIM (Building Information Modelling) Scotland Conference last month, hosted by futurescot.com. Taylor, head of technical information at Crossrail, spoke about how data was being used to manage the project: "It's got a great business case. It will increase the public rail capacity by 10% and bring an extra 1.5 million people to within 45 minutes of the capital. But it's a big project, £14.8 billion."

The Crossrail programme is Europe's biggest infrastructure project. Construction began in 2009 at Canary Wharf. The programme is now 80% complete and is on time and budget. The new lines and stations will become the Elizabeth Line, running from Reading and Heathrow in the west, through new tunnels under central London to Shenfield and Abbey Wood in the east. "And it's a complicated job. There are 23 design contracts, 34 enabling works contracts and over 60 construction and logistic contracts. It's complicated contractually. And it's complicated when you

look at what we are building underneath what is quite a busy city," he said.

Tunnelling finished in 2015 and the project is now focused on the complex job of fitting out the stations and tunnels with the equipment and systems needed to operate the railway. This includes the installation of track, ventilation, power, signalling, communications and overhead line equipment. There will be 40 Elizabeth Line stations including 10 new stations at Paddington, Bond Street, Tottenham Court Road, Farringdon, Liverpool Street, Whitechapel, Canary Wharf, Custom House, Woolwich and Abbey Wood. Services through central London are due to start in December 2018.

Taylor's responsibilities include BIM strategy and implementation, geographic information systems, asset information management, technical data management, document control, data handover strategy and configuration management. He is a chartered engineer and before joining Crossrail he was rail director for a major global consultancy working on many UK and international rail projects. Starting as a graduate with London Underground, he has more than 35 years' experience in the design, construction and maintenance of large-scale transportation projects around the world, with an emphasis on railway design, programme and project management.

"The stations are also now taking shape," he said, "and we have gone to some length to ensure that the stations

and over-station developments have been designed by leading architects to provide a positive physical legacy for London and its future street-scape. Given the sheer scale of Crossrail, all the new central London stations are significant structures. For example, our station at Paddington is the equivalent of taking No 1 Canada Square at Canary Wharf, lying it on its side and burying it between the mainline station and Eastbourne Terrace."

Taylor said they were building two railway lines; an actual line and a virtual one: "Both have to be right, because it's the virtual railway we are going to be using to help us manage

and maintain the physical one. So, we have had a BIM environment before it was mandated by the Government. For me, it was all about what we were going to use the information for. How do we get all those contracts to work in a common data environment?

"We had to use technology to create a world where everybody works on single with a source of truth. It was the only way for everyone to collaborate. We also had a concept of models – information, 3D models were incredibly important early in the visualisation of what we wanted to create. But when you get into management and maintenance, data models – algorithms for the condition of an asset, when are you going to replace it before it fails? – those are information models. That world of information modelling and scenario planning is a real part of operating and maintaining the railway.

"We are trying to get out of that old world where everyone has a copy of everything into a BIM world where you have this single source of truth. We as a client create that information world and we require contractually everybody to use our systems, our processes, our way of doing things. There was a lot of difficulty at first, to get a lot of big contractors to follow our systems – 'Why don't you use ours?', they'd say – we had to have everybody use our systems to enable us to create that single source of truth. You create a lot of information building, and you create a lot of information for maintaining it.

"We are trying to get out of that old world where everyone has a copy of everything into a BIM world where you have this single source of truth"

Malcolm Taylor, Crossrail



Eyes on - The westbound tunnel cross-over at Whitechapel Station, Her Majesty the Queen visits the under-construction Bond Street Station and a proposed upper escalator at Bond Street



You need that information to control the construction environment and you need to be careful about the technical information you are creating for operating and maintaining.”

Taylor said that Crossrail used “the power of databases”, rather than a myriad of software programmes that contractors were eager to use early on, to manage information and workflows: “That saved a lot of money [in unnecessary software licences] and allowed us to create our common data environment. And it made so much quicker to source information. This technology allows us to coordinate all the different disciplines – mechanical, architectural, structural. For example, through overlaying laser point cloud surveys to assure the design. We have been using BIM in planning, design and further into 4D and construction –

take those models we have been using in design and monitor progress, to see how installation of the design is going where we want.”

Crossrail has “pinched the concept of the iPod” to take information from all the projects into the common data environment and then create playlists depending what people want. “The sort benefits we can get from this world? Amazing how much safety has improved by being able to visualise what we are going to do, make sure people understand what it is they are going to build.”

Taylor showed an animation of the new route as it was being built, passing 83cm over the top of the existing Northern line. “You have to be pretty brave to do that, but it was data and information that we could understand and trust and enabled us to make that

decision. It’s been quite a journey; making sure people value data.”

The conference also heard from a range of speakers including Adam Matthews, chair of the UK Government’s BIM Task Group, Morag Angus, chief surveyor at the Scottish Government, Bruce Newlands, head of technical operations at the Construction Scotland Innovation Centre, Adrian Shilliday, technical director and BIM leader at Galliford Try Construction and Ryan Tennyson, chair of the Construction Scotland BIM Suppliers Group and associate and lead information manager at WSP | Parsons Brinckerhoff. The conference was chaired by David Philp, global BIM consultancy director for AECOM and chair of the BIM Delivery Group for Scotland.

<http://bim.scot/>

Industry led and demand driven

Bringing together business, universities and the public sector to deliver transformational change

BY LISA DEANE

The Construction Scotland Innovation Centre (CSIC) is one of eight industry led and demand driven Innovation Centres supported by Scottish Funding Council, Scottish Enterprise, Highlands & Islands Enterprise and 13 Scottish universities. We support innovation projects that bring together construction businesses, university experts and public sector partners to deliver transformational change, typically tackling innovation challenges that will drive greater profitability, productivity, efficiency & sustainability.

Digital technologies form a key strand of Scotland’s economic development moving forward and the evolution of knowledge based industries equipped to address targets for efficiencies and carbon reduction. In some areas, such as computer gaming, Scotland’s reputation as a global leader is well established. In the construction sector, initiatives to globalise digital standards and practice are gaining momentum. In the context of global, European and UK initiatives, there is a significant opportunity for Scotland to develop fresh initiatives which extend and enhance the existing knowledge base for digital working and deliver on the aspiration for a competitive and forward looking construction sector.

A key recommendation within Scottish Government’s Construction Procurement review was the implementation of Building Information Modelling (BIM) to Level 2 by April 2017. The review set out the following recommendation, which was endorsed by Scottish Ministers: “The use of Building Information Modelling (BIM) should be introduced in

central government with a view to encouraging its adoption across the entire public sector. The objective should be that, where appropriate, construction projects across the public sector in Scotland adopt a BIM level 2 approach by April 2017.”

BIM Level 2 is distinguished by collaborative working in the form of how the information is exchanged between different parties. Design information is shared through a common file format, which enables any organisation to be able to combine that data with their own to make a federated BIM model, and to carry out interrogative checks on it.

Supported by Scottish Enterprise and in partnership with Construction Scotland Industry Leadership Group, Scottish Futures Trust, BIM Region Scotland and the Scottish BIM Suppliers Group, CSIC has set out a range of support for individuals & organisations as they prepare for BIM Level 2. The support has been designed to raise awareness on the use of BIM in the Scottish built environment and to demonstrate the benefits that can be achieved through knowledge sharing, collaboration, innovation and best practice guidance.

ONLINE HUB

A ‘one stop shop’ web page bringing together the very best of BIM content including downloadable standards, free tools, links, learning & guidance. Visit www.cs-ic.org/BIM for more information.

NETWORK

On the web page, anyone can also sign up to our network, ensuring they are kept up to date with current BIM Guidance, links to key standards & news.

PREPARING FOR BIM

“Preparing for BIM” is a three-year awareness & implementation programme based around the UK BIM Task Force Learning Outcomes and consisting of free to attend monthly events aimed at all organisations involved with constructions. The events take attendee’s through a ‘step by step’ programme of awareness to implementation up to and past the April 2017 implementation date. Events will be hosted across Scotland giving every organisation the opportunity to attend.

FREE ADVISORY SERVICE

In addition to the events there is a free BIM advisory service, which has been set up to support enquiries from individuals and organisations to help them prepare effectively for adoption of BIM level 2 within the Scottish construction industry.

Lisa Deane is skills and training coordinator at the Construction Scotland Innovation Centre

“In the construction sector initiatives to globalise digital standards and practice are gaining momentum”

Adopting a 'kaizen' approach

Applying small, incremental improvements daily will serve you well

BY WILLIAM PEAKIN

"Giving people some new piece of software is not automatically going to make them more productive," says Gordon McGlathery. "Building information modelling (BIM) is equal parts technology, process and people – and true BIM lies at the convergence of those three. It's critical that organisations devote as much time to their people strategy as to their technology and process strategies."

McGlathery is head of training at Cadassist, the 3D design and data management company. "It is very satisfying to see companies transition from being laggards in their field to being leaders, through the successful implementation of BIM. But there are some who make a major investment in the technology and none in education and training. They have tried to make the leap without a learning strategy, and they wonder why their BIM projects lose them money."

Implementing BIM needs to be led from the top, said McGlathery, not by the technologists, and it should encompass the whole organisation in such a way that every employee not only understands what BIM is and its potential, but also how it will change



their role. "Professionals are all being asked to work in a smarter, faster, more efficient, more data-rich, more interconnected way," he said. "We are grappling with new processes, new deliverables, new ways of partnering and sharing data. It goes without saying that we will need to learn and adopt new skills to respond to these challenges."

TO IMPLEMENT BIM, some organisations believe it is only necessary to find the best people and put them in

the right place. "You will need much more than that to transition to BIM successfully," said McGlathery. "To cope with this level of change, I believe we need a learning strategy for BIM." A successful learning strategy, he said, involves the whole organisation, the starting point and desired outcomes are known, it caters for different skill levels, the quality of the training is high, the learning continues when the training ends and, crucially, there is a system for learning in place.

"The most important questions don't

come up during training, they come up in the middle of that first project. That is when a new user is under real pressure to learn. It's critical they have support at that moment. Some of the most important outside-the-classroom learning that I've seen around BIM takes place when you have an independent review – either through a review of one of your building models or a review of your BIM protocols. The learning that takes place around one of these reviews is a lever you can use to raise your game. You can then

Continual learning is at the heart of Japanese business philosophy

"Equal parts technology, process and people – true BIM lies at the convergence of those three"

Gordon McGlathery

apply these new best practices to every project that follows.

"And to keep up with the rapid pace of change around BIM, creating a learning management system (LMS) for your organisation is key. It is a platform for you to provide your teams access to on-line training and assessments. Imagine the impact of your teams being able to learn essential skills anytime, anywhere, at their own pace, and then applying those skills immediately. And then going back and learning some more. On demand technical training with minimal employee downtime; it's an exciting idea, and one that more and more organisations are turning to.

"A commitment to ongoing learning needs to be central to our BIM learning strategy. We are used to thinking of training as something we do once, when we start to use new software for the first time. Sometimes we are lucky to get any training at all. That old thinking puts our move to BIM in jeopardy. We need to accept that continuous learning is part of this new BIM landscape we are navigating. This attitude is captured in the Japanese business philosophy called 'kaizen' which focuses on applying small, incremental improvements on a daily basis. Adopting a kaizen approach to learning BIM will serve you well. And implementing a learning management system will help you deliver on this approach."

www.cadassist.co.uk

Clearbox partners with Kier to drive efficiency gains for Ayr Academy

Kier is working closely with South Ayrshire Council and hub South West to construct the new £25m flagship Ayr Academy project. The secondary school, which is currently located in the town's Fort Street, will relocate to the new Craigie Estate in August 2017, providing state-of-the-art education, teaching and sporting facilities to the local community.

This project is offering a great opportunity for the team to hone its Building Information Modelling (BIM) skills, using BIMxtra software from Clearbox to enable the process to drive through efficiency gains for the project and its clients, South Ayrshire Council and hub South West.

Throughout each stage of the build the techniques applied have helped drive collaboration and coordination across the supply chain,

from client through to subcontractor, ensuring the mitigation of risk, improved commercial management and increased stakeholder engagement.

Michael Ross, Project Director, hub South West, said, "Kier Construction's approach to BIM on the Ayr Academy project has promoted enhanced collaboration and coordination, bringing significant benefits through all stages of the project. By utilising innovative solutions to engage with South Ayrshire Council, hub South West and the Teachers/Pupils, Kier has used BIM to provide all parties with far greater insight and understanding into the final design of this fantastic school."

BIM-enabled design team meetings and co-ordination workshops take place regularly to facilitate the process. Part of these meetings involves carrying out automated clash detection on the models. This allows the project team to address and resolve coordination issues which, if identified on site, would cause programme time delays or incur additional costs.

BIM-enabled Commercial Management has brought significant benefits throughout the project, providing increased



cost certainty and management controls through the checking, reviewing and validation of the geometry and data within the models. This includes scoping out work packages with subcontractors and specialist designers, undertaking pricing and quantity validation, and linking the change management and change control processes to the models, which in turn tracks design development and work package scope creep.

A greater level of cost certainty was achieved on the furniture, fixtures, and equipment (FF&E) package through early engagement with Specialist FF&E Designers who developed a cost effective, scalable and repeatable design using BIM. The FF&E BIM model, along with the room based components contained within the Mechanical, Electrical and Plumbing (MEP) BIM model, facilitated the creation of coordinated 1:50 room layout drawings. These drawings, along with the models, allowed the client to visualise the proposed design, greatly facilitating the room sign off process.

Commenting on the project, Craig Mason, BIM Manager, Kier Scotland, said, "Ayr Academy has provided us with a great opportunity to work collaboratively with the client and project team to drive through the real benefits of BIM. This has allowed us to deliver the build in a far more effective and efficient manner as a result of better information management and stakeholder engagement."

The team has taken stakeholder engagement one step further, using emerging technology through mobile devices and Virtual Reality to talk the client and end users, including pupils, through the proposed design. This has proved to be an invaluable tool, allowing a far greater understanding for stakeholders who potentially don't fully understand traditional 2D drawings.

Graeme Forbes, CEO, Clearbox, added, "Ayr Academy really proves the benefits that can be gained by using new digital construction processes. The Kier Scotland team has demonstrated that by engaging the supply chain and working collaboratively from the outset, real efficiency gains can be made by delivering the right information, to the right people at the right time."



Clearbox
www.clearboxbim.com
Images courtesy of BDP

Construction is moving towards a digital future



Innovation plus data equals opportunity

Scotland's journey to the digitisation of construction

BY PAUL DODD

The merging of digital technology with the physical built environment is becoming faster and more real than ever before.

As Scotland's construction sector continues to move towards becoming digitised, the management of digital data and information within the public estate is seen as a key mechanism to drive efficiencies during the construction and operational stages. This process of accurately creating and managing digital information and exchanging data within the built environment is globally referred to as Building Information Modelling (BIM) and is underpinned by a suite of British Standards.

BIM is fundamentally a collaborative process for generating and managing a digital representation of a building using technology to improve the shar-

ing and analysis of data across the life of a building. This digital twin provides a virtual, 3D representation of a building or infrastructure project's physical and functional characteristics which can be tested and refined before the project starts on site. The combination of computer readable construction data and innovative, more collaborative working practices is a powerful one, offering a world of opportunities to the Scottish construction sector.

THE SCOTTISH Futures Trust (SFT), is working in partnership with Scottish Government on a programme that is set to push forward the union between technology and construction to ultimately help the public sector better procure and care for their buildings through the use of BIM and its data rich environment. Scottish Government accepted the recommendations of the Review of Scottish Public Sector Procurement in Construction which stated that "BIM should be introduced in central government with a view to encouraging adoption across the public sector. The objective should be that, where appropriate, projects across

the public sector adopt BIM level 2 by April 2017."

In response to this and as part of the wider public procurement reform, a Scottish BIM Implementation Plan was published in October 2015 and the BIM Delivery Group for Scotland set up. The BIM Implementation Plan sets out a roadmap to deliver Scottish Government's objectives and focuses on several enabling actions including guidance creation, pathfinder projects, and training for the public sector which have all been delivered.

Scottish Futures Trust led the formation of the BIM Delivery Group for Scotland and appointed David Philp, Global BIM Consultancy Director for AECOM as chair. Paul Dodd, associate director from SFT noted: "David's experience, expertise and support has been of great value to the BIM programme within Scotland."

As we head towards April 17, the BIM Delivery Group for Scotland are ready to launch their innovative BIM Guidance website. The website will support public sector procurers adopt BIM within new construction projects.

The new guidance website seeks

to answer three questions for the procurer: what is the appropriate level of BIM maturity for my project? What is the likely return on investment, and thirdly, how do I execute it? Intrinsic to the website is an on-line "BIM Grading Tool" which helps the public sector determine an appropriate level of BIM maturity and supports the objective of adopting BIM Level 2 where appropriate.

Next, a pioneering return on investment calculator helps create a business case for BIM on their project through comparing the cost benefits and likely investment needs. Finally, through a navigator tool the procurer will be taken to a specific guidance with all the relevant tasks, templates that will demonstrate how to successfully implement BIM on their project.

The BIM Delivery Group for Scotland has worked collaboratively with industry and created a joint working group with Construction Scotland to align the approach of the public sector to the needs and capacity of industry. Scotland's BIM programme has attracted interest both nationally and internationally. This has enabled collaborative working with other national

BIM programmes including Germany, Ireland, Singapore and New Zealand.

"The Scottish Government's BIM programme has delivered new innovative tools to ensure that an appropriate journey towards digitisation for the Scottish public sector can be determined and built upon. From my global perspective the Scottish BIM programme is attracting a lot of positive interest nationally and internationally, and is a true partnership between government and industry seeking new ways to better our construction industry," said David Philp.

The BIM Delivery Group also recognised how digital working can support the skills shortage within the construction sector. A BIM academia working group was created to consider the approach to skills, training and using digital working to attract new entrants to the construction industry. Furthermore, the BIM Delivery Group delivered training workshops across Scotland where 350 public sector delegates attended.

"The BIM programme for Scotland set ambitious and bold objectives which will be delivered this year. Through embedding BIM requirements within Scottish Government policy, the new innovative guidance portal and collaborative working across industry, Scotland is well placed to adopt digital working to support better outcomes within the built environment," said Paul Dodd.

The construction sector has seen gradual adoption of digital working and there are many recent examples of infrastructure projects within Scotland adopting greater digital working. The new BIM requirements will be a further step in Scotland's journey towards digital working within the built environment.

Paul Dodd is associate director with the Scottish Futures Trust and is a member of the Scottish BIM Delivery Group.

“The BIM programme for Scotland set ambitious and bold objectives which will be delivered this year”

Paul Dodd



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vincenzo@canongate.org

Digital transformation within the construction industry offers a new paradigm for efficiencies in project delivery and it is important that BIM technologies and processes are adopted if Scotland is to have a leading place in the world.

Timed in advance of the Scottish Government's BIM Level 2 mandate, you can now review all the presentations from FutureScot's BIM Scotland 2017 Conference at <http://bim.scot/speaker-presentations/>

**Think
Digital,
Think
FutureScot**

FutureScot features digital leaders and disrupters, policymakers and grassroots groups helping to make Scotland a leader in technology and digital transformation. A rapidly evolving media brand, FutureScot also delivers leading conferences and tailored events to support the sharing of information, best practice and exploration of innovative solutions across the digital sectors.

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IS YOUR ORGANISATION BIM-READY?

As the Scottish Government deadline for public sector projects to adopt BIM Level 2 gets nearer, Andy Butterfield, Product Certification Director of Built Environment at BSI explores the current BIM landscape...

BIM (Building Information Modelling) has been high on the agenda for the global construction industry for some time now. In Scotland, it's seen as a key part of the future of the construction industry following the publication of the Government's *Construction Procurement Review*. This called for all public sector projects across Scotland to adopt a BIM Level 2 approach by April 2017¹. Yet despite the push from Government, organisations are increasingly seeing the benefits that BIM brings regardless.

BIM is a collaborative way of working that uses digital technologies to enable more efficient methods of design and construction, ultimately driving out waste and inefficiency. Historically, those involved in a project have each managed and owned their own area of the project, often using different models and drawings. BIM Level 2 brings together stakeholders so they work collaboratively throughout the design, delivery and construction phases of a project. Using BIM technology can give organisations competitive advantage when it comes to private projects, and is fast becoming a key driver.

BSI recently launched a new Kitemark for PAS 1192-2 *Information management for the capital/delivery phase of construction projects*, helping construction businesses around the world prove their capabilities in delivering projects at the design and construction phase. The BSI Kitemark for PAS 1192-2 was developed in collaboration with industry stakeholders to ensure that they add value and address the key issues which will help the construction industry with BIM implementation and demonstrate their commitment to best practice.

The scheme is available to all companies whether or not they have already achieved the verification stage. Certification to ISO 9001 Quality Management Systems is also a requirement. It is aimed at both Tier 1 and non-Tier 1 organisations and will provide the most robust measurement of a company's delivery of BIM projects, certifying businesses for their diligence in design and construction, supply chain management and delivery of customer service excellence. As with other BSI Kitemarks, organisations holding the Kitemark will be routinely assessed, providing clients with complete confidence in their delivery to industry standards.

"We believe the BSI Kitemark will not only further strengthen our position as market

leader, but also give customers confidence in our ability to work collaboratively with others in the supply chain, and prove we have the expertise to provide a service that goes above and beyond the standard BIM offering," Alan Harris, Quality Manager, voestalpine Metsec plc, one of the first six organisations to achieve the BSI Kitemark for PAS 1192-2.

The BSI Kitemark for Design and Construction builds on the verification scheme for PAS 1192-2 launched last year and involves the sampling of completed projects, assessment of customer satisfaction through ISO 10004 *Customer Satisfaction Guidelines* for monitoring and measuring and will use additional assessment parameters through BS 11000 *Collaborative Business Relationships*. Like the verification scheme, the BSI Kitemark for PAS 1192-2 is an important component of BIM Level 2 and sets out the requirements for the Design & Construction phase.

The BSI Kitemark is one of the most recognizable trust marks in existence today and demonstrates that each Kitemark approved product or service, has gone above and beyond the normal requirements to achieve the highest standards. For over a century, it has safeguarded consumers and helped businesses demonstrate clear commitment to excellence across everyday goods such as locks and windows, gas appliances, motorcycle helmets and smoke detectors.

David Throssell, BIM and Digital Engineering Operations Manager, Skanska UK, who also achieved the BSI Kitemark in December 2016, commented: "The BSI Kitemark is a respected brand. Applied to our services it will reinforce client confidence and prove greater quality in the delivery of BIM projects."

The influence of digital technology on the built environment is only going to increase, and BIM is an important aspect of this new world. For those companies looking to gain competitive advantage, reduce outgoings and work more efficiently, certification can help to support this strategy.

Mark Taylor, Digital Construction Manager at BAM Construct UK Ltd comments: "BIM is a major driver for the digitisation of the construction industry, influencing its direction both in the UK and abroad. We were pleased to work with BSI and our peers to develop the certification, providing a clear assessment pathway to achieve the Kitemark. This will reassure clients and partners

that we are working efficiently to the highest possible standards and that BIM processes are embedded within our systems."

Organisations must understand what is most important for their business, how they can make improvements within the supply chain and ultimately deliver what clients need. In order to support businesses, BSI has developed a number of training courses in order to help raise awareness and ensure that BIM is embedded within each organisation. These courses are fully aligned with government and industry requirements, as well as the relevant BIM standards.

It's important that all those involved in the construction supply chain are BIM-ready – not just the main contractors or Tier 1s. BSI has been engaging with local authorities in Scotland and contractors to help raise awareness of the support that BSI offers in the marketplace as all organisations must be able to demonstrate their BIM capability in order to be considered for publicly procured projects. Those main contractors who wish to better manage their supply chain will require sub-contractors to demonstrate their capability to deliver projects using BIM. The BSI Kitemark can help organisations to assure customers of customer excellence, enhance project delivery and enable collaborative working within extensive supply chains. As the Scottish Government deadline looms, organisations should be asking, are we BIM-ready?

For more information, please visit www.bsigroup.com/en-GB/Building-Information-Modelling-BIM/ or call +44 345 0765 606



¹<http://www.scottishfuturetrust.org.uk/our-work/sft-build/construction-procurement-review/building-information-modelling-bim/>