Building Information Modelling
Report March 2011

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Contents

Putting the 'I' into BIM

This is the first 'NBS BIM Report' in what will be a series of reports on the adoption of what we currently call 'BIM' or Building Information Modelling. These reports will track changes in attitudes towards BIM as well as implementation within the industry. They will act as a reference point for the industry to share success and to highlight areas of developmental need. Ultimately, they will also strip away much of the hype and hysteria around BIM to provide detailed answers to important issues including Return on Investment.

Searching for a definition of BIM, it is clear that there are many views as to what BIM is. Incorrectly seen as a technological solution to CAD integration, BIM places the effective use and exchange of 'Information' at its heart. As a result, BIM will have an impact on most areas of business management and operation. It will revolutionise methods of working and fundamentally redefine the relationships between construction professionals. It will challenge current thinking on contracts and insurance and most importantly, it will support the integration of the design and construction teams.

Whilst such fundamental changes should be high on the agenda for all professionals, the NBS research indicates that this is not the case. There are distinct areas of expertise developing in many organisations and they are already challenging current methods of working. However, there is a risk that many others will be left behind as other organisations fail to achieve the returns required for investment in both technology and training.

For organisations looking to justify investment in this area, they would be well served by looking beyond their own systems to those of their partners. As the sharing of data increases, standardisation of systems and processes will become more important. They should also look at the services they can offer. Costs of investment could be more than covered as the information systems allow for other new service options to be provided. The latter issue on training has been covered by a small number of forward thinking universities. These agile academic institutions will provide many of the experts that the industry will need to evolve.

So where does NBS fit into this new world? Our aim is to focus on the centre of BIM, placing 'Information' at the heart of the construction process. We will show that there is much more to BIM than enhanced visualisation and automatic scheduling! We will provide the information needed to improve decision making at each stage of the construction and operation process, as well as developing libraries of data that will support this information revolution. We will also be providing guidance and links to other published sources of knowledge that will support the idea of 'getting it right first time'. In all its forms, both graphical and textual, information will be central to the new models of building!

Richard Waterhouse
Chief Executive, RIBA Enterprises

The rapid acceleration of BIM

by Dr Stephen Hamil, Director of Design and Innovation and Head of Building Information Modelling at NBS

Stephen has a particular interest in Building Information Modelling (BIM) and is one of those leading the work at NBS to change specification data from 'words on a page' to 'intelligent objects describing the building'. Stephen joined NBS in 1999 and has led the software development of products and services such as NBS Building, NBS Plus, NBS Scheduler and NBS Domestic Specification. Prior to joining NBS, Stephen studied at Durham University where his first degree was in Structural Engineering, followed by a PhD in the computer modelling of reinforced concrete beam to column connections.

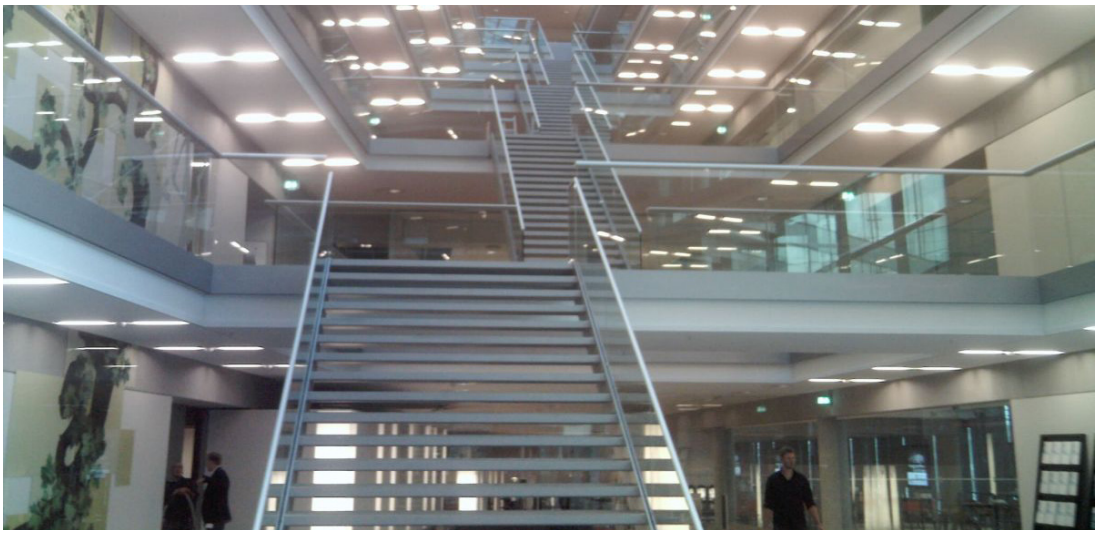
All around the world

This time last year, many people's view of BIM was that it was something that only a small specialist area of the industry had really adopted. There was a perception that it required a large investment, both financially and in training, and was a long way from entering mainstream construction practice. However, throughout 2010, I was fortunate to meet with many people in the construction industry working at the forefront of BIM, and it was clear that the rapid acceleration of BIM adoption had now truly started.

In September I attended the buildingSMART summit week in Copenhagen and it was fascinating to see how BIM models were being passed between different software applications and how knowledge was being shared between different disciplines on a project team. The high point of the week was the evening we spent at the new Ramboll head office, where they showed us how they had adopted BIM from day one to produce a truly magnificent building. The designers worked together sharing their models. The construction team used a combined single BIM to schedule the work and eliminate clash detections. Finally, Ramboll, as the building owner, is now using this BIM for facility management of the premises.

Ramboll building, Copenhagen

Other highlights of 2010 for me include the BSRIA and CIBSE BIM conferences at the end of the year. Memorable presentations from Paul Morrell (Chief Construction Advisor), Sam Collard (Laing O'Rourke) and Dan Clipson (Arup) left all attendees with a feeling that, after many years of talking about BIM, now was really the time it was hitting the mainstream. Paul Morrell went as far as saying that an upcoming report to the Construction Clients Board in March 2011 would 'mark the beginning of a commitment to a timed programme of transformation'. It is expected that BIM will be a requirement for all government construction projects above a certain size.



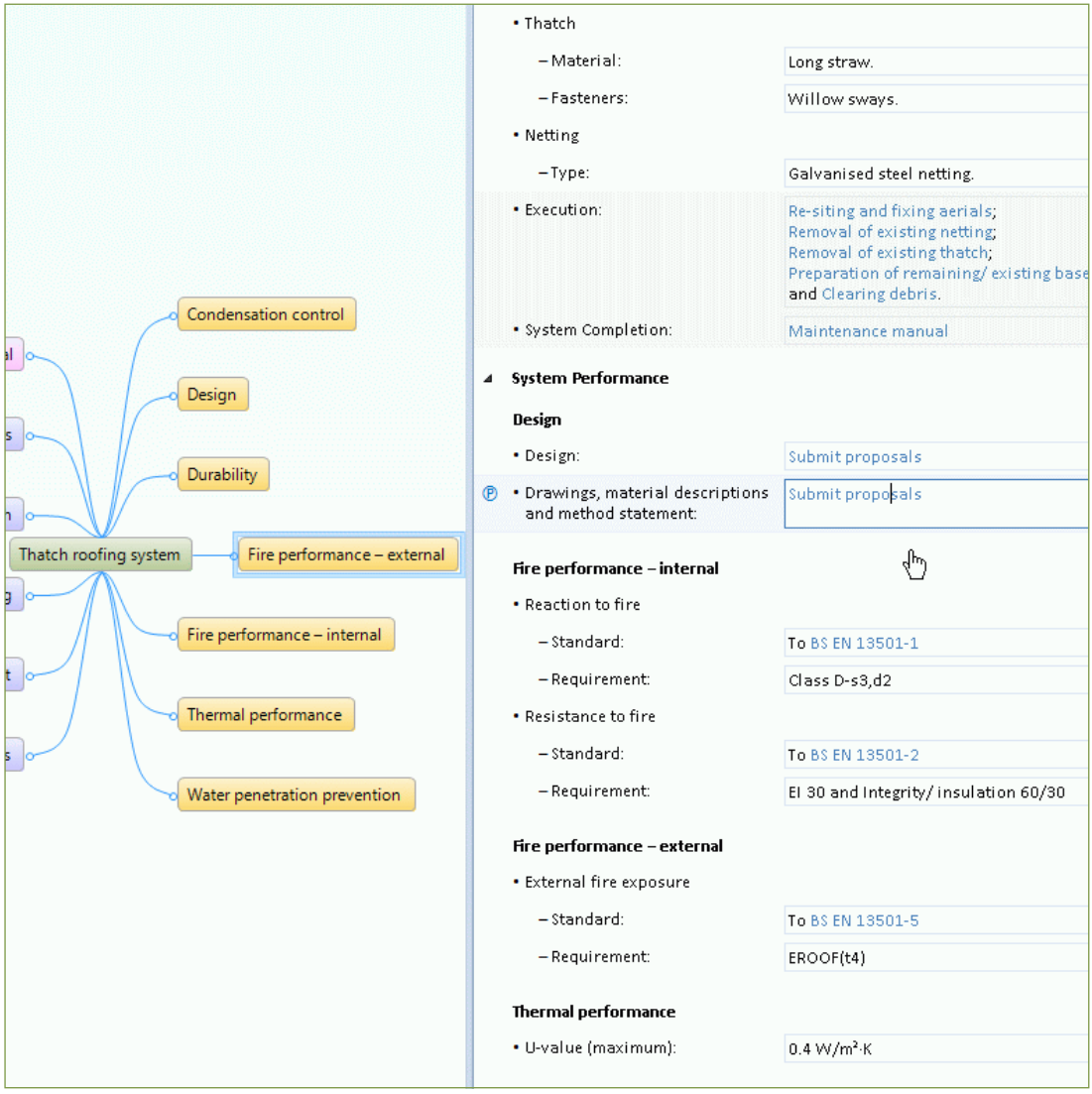
Ramboll Building, Copenhagen

BIM now, in the UK

In November, NBS sent a BIM survey to over 6,500 construction industry professionals. The results were fascinating and will soon be published in a report. They showed a clear split in the industry. Almost half admitted they were not even aware of BIM; however, the remainder were aware and are making preparations to adopt it on the majority of their projects. What this may leave us with, is a two tier construction industry, with a real risk of many companies being left behind. The key now is for companies such as NBS, and organisations like the RIBA, to keep on pushing the message to make all aware of the benefits of BIM.

Activity at NBS

At NBS, we are investing heavily in turning our specification and product information into digital objects in anticipation of the widespread adoption of BIM. This work is well advanced and we have a number of our existing NBS Building and NBS Engineering Services customers beta testing the developments each month. Moving the words in a specification into a rich information model will allow this data to be shared amongst the project team more effectively and allow work to start very early in the project with an outline specification. Then, with no information loss, this will be developed alongside the CAD model through the life of the project to produce a contract specification and finally a record specification. The specification model and the CAD model will be integrated so that design decisions are documented once and in the right place.



The new NBS specification model

Our new specification model will make life much easier for design and construction teams. We are modelling the relationships between the products that comprise construction systems or elements. This means that, for each system, the designer is offered the appropriate products automatically. Because the relationships are modelled properly, deleting the parent system will also delete all of the child products. In addition, the links to standards, regulations and product information are being improved and it will be possible to interrogate the specification for reports on key items such as contractor actions, reference documents and other user defined items.

We also realise that the NBS specification is most definitely not a silo of static information. Through on-going research and collaboration we are partners in:

- A Technology Strategy Board project developing an interoperable toolkit for costing embodied and operational carbon
- A project with Northumbria University looking into how information in the CAD and specification models can be used to drive automated Building Regulations approval.

Not a specialist activity

Some see BIM as a new specialist activity that is too big a leap to take. However, I believe that it is the job of the construction industry data providers and software companies, such as NBS, to make BIM happen 'under the hood'. What we need is quality, structured data – specifications, standards, regulations, products, and costs – alongside amazing, intuitive, software. With this in place, over time, people will no longer talk about BIM as a specialist activity, it will simply be designers designing and constructors constructing more effectively.

BIM survey: summary of findings

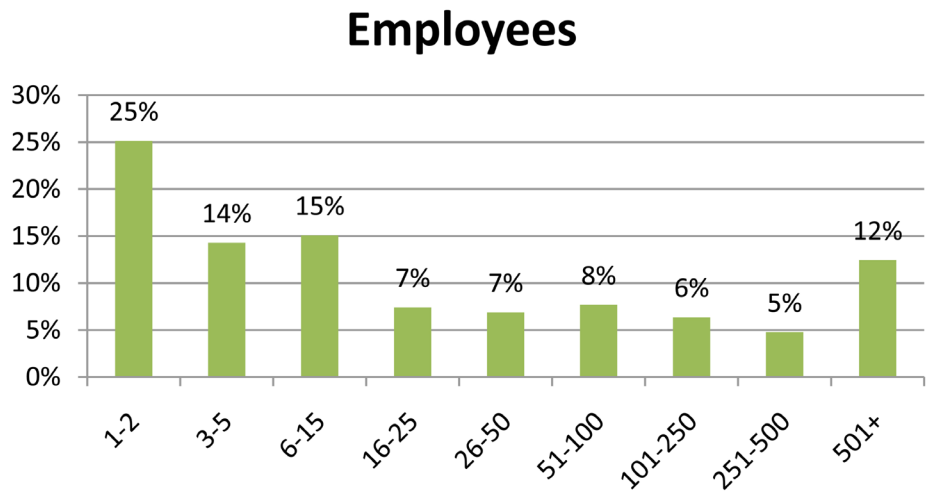
Introduction

In September and October 2010, NBS carried out a research project into the UK construction industry's attitude towards Building Information Modelling (BIM). We did the research using an online survey. More than 6,500 people received an invitation to take part. Around 400 people completed the survey, a response rate of 6 per cent.

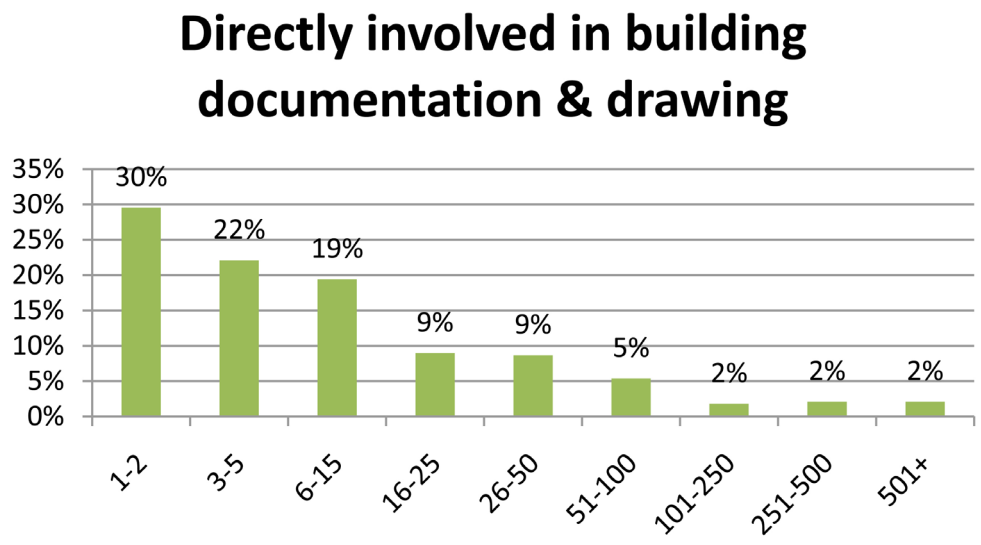
NBS used its extensive database of those in the construction industry to make sure that a broad range of professions was represented. Of those who took part in the research, 40 per cent were architects, 11 per cent were from multi-disciplinary firms, and 10 per cent were from the public sector (including Local Government). Some other professions that took part included architectural technologists and technicians, building surveyors, quantity surveyors, and manufacturers as well as structural, civil and service engineers.

A range of business sizes also was represented. A quarter of those who took part were working in places that had only one or two employees. At the other end of the scale, 12 per cent of those who took part worked in firms with more than 500 employees.

Including yourself, approximately how many people are employed in your organisation?

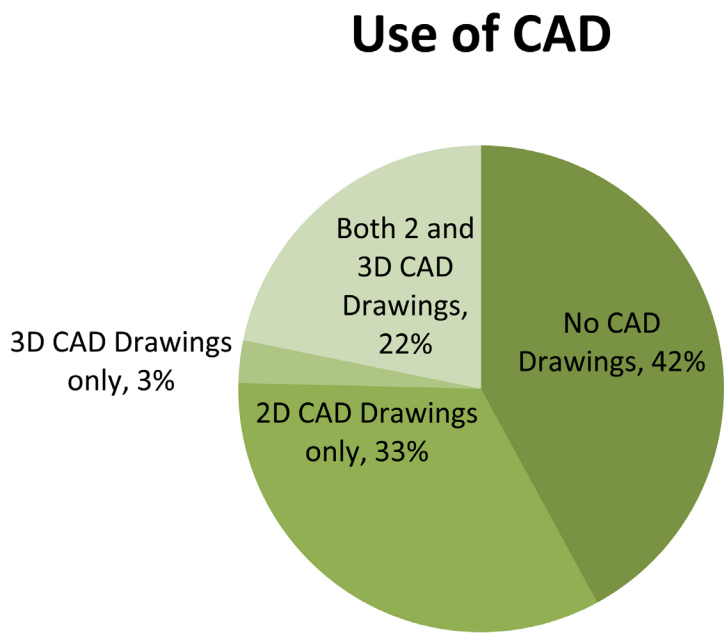


This range in employee numbers was complemented by the range in the number of those who were involved directly in building documentation and drawing, within the organisation, as shown below.



CAD

The survey did not approach the topic of BIM adoption straight away, but started with questions about working practice and the use of CAD. By taking this approach we found that CAD usage among individuals is widespread, but not universal. 3D CAD is used by just under a quarter, a third use only 2D CAD. 42 per cent do not use CAD at all.



There were a range of comments about CAD and they reflected the differences in the depth of usage:

'I have used 3D CAD for over twenty years'

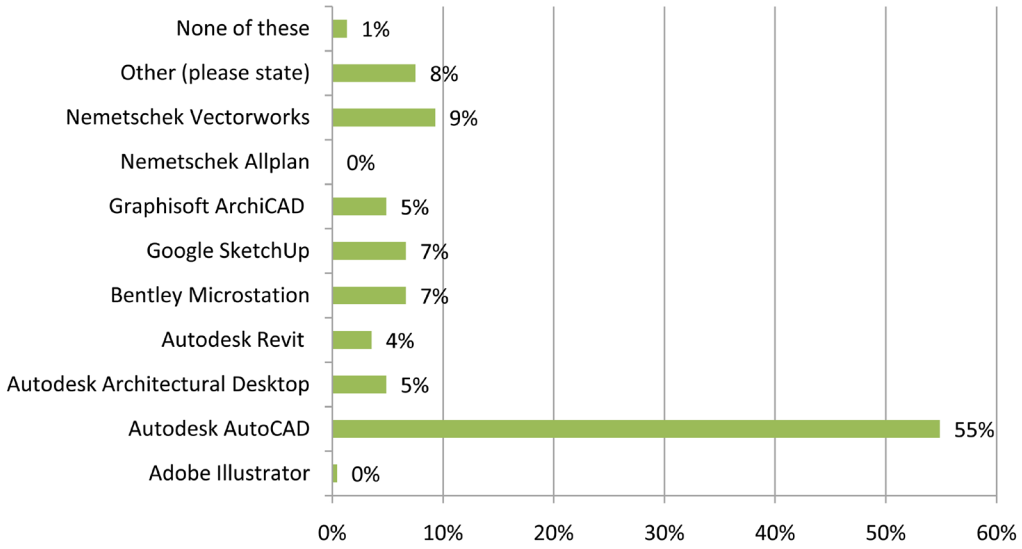
'We use CAD only to produce neat plan drawings'

'I draw by hand and this is unlikely to change'

We found out from those who use CAD, which packages they used, both their 'mainly used' package, and any other package they used.

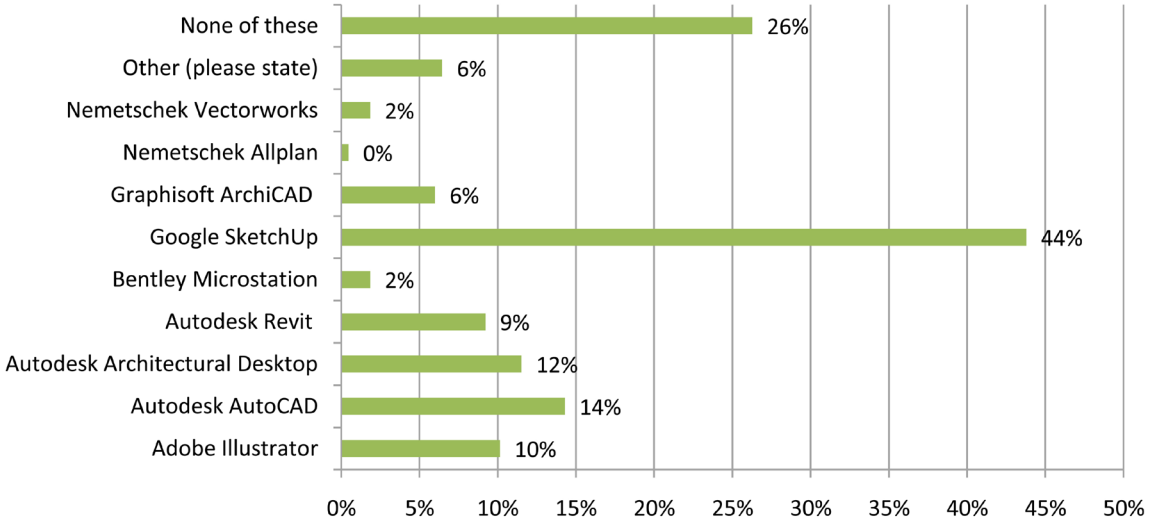
Autodesk AutoCAD is the most 'mainly used' package with 55 per cent of CAD users saying it is their drawing tool of choice. There is no one vendor that has an exclusive hold on the market though, with other drawing tools hovering around the 5 to 10 per cent share.

When producing CAD drawings, which of the following tools do you mainly use?



When looking at other packages people use, Google SketchUp turned out to be very popular. 44 per cent of CAD users are using it as a complementary tool.

When producing CAD drawings, which of the following tools do you also use?



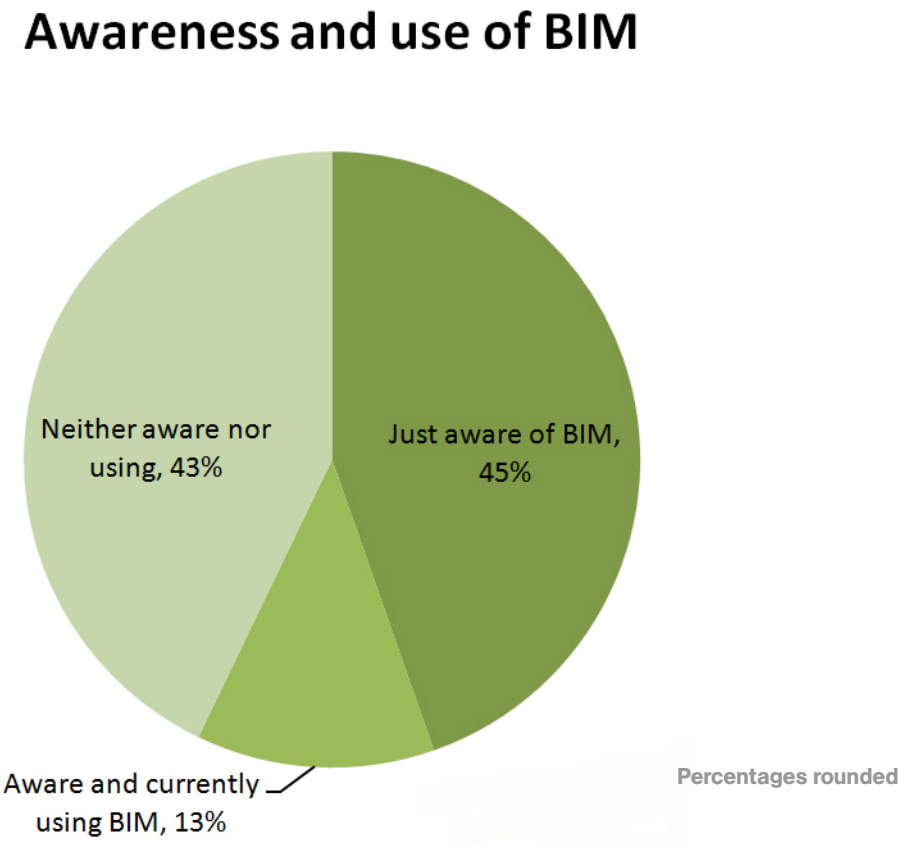
The comments suggested that Google SketchUp is particularly useful early on in a project, especially for working with clients.

'Google SketchUp has been used for early concept sketches for client presentations'.

BIM

BIM now: Use and Awareness of BIM

We asked all those who took part in the survey, 'Have you ever heard of BIM (Building Information Modelling)?' The response showed that BIM is not universally known of, let alone used. 58 per cent are aware of BIM and, among them, 13 per cent are using it. But that leaves a significant proportion, 43 per cent, who are neither using nor aware of BIM. Further analysis of the data was unable to uncover any significant correlation between company size or type and BIM awareness.



What is BIM?

At NBS we describe a Building Information Model (BIM) as a **rich information model**, consisting of potentially **multiple data sources**, elements of which can be **shared** across **all stakeholders** and be maintained across the life of a building from inception to recycling (cradle to cradle). The information model can include **contract and specification properties, personnel, programming, quantities, cost, spaces** and **geometry**.

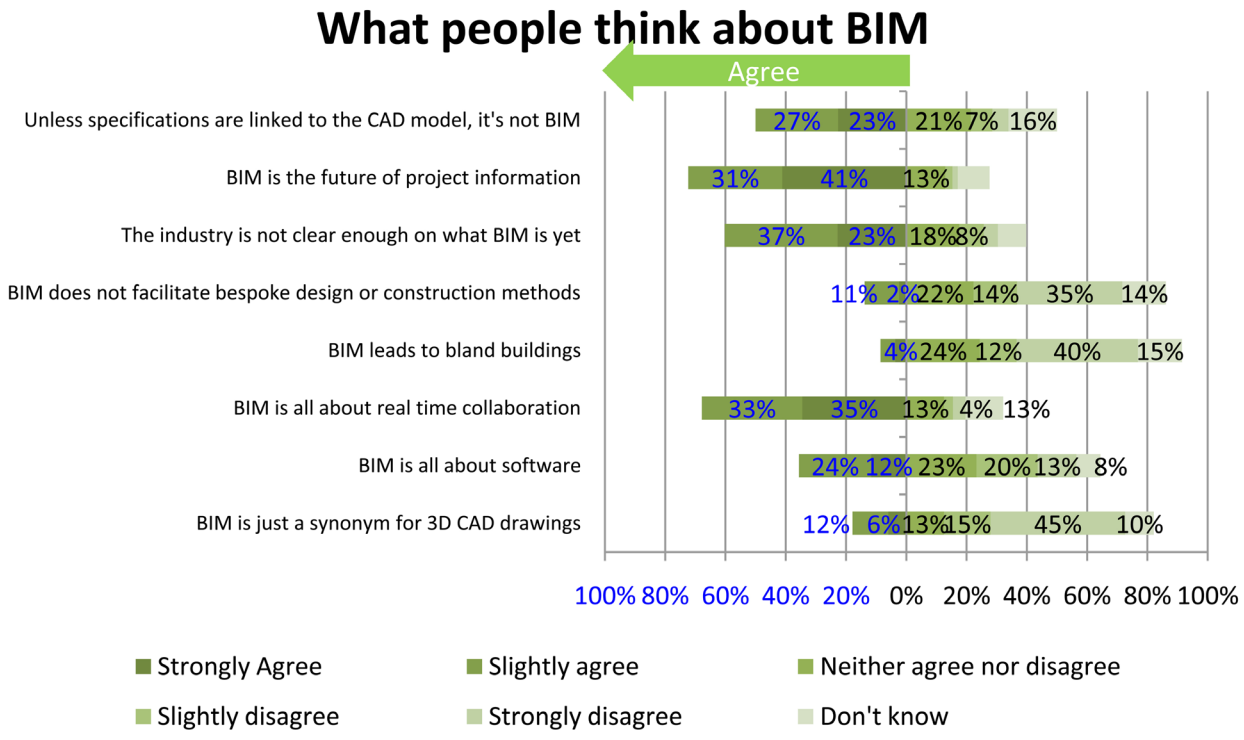
We asked those who were aware of BIM to tell us, in their own words, what 'BIM' meant. The responses were sufficiently diverse to suggest that the industry has yet to agree on a single definition of BIM.

'I have heard of it, but have forgotten what it is... at least I'm honest!'

'Building Information Modelling is the process of creating and using electronic data models of buildings to facilitate a co-ordinated understanding of a broad range of real world building issues, both as a design/specification tool and as an analytical tool for achieving statutory approvals or client driven performance requirements.'

The picture below shows the type of words people chose to use when describing BIM. The larger the word, the more often it was used.

We also asked them to agree or disagree with a set of statements about BIM, and this is what they told us:



64 per cent per cent don't agree that BIM is all about the software. Only 18 per cent agree that 'BIM' is a synonym for 3D CAD drawings. So we can see that there is a pretty clear understanding that BIM is not just about the software or CAD drawings (though they may well, of course, be involved in the creation of an information model).

There is general agreement that BIM doesn't lead to bland buildings (only 9 per cent agree) or stand in the way of bespoke design (only 13 per cent agree that 'BIM does not facilitate bespoke design or construction methods').

'It is a different way of doing things and expands the possibilities of feasible design'

BIM *is* about collaboration and it does involve specifications.

'[BIM is a] comprehensive combination of drawings, specification and schedules'

Having said that, when it comes to exactly what BIM is, there's agreement (60 per cent agree) that the construction industry is not clear enough yet. Indeed, at the time of writing Wikipedia stated that its entry on BIM 'may be confusing or unclear to readers'.

What people do seem to be clear on, though, is that BIM is the future of project information.

'BIM is the future of construction'

Some are living in that future, so let's turn now to those who are already using BIM.

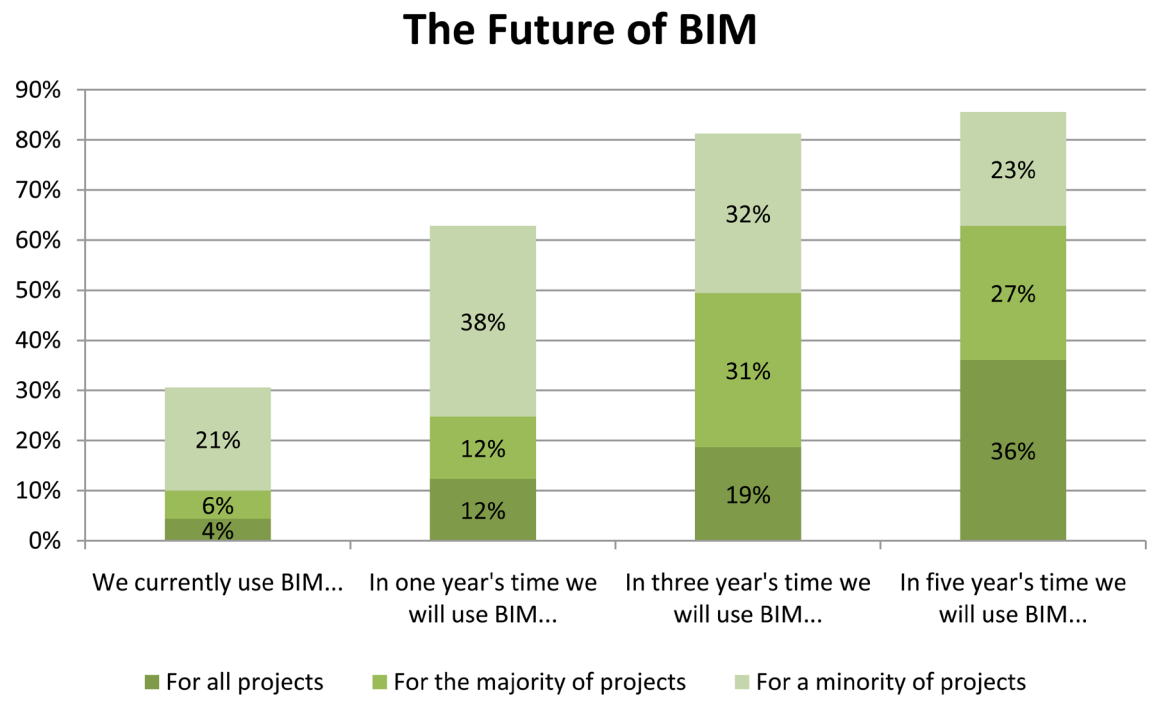
BIM in the Future

How might it work in the future for those not using it now?

It's often said that BIM is the future. Some of those who contributed to the research said it too.

'It's the future for information on complex projects.'

We wanted to see if this is a widespread belief, and whether people currently intend to adopt BIM any time soon.

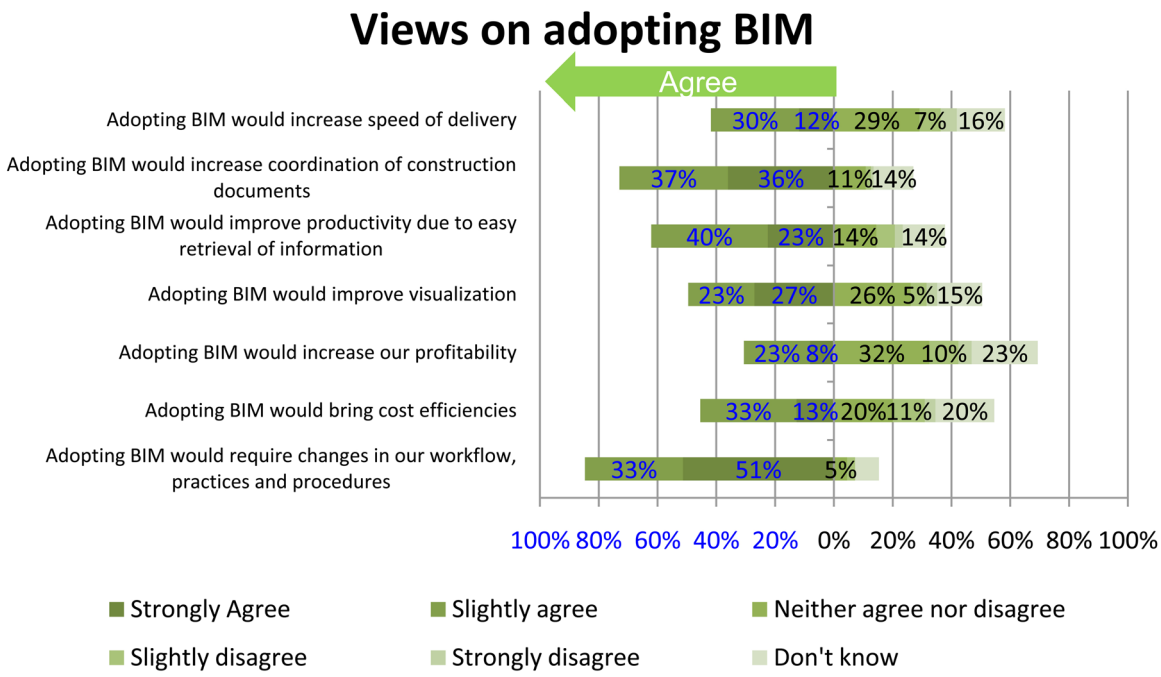


We found that *if people carry out their intentions*, a significant majority of those who are aware of BIM will be using it in one year's time for at least a minority of their projects. Within five years, over 85 per cent will.

The intention to adopt BIM is being brought about both by internal and external factors.

Externally, 57 per cent of those currently using BIM and 32 per cent of those aware of BIM feel that contractors will increasingly 'insist on us using BIM'. 67 per cent of those currently using BIM and 29 per cent of those aware of BIM think clients will.

There are internal reasons too. Those that see themselves adopting BIM have a broadly positive picture of it, like those who have already adopted BIM. Generally, those who are yet to adopt BIM believe that it will bring better co-ordination of construction documents, improve productivity, increase delivery speed and improve visualisation. That said, there is a strong appreciation that BIM brings change; 84 per cent agree that 'adopting BIM would require changes in our workflow, practices and procedures'



So, given the perceived advantages are there, what's stopping organisations adopting BIM? Well, the recession has been particularly hard for our construction industry and it is a reason. Almost half say they need to get through the recession before considering BIM.

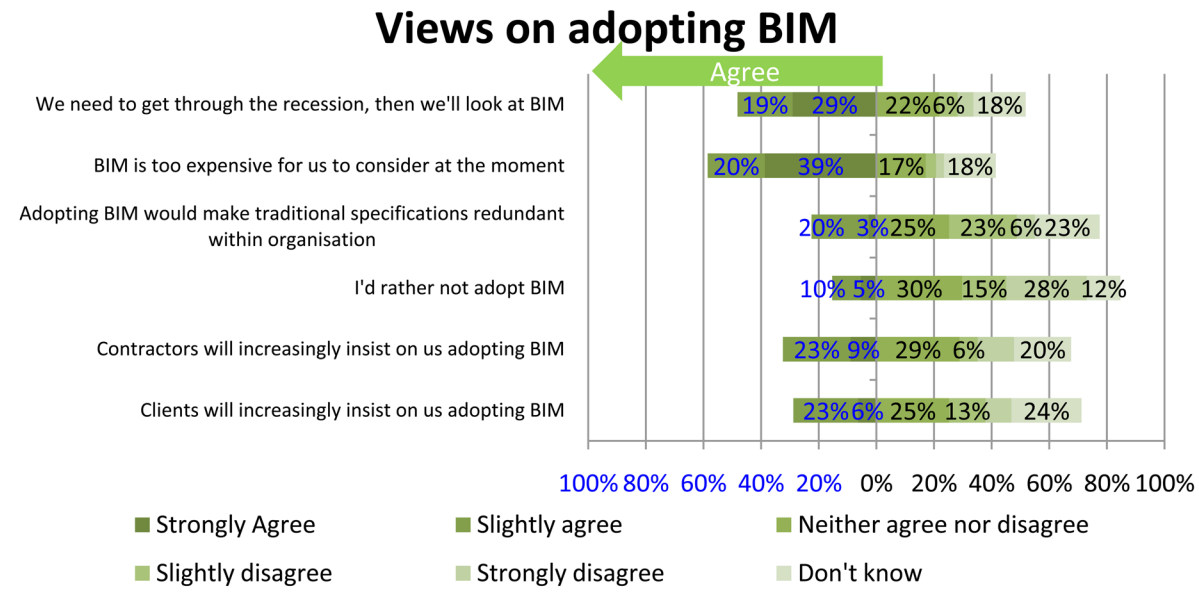
'We are just focused on getting through the recession at present.'

Cost too is a reason with a majority stating that BIM is 'too expensive to consider at the moment'.

'In the current context of required cost savings, BIM would be unviable.'

People are not shying away from BIM though, and very few saying they would 'Rather not adopt BIM'

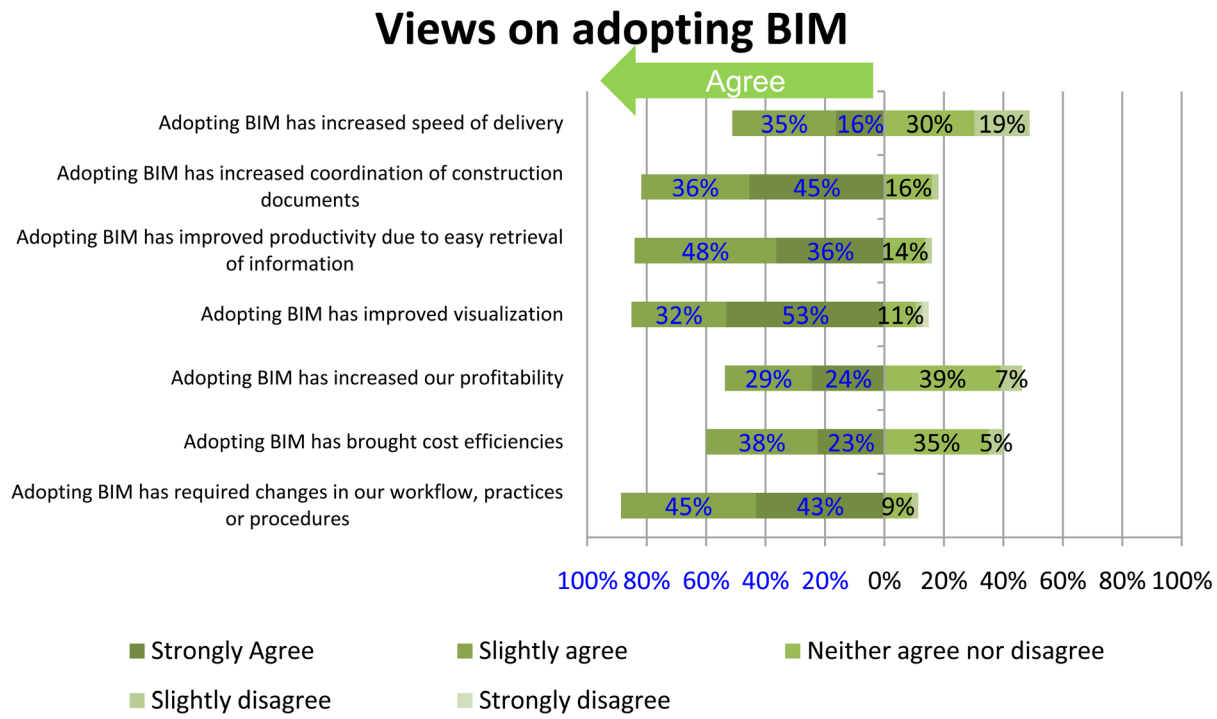
'All things considered, there is no better time to adopt a new technological advance'



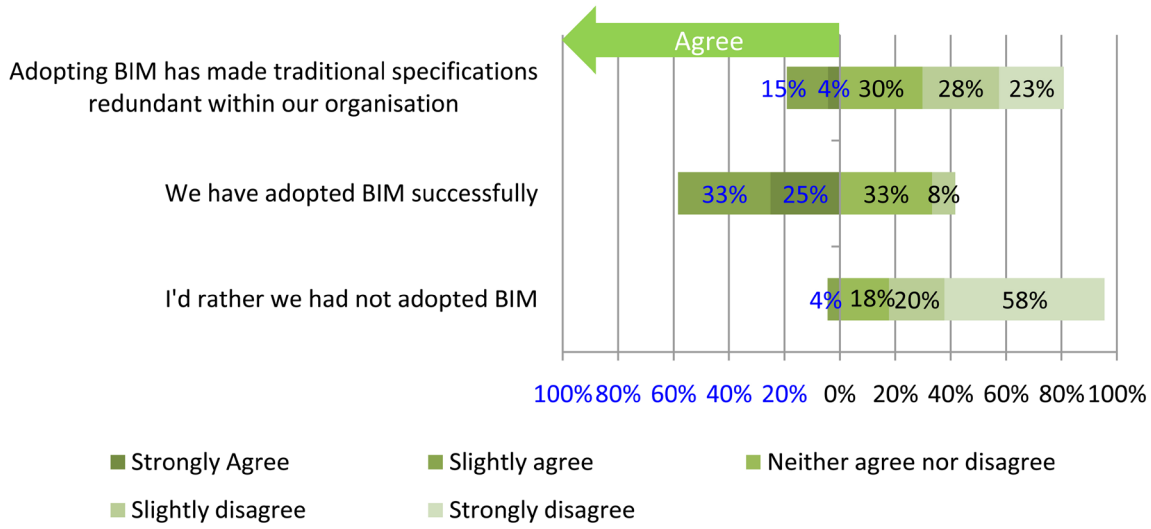
BIM now: How it's worked for those using it

Those who are using BIM told us how they were finding it. Because only 13 per cent currently use BIM, our sample is small, so the findings should be treated as indicative and not definitive.

BIM users agree that using BIM brings better co-ordination of construction documents (81 per cent agree), improves productivity, (84 per cent), increases delivery speed (51 per cent) and improves visualisation (85 per cent). To get these gains through BIM, nearly 90 per cent of people have needed to change their workflow, practices and procedure; adopting BIM is not just a matter of buying and using some software.



So, adopting BIM has, overall, been a positive experience, with very few, only 4 per cent, wishing they had not adopted BIM. The majority say they have adopted it successfully.



End Note

Our research gives some pretty unambiguous findings.

The industry is not clear on BIM. Many people within are unaware of it. That said, people do understand that BIM is not just CAD. BIM is about collaboration and needs to include specifications.

BIM is the future. Those who are aware of it can see the advantages of adopting it. Cost and the current difficult market stand in the way, but within 5 years over 85 per cent of those who are aware of BIM see themselves adopting it for at least some of their projects.

It looks like it might pay to get on board sooner rather than later.

BIM – The long view from architectural and design practice

by Robert Klaschka, Principal Director, Studio Klaschka

Robert has over 15 years experience working in the UK and Europe in architecture and design. He has experience in cultural, developer residential, student accommodation, sports and office fit-out projects. Whilst there is no question that he enjoys working at the leading edge of design software use and development, his focus is on maximising design flexibility and creativity whilst understanding the consequences of design and briefing decisions.

In 2001 he formed Markland Klaschka which he has since taken full ownership of. Over the 10 years of the practice he has driven the adoption and use of BIM software seeking to make the most of small intelligent teams versatile. During that time he has overseen the bulk of the practice's construction work. He has close links with the development team at Bentley Systems and was an Advisory Panel member for NBS and has advised on the development of the data exchange between NBS Building and Bentley Architecture.

He is the current chair of BCUKI (The Bentley Community UK and Ireland) having been elected in 2010.

Since Studio Klaschka was formed in 2001 most practices have started to consider or are already beginning to use one of the various flavours of BIM software that are now available. When Studio Klaschka (then Markland Klaschka) began I had been working for David Morley Architects for three years and had become interested in the use of 3D models for design, but was aware that in an already established practice there were cultural and training issues to overcome. It seemed natural that starting from afresh we should choose a more advanced option. We've used Bentley Architecture since that point and with the exception of one trial 2D project three years ago, to check we weren't missing a trick, we have produced all of our information between feasibility and assembly level of detail for construction from 3D models.

I forget when the acronym BIM first found its way into the language of construction. It must be five years or more ago. Whilst this had the benefit of branding the process it doesn't do it justice. BIM has the status that the term sustainability had ten years ago, it could mean anything you wanted, it looked great in your marketing material and clients were so confused about it that you could offer it without the risk of having to worry too much about delivering it. This is starting to change, but it's frustrating to see the very low level of understanding higher up the food chain from architects.

BIM is now hot property for the CAD vendors and with improvements in hardware handling large models with good performance is a reality. However the costs are still high. Our basic workstation is a Win7/64 quad core xeon with 12GB of RAM and a professional graphics card; throw in a couple of good 20" multisync monitors and there is no change from £3K. You also still have to buy the software and that will be at least as much as the machine.

Finding the right staff is another interesting proposition. There are increasing numbers of young designers who have had some experience of working with BIM software. I have spoken to people from widely varying backgrounds which includes some graduates, but have also found architectural visualisers, surveyors and technicians switching to BIM operations.

Over the last nine years I have seen that the knowledge that architects or architectural technicians have after five years or more of work gives them the greatest ability to understand the BIM work-flow. Without this level of knowledge it is too easy for the software to lead people to do things that you wouldn't normally do. I'd set this in the context of CAWS (the Common Arrangement of Work Sections) which in 2D we all use successfully to build up an appropriate level of detail for each stage of a project. The delivered datasets that come with each of the software products lead you to start drawing a construction grain of model from the point you start

working. This doesn't reflect the way that the design of a project goes through the transition from feasibility through development and finally crystallizes into construction documentation. Whilst it is possible to build a dataset that acknowledges this it is not embodied in any of the available software at present. I believe this is why architects have struggled more with implementation for design and construction while main contractors have found it easier, because they generally model at a stage where the design layout is more fixed and modelling is focussed on a completed package of information.

This leaves a great deal of work to do on the day that the software arrives box fresh, the investment of time required is considerable but worthwhile. Perhaps this is the reason for the profusion of a new profession that has sprung up – the BIM manager or BIM co-ordinator. I'd encourage any design practice wanting to develop an in-house system that suits their work-flow to look for someone who has worked throughout the whole design process for at least five years, with a technical ordered mind.

So what are we doing as a practice? Where is the business of BIM taking us?

We generally work on projects, and these are too small (£1M-15M contract value) for the client to have a particular interest in specifying that a project model should be used. This means that financially the BIM work-flow has to stack up in its own right because we are not paid a premium to use it. We're in a good position on the 7th generation of our system and the pace of software development makes getting the most out of new features and potential work-flows a constant challenge.

Increasingly though the work we do is turnkey with contractors as part of the team from the earliest stage. An integrated designer and contractor team is ideally suited to getting the most out of a project model. We have developed our dataset to allow us to provide as much outline information as possible during the early stages of the design producing models, drawings, schedules, quantities and high quality visualisations incrementally as the design develops.

Of these the most contentious has to be quantification. Should designers even be doing this? The raw output from a model has much to offer but doesn't look like a conventional bill of quantities. I see great potential benefit in early measurements where conventional teams would be using metre rates. Whilst there isn't scope to fully measure at the early stages the incremental outputs can be used as modifiers. As the model increases in complexity the scope for more measurement also increases. However integration of measurement at the design stages where a scheme goes through rapid change and development has the scope to increase understanding of the consequences of different approaches to a much greater degree than conventional cost assessments at a very low risk.

Working with contractors has revealed that they are much more focussed on exerting business pressure over their competitors, and as a result a great deal more secretive about how they are benefiting from BIM. Compared to the generally open dialogue that has been going on in consultants' circles for a long time this has been quite an eye-opener for me. Having been very open with what we have been doing as a practice for nearly ten years I'm now seriously considering whether it would actually be better to stay quiet and push hard.

This may seem a negative note to end on, but for me the major factor standing in the way of the market penetration of BIM is making it pay. Until a team of consultants can work more profitably than their counterparts working with conventional CAD it will continue to hang in the balance.

BIM – measurement and costing

by Dick Barker, Director, Laing O'Rourke, Head of Model Based Measurement and Costing

Dick has over 30 years experience, working in the UK, Europe, Japan, Africa and the Middle East, responsible for building and civil engineering projects as a contractor. He is passionate about using modern technology to find better ways of doing things and drive out some of the much talked about waste in the construction industry. Over six years ago, he established Privica Ltd with a group of enthusiastic like-minded colleagues, comprising civil engineers, architectural technicians, software engineers, product designers and technicians. During this time they developed the algorithms, processes and skills to populate Bills of Quantities dynamically from 3D object-based models. These have been applied to over 500 projects, ranging through highways, railways, water and sewage treatment, process facilities, residential and commercial buildings. Privica was acquired by Laing O'Rourke in December 2009, and are now established as part of an innovative team keeping Laing O'Rourke at the forefront of model based cost management and measurement.

Setting the scene

Most people in the industry will now have their own definition of BIM, and the majority will have a 3D model and data in there somewhere. The term BIM is to an extent limiting; it is not all about buildings with walls and roofs, we need to include roads, bridges, railways, process plants and infrastructure generally.

Competent functionally rich 3D object based modelling tools have been widely available for over 15 years. 3D models and computer rendered visualisations and virtual walkthroughs of the completed facility are often the norm on larger projects. Somewhere in the food chain from project inception to decommissioning someone has to define the scope of work and quantify it to enable budgets to be set, costs to be estimated, resources procured and the works to be planned; measured quantities have been captured in Bills of Quantities for years. Quantity surveyors are well versed in cost planning and contractors have been using computer based estimating systems for over 30 years. So are we not already doing BIM?

In my view, we start to scratch the surface of BIM when we use the best available technology to do things faster and better, and eliminate waste and repeated work at the interfaces. To drive out the inefficiencies we need to normalise data, enter information once and reuse it many times, turning data into an asset. It could be as simple as entering the name and address of a supplier once in a single place at the inception of a project.

We found however, that the process of taking the existing set of design information at key stages of design development and modelling it in 3D paid for itself just in terms of the identification of, and as an aid to, eliminating clashes and co-ordination errors. Once we developed the modelling skills and processes to dynamically populate Bills of Quantities from models, our services became in demand by being able to compete on cost with traditional methods but able to respond faster and leverage the core process of modelling to provide a visual record of what has been measured where.

Due to the speed of response created by auto-measurement we are able to influence and inform the design as it develops with the knowledge of quantum and cost, not just measure and cost the design, which is often too late.

Considering BIM from a measurement and costing perspective there are three important cornerstones of the process:

- 3D modelling to generate the geometry of what has been or might be designed
- Defining the scope of work in Bills of Quantities and dynamically populating the Bills with quantities from the model
- Specification, auto-annotating the 3D and 2D drawings from the model as well as dynamically linking the Bill descriptions to the specification.

The core process of 3D object based modelling for measurement produces a model that can be leveraged for many other purposes at marginal cost: clash detection, construction sequencing, printing physical models, presentation and visualisation, speeding up the process of assimilating information about the project and communicating it to those who are not so adept at reading drawings.

Clearly if the designers are using 3D tools for design and we can utilise their models for measurement then we will be able to eliminate another element of repeat work. Even when we have received some of the best models from designers, particularly in the early stages of design development we need to augment them to be able to measure and therefore cost things that need to be considered but not yet designed.

Once we have made the associations between an object in the model, say a window, and the relevant items in the Bill of Quantities and specification on one project, we are able to re-use this on future projects, adjusting for project specifics but not reinventing the wheel. In this way we increase our library of valuable data assets, making future measurement faster and cost effective.

We have already achieved similar efficiencies by linking the Bills of Quantities to cost estimation systems. The cost estimate build-ups for a particular item of work, in terms of their rates of consumption of the necessary resources and productivity, are saved for future use. Once we have reached this state it is relatively easy to extend the estimate to include the embodied carbon values of the resources consumed and calculate the embodied carbon value of the facility. We add additional information and reuse that already captured for other purposes.

We are limited more by how we organise ourselves for BIM and the choices we make in terms of IT infrastructure and software than available technology. Almost everyone involved in a project has a contribution to make to the BIM; it is not another silo of service and we all need to consider the inputs we need and outputs we produce as individuals and what we can do to drive out the inefficiencies at the interfaces. The technology exists to achieve all of the things covered above, however we are not all using the same data structures, and we use a variety of different software packages that are not always interoperable. Even within a single organisation it's often difficult to resolve these issues, and it is compounded when we have many people from multiple organisations in multiple locations working on a single project. The IT infrastructure adopted has to be more than a reactive afterthought; it needs to be integrated and interoperable.

To reap the benefits we can no longer throw information over the wall from one silo to the next: design, quantity surveying, estimation, procurement, construction, operation etc.

New skills are required that cross the traditional boundaries; in our experience it takes something like seven years post graduation for what we call the Construction Process Engineer to be trained. They need to be versed in 3D modelling, design, engineering, construction technology, quantity surveying, be knowledgeable about databases, and have the technical skills to resolve difficulties at the interfaces between processes, on top of undertaking Continuing Professional Development in their core discipline of architecture, engineering etc.

Perhaps the most important thing we have learned is to do it, not just talk about it, and hone the processes, skills and data assets in a cycle of continuous improvement.

BIM and education

by Steve Lockley, Professor of Building Modelling at Northumbria University

When setting out to write this article on Building Information Modelling (BIM) I was reminded of the old adage that before putting pen to paper you should 'know your audience'. So who are you? Is this article for the Architect who is interested in the potential of BIM to improve their 3D design capacity; the Quantity Surveyor who expects automated take-off; the Building Services Engineer looking for a more efficient way of calculating energy consumption; the Structural Engineer aspiring to greater integration between analysis and design; the Project Manager needing to simulate the construction sequence; the Contractor wanting to reduce risk and error; the Client wanting to reduce construction cost?

The reality is you may be all, or none, of the above as BIM is relevant to most, if not all, of the roles performed in building procurement. In its most acceptable form it is agnostic to our traditional discipline silos, seemingly supporting our conventions and ways of working, leaving us with the comfortable feeling that we are improving our productivity and efficiency, without exposing ourselves to the risks entrained in real change. Indeed this is the main reason BIM has made headway in its market penetration over the last 3-5 years. In reality, BIM technologies have been available for at least 20 years but like all youth they were perceived by their elders as a little too radical for serious consideration. Now though, BIM has come of age, it is no longer a recalcitrant teenager, it is looking for acceptance from its peers and it is doing this by making concessions that help it integrate with traditional or mainstream construction procurement.

So yes, to the Architect BIM provides 3D support, but is it better than the previous generation of 3D CAD? The QS can automate take-off but does it breakdown a building in accordance with the rules of measurement? The Building Services Engineer can produce quicker energy calculations, but are they as accurate and do they inform the design? The Structural Engineer can perform integrated analysis and design but are the benefits of leaner design carried through into fabrication? The Project Manager can visualise construction sequences but is it having an impact on the building process? The Contractor is reducing risk and error but are they generating better value and profit? The Client may be getting better value but do they realise it and are they willing to invest in BIM?

The answers to all of these questions are slowly beginning to reveal themselves to the industry and in doing so they raise more questions. If the Architect invests in BIM at the early design stage, who benefits and who will pay for this investment? Should the rules of measurement be changed to be more considerate of BIM capabilities? Should the Building Services Engineer be engaged at the early design stages so that they can impact on and improve the energy design of the building? Should fabricators be working with Structural Engineers as part of the Design and Analysis phase? Will construction and resource planning become an integral part of the design process? Could Insurance companies reduce premiums to reflect the lower incidences of error in the construction phase? Will clients favour the appointment of design teams that use BIM?

It is clear that when writing about BIM the audience is not defined by its discipline but rather by its desire to work collaboratively. The tangible benefits of BIM will not come from doing 'business as usual more efficiently', they will come from changing the way we work together. Worse still there are those who perceive BIM as a new discipline, the BIM manager. This view turns BIM into some kind of project extranet that is so sophisticated and complicated that it requires a specialist to manage all interactions between it and the design team. Typically we find this referred to as the 'single building model' or the 'building model server'. There is little doubt that in a few years time the technology to support this ideal will reach maturity, but will the working practices and the ability to collaborate in construction projects have matured to a level that can exploit this technology?

Educational establishments clearly have a major role to play in this transition, they should and will seed the next generation of professionals who understand BIM as a technology that supports collaborative working. However, there are barriers to change built into our Universities

and Colleges, not least of which is the entrenchment of the traditional professions. In an ideal world these institutions should be microcosms of the way we desire the industry to work in the future. High levels of integration; inter-disciplinary working designed into course content; project work that integrates rather than isolates professional roles. Unfortunately the established rules of engagement between educational institutions and the professional accreditation bodies often mitigate against this form of collaborative education. It begs the question, can collaborative working be taught without actually being practiced? At Northumbria University we have taken initial steps to address this through the formation of the BIM Academy. Rather than force dramatic change into the curriculum the academy seeks to engage with industry and to foster BIM or collaborative thinking in our staff's research, teaching and consultancy. Just as BIM needs to support our existing working practices it also needs to support our existing educational processes before we can move to the next level of inter-disciplinary qualifications.

How far are we from the day when sending a drawing seems a rather naive and perhaps unprofessional way of exchanging information? When this happens, and it undoubtedly will, we will know that BIM has truly come of age; in the meantime may those who value improvement through change and collaborative working enjoy the journey.