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The Big BIM battle

BIM adoption in the UK for large and small companies

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Abstract. As BIM adoption continues, the goal of a totally collaborative model with multiple contributors is attainable. Many initiatives such as the 2016 UK government level 2 BIM deadline are putting pressure on the construction industry to speed up the changeover. Clients and collaborators have higher expectations of using digital 3D models to communicate design ideas and solve practical problems. Contractors and clients are benefitting from cost saving scheduling and clash detection offered by BIM. Effective collaboration on the project will also give speed and efficiency gains. Despite this, many businesses of varying sizes are still having problems. The cost of the software and the training provides an obvious barrier for micro-enterprises and could explain a delay in adoption. Many studies have looked at these problems faced by SME and micro-enterprises.
Larger companies have different problems. The efforts made by government to encourage them are quite comprehensive, but is anything being done to help smaller sectors and keep the industry cohesive?
This limited study examines several companies of varying size and varying project type: architectural design businesses, main contractor, structural engineer and building consultancy. The study examines the barriers to a truly collaborative BIM workflow facing different specialities on a larger project and a contrasting small/medium project.
The findings will establish that different barriers for each sector are actually pushing further apart, thus potentially creating a BIM-only

construction elite, leaving the small companies remaining on 2D based drawing.
Keywords: *BIM collaboration, BIM adoption, Government BIM policy*

1. Introduction

As BIM technologies advance, the operator skill and information protocols need to advance too. The most recent developments in the evolution of BIM tools have been to organise the collaboration functions of BIM. The gains offered by maximising the efficiency of this process are potentially large as the construction industry can be notoriously bad at working together (Latham, 1994).

1.1 CURRENT INITIATIVES

The UK government have introduced standards of adoption of BIM technology and are expecting compliance with these standards by 2016 i.e. Level 2 BIM. These will mainly affect the larger construction projects (over £5m project cost) and are mainly concerning collaboration and information exchange formats (PAS 1192-2:2013*)*. If the companies working on these projects wish to continue trading, it would be considered essential that they made the effort to adhere to these new standards. Compliance could be an expensive exercise however, with a large number of staff requiring re-training to use the new BIM software and procurement of new software licenses and computer hardware (BIM task group, 2015). Smaller companies, who have been using 2D based drawing packages such as AutoCAD or TurboCAD, have that expense too and these would be more significant to a business of much smaller turnover. But these outfits may not be working on government projects and won't have the same legal obligation to change their work methods so they would be inclined to stay with a CAD tool.

Governments are able to legislate in relation to their own projects, but are limited in their powers over private sector construction. This selective regulation would appear to be another barrier to across-the-board BIM adoption. And with the problems facing smaller businesses, these barriers could be creating a 2 tier system of BIM enabled medium/large scale designers and traditional CAD SMEs. This paper will analyse the growth and proliferation of BIM with reference to more traditional CAD packages, establish whether a gap is being created and seek to suggest solutions. (Harty et al, 2016)

1.2 ISSUES IN PRACTICE

Despite the solutions that BIM can provide, it can generate some significant problems for small companies. The increased initial drawing period has already been mentioned as an issue and knowing when this period is completed is the effected arising problem. Due to the thinking required in drawing the parametric building components, The BIM environment is a tricky one for early conceptual design. Several studies have been done to develop early pre-BIM design protocols to help this stage of the design (Leon et al, 2015).
This would be minimal in a small project- an especially within one practice, but in a larger project spread across multiple offices, it could present a significant challenge. Unclear definition of responsibilities within the design team can lead to problems with duplication of work and data. Again these issues are proportional to the size of project and mainly affecting small companies not already needing to adhere to the level 2 BIM PAS standards.

1.1 FUTURE STRATEGY

The level 2 BIM standards are very comprehensive and are designed to get the industry on a level playing field. However, technology is pushing forward and it is possible to achieve even more with BIM. Level 3 BIM is much more all-encompassing – in that every part of the design, supply and

construction process is involved in the BIM model and connects the data chain from start to finish, helping create end-to-end efficiencies. BIM level 3 also takes the above PAS 1192-3:2014 standard and develops it fully with the BIM model being utilised to its full potential for facilities management.

In some ways, BIM level 3 may be easier to implement. One of the crucial points of level 2 specification is that, generally speaking, each contractor can make their own model to the previously mentioned BS standards and then exchange information later. With level 3 there will be one central model held by one party (Barriers to BIM, 2013).

2. Interviews /meetings

The following section presents brief transcripts and appropriate highlights of the interviews with the various companies to get a good snapshot of the current state of the industry.

2.1 KEIR CONSTRUCTION AND BDP, EDINBURGH- EUAN MACDONALD

Analysis of BIM technology used for design of new Scott Sutherland School at RGU

- Kier Construction — UK-wide construction
- BDP — International design practice
- Project completion- — May 2015
- Project duration- — 16 months
- Value- — £16 million
- Other Typical projects: large commercial, government and industrial.

Euan MacDonald was the project manager for Keir construction, the main contractor. The project was a design and build contract with BDP subcontracted as project architect. BIM was used by BDP as the primary design tool for the project. The main BIM Revit model was set up by a senior BIM manager and many ATs and project architects collaborated to add to the model. Some sub-contractors, notably mechanical and electrical

used the BIM model to add information into the project. The vast majority of subcontractors still worked with AutoCAD drawings while in the digital domain or even just PDF/ hard copy tender and production drawings. This produced a fair bit of extra work for BDP which offset some of the productivity gained by using a BIM model in the first place. Keir construction was mainly working from hard copy drawings produced by BDP.

BIM was not used directly during the construction process for project management purposes, instead relying on a more company specific scheduling software. It was used however for certain site meetings for 3d walkthroughs of ducts and risers as a primitive form of clash detection. Although Keir could see the benefits offered by BIM in a project, they already had a bespoke workflow with discrete standalone packages. The large amount of training required to use project management flavours of BIM (such as Navisworks working with a Revit Model) would really hinder adoption and outweigh any benefits. Especially as most designing would be sub-contracted out to a fully BIM enabled firm (such as BDP in this and other Design and build contracts) or the designs would arrive fully finished (in the case of a traditional contract).

2.2 CHARCOALBLUE, LONDON

- multi discipline consultancy focussed on design of performing arts buildings
- projects worldwide, but with a focus on UK and US

Charcoalblue usually works as a subcontractor for the main project architect. They are based on the South Bank in London and now have offices in Melbourne, Bristol and New York. Charcoalblue were the theatre consultants on the Sterling prize winning Everyman Theatre in Liverpool and also use their expertise in acoustics, theatre/ auditorium planning and lighting design for numerous private and commercial clients. The nature of their work depends on the interchange of design information with the project architect, client and contractors. One would assume that

this would be the ideal for use of a BIM model, but even large projects are having significant problems in adoption of the new software.

Charcoalblue have multiple packages in use- AutoCAD, Microstation, Vectorworks and Sketchup and this helps them deal with the variety of ways that project architects are designing. Though, as one would expect, this could lead to compatibility and communication issues. They are well aware that BIM would seem to be the future of the industry and would like to steer in that direction. With these sizes of projects however, the amount of software needing to be purchased, the amount of people requiring to be trained and time required to become fluent is a problem. When companies such as Charcoalblue would seek to change their main drawing tool, everyone should change at the same time- in an ideal world.

The 2016 level 2 BIM deadline is another factor to consider, as Charcoalblue are mostly dealing with publicly funded buildings.

Designing theatre auditoriums has been tricky in Revit and a lot of projects are using Microstation or other more familiar packages to complete the auditorium and other design consultants are being employed to re-draw these into the Revit Model. This will undoubtedly change as more designers become skilled in Revit and Autodesk/ third party plugin developers hone the software tools available.

2.3 RJM ARCHITECTURE, ABERDEENSHIRE- ROSS MCWILLIAM

- sole trader Architectural technologist
- small scale commercial and domestic extensions and new-build dwellings

RJM had been contemplating for some time, a possible move to Revit. The main attraction for him would be the ability to quickly generate 3D visuals and renderings to effectively sell design schemes to clients. Private, domestic clients tend to be inexperienced in reading professional technical 2D drawings and can find it hard to visualise the completed project and options.

Ross had worked previously with a slightly larger local practice (again AutoCAD based) and they saw absolutely no mileage in aspiring to BIM

adoption for their future business. RJM meanwhile could see some benefits even though, as a single person company, the main collaboration factors would not be applicable. AutoCAD and Revit did however sit quite well together in a small practice. Projects would find themselves more suitable to either platform.

On-board functionality within Revit (native and via third party plug-ins) can be quite attractive for smaller operations. The ability to produce renderings, quantity schedules and energy performance analysis all in one package certainly can speed up workflows. Some of the new free accessories such as Autodesk iPad apps for sketching and survey recording are also useful. The major barrier for Ross, however, would remain the cost of licenses- even for a Revit LT package.

2.4 CUMMING AND CO ARCHITECTS, ABERDEEN- GRAEME HOGG

- Aberdeen based Architectural practice with 10 employees
- Mixture of small to medium size commercial and domestic projects

Cumming and Co are a medium sized architectural practice using traditional CAD methods, but are engaged with the possibility of a move to BIM. They have a reasonably varied portfolio of commercial and residential projects from single dwelling and conversions to large office complexes.

The company is well aware of the benefits of moving to BIM – especially the work-sharing on larger projects, but the time taken to re-train and the initial cost of the software are significant barriers. The decision to use a fully enabled BIM model for a project does tend to rely on external forces and have been initiated by the client so far. It is unclear whether this is to gain efficiencies in the construction process or to aid in the whole-life facilities management in the long term.

Clients are now expecting high quality visuals and fast 3D rendering in Revit or 3DS max are becoming very powerful tools in communicating design strategies and options- especially when the client isn't used to reading 2D drawings to change.

2.5 WRIGHT ASSOCIATES CONSULTING CIVIL AND STRUCTURAL ENGINEERS, ABERDEEN- GRAEME MACGREGOR

- small to medium Aberdeen based engineering and construction management consultancy
- very wide range of projects- from small domestic to large industrial Oil projects

Wright associates are a long standing local firm using standard AutoCAD packages but are starting to move towards BIM. They have a wide range of small to medium sized projects from small domestic extensions to larger commercial projects. The collaborative nature of a structural engineering practice does largely dictate that they will work on whatever file format the initial project design is drawn on by the architect. According to Graeme, this is tending to be more frequently a Revit model and they are quite happy facilitate this. The company can see many benefits offered to them by BIM- mainly the speed of drawing revision when Client alterations to the model come from the Architect. They also see speed benefits when other key contractors/ designers such as Mechanical and Electrical are collaborating via the model. This would then naturally reduce on site problems such as clash issues and scheduling.

Smaller projects wouldn't be helped by any of these points though and although Wrights do sometimes create BIM models from scratch, it wouldn't be worth their while on a smaller job. It still takes a lot of time to setup a proper Revit model and the man-hours can't be justified.

3. Analysis

Although being limited in the range of data, the interviews do point to a disconnect in the construction industry. Even larger operations are sticking to 'Old school' level 0 BIM methods of CAD and printed physical drawings. Big collaborative projects such as the ones Charcoalblue are involved with are still varied and the lack of common software platforms

and workflows are forcing people to revert to CAD drawings to ensure compatibility. This will obviously affect efficiencies.
It does seem though that there is still a 'momentum' ongoing in BIM adoption and that most companies that can adopt are willing to do it. They may already be there or will be there in the near future.

Interviews with the smaller companies in this research show less urgency for adoption. The complex standards required to achieve Level 2 BIM compliance are far too much for a one or two-man operation to have time to deal with. If they are making a living with existing methods and workflows, then why change?

3.1 EDUCATIONAL FACTORS

Another issue to be addressed is that a large number of students graduating in the near future may only be proficient in BIM software and integration with existing AutoCAD based company workflows could be difficult. This will sort itself out eventually, but unless the company starts the BIM adoption themselves, there will be a messy and inefficient crossover period. The existing experience of senior members of the practice who may be unwilling to make the change to BIM might not be passed on to the new breed of BIM graduates.

4. Conclusions

4.1 CONCLUSIONS FROM RESEARCH

BIM adoption is being influenced by the 2016 deadline only slightly for larger companies. This deadline seems of no real issue to SMEs.
Official reports on BIM seem to have different purposes and agendas. The Government based ones (BIM task group, 2015) lean towards a rosy view of BIM's benefits, whereas the industry analysts are more balanced and tie in with the first hand evidence of this report.

Issues with cost of software/hardware and cost of/time taken for training are still the most significant barriers for small and large companies alike. Most parties are well aware of the benefits of adoption, but just have to balance barriers against these benefits

4.2 GOVERNMENT & LEGESLATION

The barriers are definitely creating a two tier system of BIM enabled medium/large scale designers and traditional CAD SMEs. The smaller companies will find it increasingly difficult to expand and access larger scale work. Also small companies working as sub-contractors on a large collaborative BIM project will find it difficult to keep up with the constant updating of BIM standards, as the collaboration landscape continues to change at a fast rate. The tide of change will only accelerate as the aforementioned new graduates, exclusively using BIM, become part of the workplace. All companies need to exchange data and it is only a matter of time until the new business start-up with only AutoCAD skills needs to train up. By this time though, the same new business may have been left behind.

As mentioned, it is very difficult for government bodies to directly effect change in the commercial sector. It would however be in their (and the country's) interest to legislate to promote small company BIM adoption. It would encourage enterprise and company start-ups in this sector and the opportunity for a small company to grow. It would promote excellence and good practice at all levels and encourages small companies playing a small part in a large collaborative project. This point will also provide valuable career development for employees –who could otherwise be trapped on each side of the BIM 'divide'. Regulation would also lead to economic gains due to efficiency savings.

The Latham report and many others previously identified some of the inefficiencies in the construction industry. A 'two-tier' construction industry would be incredibly inefficient and risk many small companies being left behind. (Constructing Excellence, 2015)

4.3 LIMITATIONS OF THIS STUDY

The limitations of this research need to be taken on board when considering any of its recommendations- namely;

- Geographic location of sample interviewees
- Diversity of project sizes
- Diversity of company sizes
- Different experiences of companies of equal size & project size.

This paper was originally written as a dissertation for an, as yet, unfinished honours degree and there was not the time or resources to increase the sample breadth. Widening the geographical locations of the samples would have been advantageous too.

5. Possible solutions

As the government are driving the changes to larger projects, they could also be seen to be driving the aforementioned 'divide'. It would then seem appropriate that the government should introduce matching schemes to ensure that the whole AEC (Architecture, Engineering and Construction) industry move to the future together. These solutions should be forward thinking and not only serve the purpose of keeping the industry coherent, but also use the opportunity to encourage new innovation and working practices. The advances in BIM technology should be seen as positive and not just a problem to be solved. This report considered financial incentives, but settled on changes in the planning rules as an effective possible solution.

5.1 PLANNING APPLICATIONS

Currently, council planning departments are trying to move from the traditional method of multiple copies of A1 drawings stuffed into small envelopes – to a more modern system online forms and pdf documents uploaded to the eplanning Scotland website. This has already speeded up

the planning process and a digital model version would be the next logical advance (eplanning Scotland, 2015)
It could be made compulsory to present a digital model for planning applications. This digital model would feature regular sheets (in the same style as presented for applications now) that could be printed if needed by the planning authority. The data format would need to be based on some of other BS and PAS standards in existence on large government collaborative projects. There would be no real issue for data protection or protection of intellectual property- as it would be based on the same principals of 'public realm' planning documentation.

5.1.1 Facilitating SOFTWARE
Autodesk now have A360 viewer – which is an online web viewer for CAD formats. Currently it supports a wide range of Autodesk formats including Inventor, AutoCAD and Revit. Using a Revit model, it is possible to use A360 viewer to navigate from a webpage without the need for any special software or special training. Perspective viewpoints can be set up and walkthroughs can be viewed. Materials can be exploded, isolated and analyzed. Traditional sheet views can also be attached as pdfs and printed off at the correct scale as required. All this functionality remains un-editable- which keeps control of the data embedded in the model and the intellectual copyright. It works in a very similar way to how a pdf viewer works (Autodesk, 2016).

This existing web browser viewer technology could be expanded to join separate models together to form a 'virtual planning environment'. The planning data could be used to analyze interaction between adjacent properties (overshadowing, streetview contexts etc.) 3D building data could also be recorded by national mapping agencies for production of future 3D mapping services.

5.1.2 Benefits
The potential for this would be enormous -as all kinds of data could be presented, added and analyzed by all kinds of branches of science and

business. Geology information could also be added. 3D scans of historical monuments and statues could be added. Ordnance survey mapping data (contour, height data, different map scales) could also be added. Google/ Bing maps could also be attached (with all the streetview data). A possible way of accessing this infinite amount of data could be in the same way as Ordnance survey tile data is issued via the digimap service. With Digimap, 2D tiles are downloaded and the new 3D BIM mapping services could take the form of downloadable 'cubes'. This concept could be developed with the help of Ordnance Survey's Geovation project. This is a new creative ideas network designed to get creative minds interested in location information and 3D modelling technology (Geovation UK, 2016).

All design companies large or small need to go through the planning system, this would seem an easy way of bringing them back together. Very small companies could also use this BIM viewer system to obtain design data from the main model as it does seem rather far-fetched that absolutely all contractors working on the project need to engage with BIM to achieve Level 3.

5.2 SUMMING UP

Level 3 BIM relies on the whole supply chain being involved in the BIM model for data exchange and if the industry develops a more pronounced 'split', then this will become even more difficult to achieve. It would be almost impossible to finish a (even large scale) project without using some small contractors (BIM task group, 2015)

The general industry consensus does seem to be that BIM is the future and that the barriers are greater than the government protagonists suggest. But with more open discussion, grabbing new innovation opportunities and courage by all involved the journey could be faster and smoother (Barriers to BIM, 2013).

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