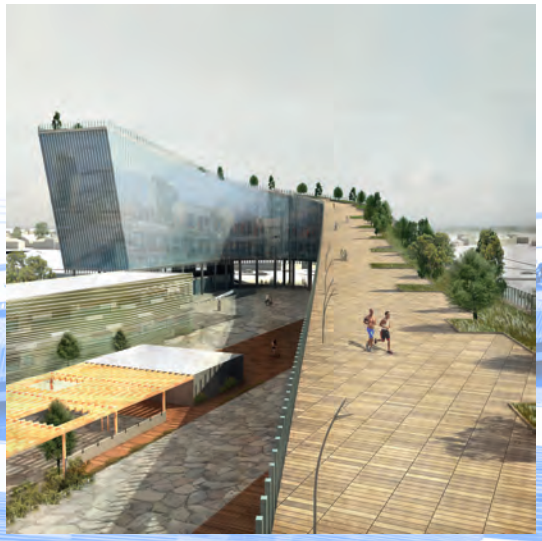
HEALTHY BUILDINGS: INNOVATION, DESIGN & TECHNOLOGY

ICAT 2016

ANTONIO GALIANO GARRIGÓS
TAHAR KOUIDER



CONFERENCE PROCEEDINGS OF THE 6TH INTERNATIONAL CONGRESS OF ARCHITECTURAL TECHNOLOGY UNIVERSITY OF ALICANTE 12-14 MAY 2016

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CONTENTS

SMES AND LEVEL 2 BIM, THE WAY FORWARD

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Abstract. The UK construction industry comprises a very high proportion of SMEs that is companies employing up to 250. A Department for Business, Innovation and Skills research paper, found that SMEs had a 71.2% share of work in the construction industry. Micro and small firms (i.e. those employing up to 50) had a share of 46.7% of work (Ive and Murray 2013). The Government has high ambitions for UK construction. Having been found by successive government commissioned studies to be inefficient and highly fragmented, ambitious targets have been set for the industry to achieve 33% reduction in costs and 50% faster delivery by 2025.

As a significant construction client, the Government has mandated the use of Level 2 BIM from 2016 on publicly funded projects over £5 million. The adoption of BIM plays a key role in the 2025 vision but a lack of clarity persists in the industry over BIM and significant barriers are perceived to its implementation, particularly amongst SMEs. However, industry wide transformation will be challenging without serious consideration of the capabilities of this large majority. Many larger firms, having implemented Level 2 BIM are now working towards Level 3 BIM while many of the smaller firms in the industry have not even heard of BIM. It would seem that fears of a 'two tier' industry are perhaps being realised.

This paper builds on an earlier one (Mellon & Kouider 2014) and investigates, through field work, the level of Level 2 BIM implementation amongst SMEs compared to a large organisation. Challenges and innovative solutions identified through collected data are fully discussed and compared. It is suggested that where the SME

perceives barriers towards adoption of the technologies which underpin BIM, they may consider collaborative methods of working as an interim step in order to work towards realising the efficiencies and benefits that these methods can yield. While the barriers to adoption of BIM are significant, it is suggested that they are not insurmountable for the SME and some recommendations for possible solutions are made.
Keywords: *Level 2 BIM, SME, implementation*

1. Rationale

The rationale behind this paper is to investigate, through field work, the level of Level 2 BIM implementation amongst SMEs compared to large organisations. There is some concern in the industry that SMEs are not keeping pace with the progress required to meet the 2016 deadline leading to further concerns about the potential emergence of a 'two-tier' industry.

A further objective of this paper is to explore how SMEs might move towards BIM practices as an interim step towards full adoption. A case study is used as background to this, along with comparisons to steps taken by a large organisation on their first Level 2 BIM project. Through this exercise, some of the potential motivations for the adoption of BIM practices will be examined, as well as the barriers to SMEs, and some practical solutions are suggested.

A survey was undertaken in the form of a questionnaire (Appendix 1) issued to various SMEs, one was also completed by a respondent from the large organisation for the purposes of comparison. The questionnaire requested information on current company work practices, future plans as well as a section requesting opinions on what can be done to encourage adoption.

2. Methodology and Data Collection

A qualitative approach to this research is adopted as the theories to how BIM may be adopted are developed from the observation of current practices. A combination of exploratory and attitudinal research is used through observation and an open ended questionnaire to evaluate the

opinions of practitioners about BIM adoption. This method of data collection was used in order to take advantage of the potential benefits of open ended questions as cited by Naoum (2007).

A selected sample is used in this research. It was important in achieving the aims of this study to examine qualitative data which in turn requires a sample with certain characteristics; that is SMEs who are considering or who have already adopted BIM practices. As suggested by Naoum (2007), some subjects with contrasting characteristics have been chosen. For example, one respondent is from a larger company and while several in the sample are from a construction background, some are from an architectural setting allowing a comparison of views to be made.

A combination of data analysis approaches is also adopted. Responses are examined for common attitudes and topics but a comparison is also made to highlight the conflicting opinions within the construction industry towards BIM.

3. Case Study

The case study which forms the basis of this paper is a Design and Build contract to extend a hotel in Birmingham's Jewellery Quarter; an area currently enjoying a resurgence. The extension consists of the renovation of a period building to provide additional hotel rooms and office space, together with a four storey extension providing 30 'apart-rooms', a courtyard area and a glass walkway adjoining the two buildings.

3.1 THE CLIENT

The client in this case is a small hotel group who offer small, well designed 'smart' rooms, for budget prices. Currently, they operate two hotels; one at Gatwick Airport and the one forming the basis of this paper. The rooms are relatively high-tech and have branded tablets installed which the resident can use to control heating, TV, water and so on. An app is also available which the resident can download to their own smartphone. While these rooms offer ideal accommodation for one or two nights, it has been recognised that there is a call for larger, better equipped rooms for the

longer term business traveller. The new ‘apart-rooms’ will offer a more spacious room, equipped with a small kitchenette area.

The hotel is fitted out with several brand specific, ‘signature’ features including lighting, the in-room technology and luxurious ‘pod’ bathrooms. The client has recently been successful in obtaining a substantial amount of funding which it is hoped will lead to expansion of the brand. Indeed, the group are embarking on the planning stage for the next hotel which will be a 25 storey new build adjacent to New Street Station in central Birmingham.

Figure 1. Hotel bedroom

3.2 THE CONTRACTOR

The contractor is a relatively small, young and innovative company who are aiming to move away from more traditional methods of construction and towards a more collaborative process. Average project size has so far been between £1 and £3 million. The current project, having recently increased in value is now at the upper end of this range. Thus far, the majority of work won has been via personal contacts and latterly, personal recommendations; design and build being the favoured procurement route for the projects undertaken.

3.3 THE PROJECT

Key to the contractor’s workflow is collaboration and this is facilitated by use of Smartsheet, an online, spreadsheet based, collaboration tool provided

on a ‘Software as a Service’ basis. Sheets can be customised to perform a variety of functions including Gantt Charts, task lists, allocation of responsibilities and file repositories. Users of sheets, once invited to collaborate, can be assigned various permissions from read only to having full editing functionality. Messaging can also take place directly from the sheet and real time alerts advise when changes are made, as well as having the option to email users to advise when a sheet has been amended.

At the outset of a project, the approach is the setup of a suite of spreadsheets in a project workspace within Smartsheet. While this approach is still being refined, the aim is to produce a standard set of sheets which will be used to begin all projects, customising each to the project as required. This is in adherence to Section 4.1.1 of BS1192:2007 which requires that ‘projects should follow a common set of generic processes at the highest level, which are fine-tuned on a project-by-project basis.’ (British Standards Institution, 2007)

Figure 2 shows the drawing register, a central record of drawings to which all appropriate stakeholders have access. Other key sheets are the project directory (containing names and contact details of stakeholders), document register and RFI schedule.

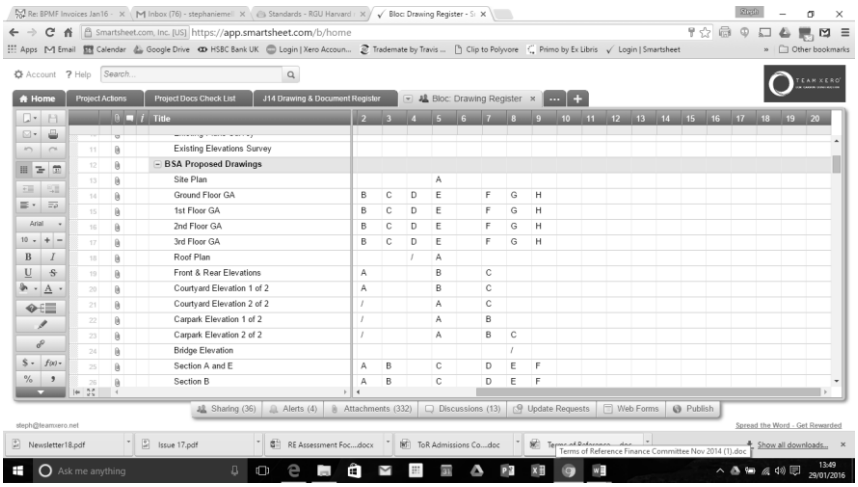

Figure 2. Drawing Register

Once the sheets have been set up and populated with existing information, stakeholders are invited to collaborate as indicated in Figure 3. While most sheets are maintained by the contractor, the architect is asked to upload new drawings as they become available to the drawing register. As alerts are set by the contractor, an automatic notification is sent to the contractor and other collaborators to advise on the changes. The contractor, as document controller, then checks the new drawings to ensure they have been named correctly and are saved with the correct version number and so on. The client and other subcontractors are given viewing permissions which allow them to view drawings and documents and message but not to make other changes.

Figure 3. Smartsheet Project Workflow

As a management tool, Smartsheet has proven invaluable. As this project has generated a substantial amount of drawings, allowing the architect to upload the drawings directly to the register, reduces risk of error. The user can be confident that they are viewing the latest drawings. This is also the case for the document register. As for the project directory, keeping this up to date allows all stakeholders to see, at a glance, who they need to contact and the details are readily available. BS1192:2007 states that '[a] major constituent of these collaborative environments is the ability

to communicate, re-use and share data efficiently without loss, contradiction or misinterpretation.' (British Standards Institution, 2007, p. 1) The use of Smartsheet can be considered as a Common Data Environment in this respect, the use of which is the primary aim of BS1192:2007.

The CIC BIM Protocol is designed to supplement existing contracts on BIM Level 2 projects. While the design output in this project is 2D PDF files, some parallels may be drawn to the role of BIM co-ordinator. As the architect is responsible for ensuring drawings are checked and approved before uploading to the Smartsheet, it is they who undertake a similar role here. The contractor's role can be likened more to the role of the Information Manager outlined in the BIM Protocol one of whose main roles is to manage '…the processes and procedures for information exchange on projects.' (Construction Industry Council, 2013, p vii)

Use of Smartsheet as a collaborative working environment has facilitated the solution to various issues and so has proved extremely useful. Recently though, the importance of using a file naming protocol was highlighted when a review of the drawing register showed some anomalies between file names and version numbers. Adherence to a system such as is suggested in BS1192:2007 may have avoided these errors and thereby potential confusion and errors in construction.

While this case study was undertaken in the early stages of the project, it is these stages which are critical in a BIM process. While the contractor in this case has not implemented BIM, we can draw some parallels with the practices followed with some BIM processes. The value of collaboration is recognised and this is seen as fundamental to project success. This is evidenced in the use of Smartsheet and through the involvement of all stakeholders in ongoing, regular meetings. While it is still being developed, the recognition of the value of work done at the early stages of a project is also encouraging. Again, this is evidenced in the use of Smartsheet, which should ensure that this knowledge is retained. Use of IT is also a further indicator of a potential move towards the requirements of BIM. The cloud facilitates real time collaboration between stake holders and this is complemented by on site equipment such as operative's use of tablets.

The contract used is design and build and has allowed the contractor to drive the level of collaboration in this project. A difficulty which has been encountered is having the brand specific elements contracted directly to the

client. This situation is currently under review however, and it is hoped that the supplier will be novated to the contractor which will allow a far more streamlined and comprehensive process.

As referred to earlier, the client is now looking towards the building of a much larger hotel. Given the high proportion of standardised elements contained within this brand, and the potential for further expansion, the use of BIM at an early stage would be highly beneficial. The current contractor is likely to be awarded this contract and so the client could also benefit from early contractor involvement from the very earliest stages of this project. This position is supported by the recent use of BIM on Premier Inn's, The Hub at King's Cross, a similar hotel concept where it was felt that implementing BIM in this standardised, high tech rooms would reap benefits on future Hub projects. (Building 2015 p. 54- 56)

4. Questionnaire Outcomes

Respondents to the questionnaire are first asked to provide some basic organisational information; name, role and number of employees. The questionnaire is then divided into three sections; A, B and C.

4.1 SECTION A

This section was completed by those whose organisations had already adopted BIM. For the contractors who completed this section (one a large organisation and one a larger SME), BIM was used on some projects and was a client based decision. One respondent here offered some interesting comments as to the lack of drive towards BIM from the client side. He felt this was due to two factors; mainly a lack of awareness of BIM and its benefits among clients, but also the use of current contracts which '…set up an adversarial approach to the team…'. This response highlights an often cited challenge that while contracts may be suitable for use on Level 2 BIM projects, they are adversarial in nature and lead to a reluctance to openly share information as is necessary in the practice of a collaborative BIM environment. He also pointed out that Design and Build contracts allow the contractor more control and therefore, more opportunity to drive the BIM process from the outset. Smaller contractors, who mainly attract Design and

Build work, may find this an interesting point of view. Responses generally suggested that without demand from the client side, there was reluctance to use BIM.

A further potential issue highlighted in responses to this section of the questionnaire was the finding that the use of BIM requires more resources far earlier in the process than is accepted using traditional methods.

Referring to BIM workflows, a mechanical and electrical engineer pointed out that even on a BIM project they frequently have to revert to traditional processes to accommodate subcontractors who do not have BIM capability. The large SME referred to above, are very proactive in this area, providing support and incentives to their supply chain to become conversant with BIM. While the other respondents profess to having support available to those who requested it, this particular SME organise and encourage training sessions for subcontractors and have reported very positive responses.

Benefits reported from the adoption of BIM have been an increase in efficiency and also an increase in confidence in the project stemming from the fact that any issues are in the most part dealt with before construction begins. One respondent said his organisation had not seen any benefits since the adoption of BIM, except on the rare occasion where a client has been prepared to pay for the extra BIM service.

4.2 SECTION B

This section was completed by those whose organisation has not yet adopted BIM. Respondents to this section could see value in the use of BIM, particularly in the co-ordination of services in ‘ever tighter spaces’.

Main barriers to adoption were cited as cost, lack of use by other parties, and client awareness. A further issue raised was the lack of high speed internet access in rural areas. A lack of client awareness is also cited by those who have already adopted BIM leading to a situation where BIM may not be used to its full potential, even among the larger organisations.

Benefits of collaborative working are clearly acknowledged by the respondents in this section as a means of sharing ideas and solutions to problems. Regular team meetings between stakeholders on the project are seen as being crucial to successful collaboration. Various tools were also mentioned such as cloud based project management tools (such as

Smartsheet), cloud based document storage which allows remote access to stakeholders.

4.3 SECTION C

Section C was completed by all and asked firstly if the respondent saw a role for the government in encouraging SMEs to implement BIM. Most felt it was the responsibility of the individual organisation to take the initiative though some felt that clarity was needed and suggested that this was disseminated through professional organisations. However, one respondent believed that the government had an obligation to ensure infrastructure, crucially the internet, was in place to allow organisations to use BIM effectively. Interestingly, those who had not yet adopted BIM saw a greater role for the government in this area.

A further question asked for suggestions which may assist SMEs in the adoption of BIM. The main theme taken from the responses was the advice to take the initiative now to invest and upskill. Further advice was to ensure a responsive supply chain was in place, making the point that an SME may well have working relationships with those who have not yet heard of BIM.

4.4 BARRIERS PERCEIVED

The main issues perceived in the undertaking of this exercise were:

Cost- The cost of extra resources required as well as the cost of investment in software, hardware and training.

Lack of Demand from Clients- Businesses within the industry seem to be waiting for clients to request this extra service for which they will be expected to pay increased costs.

Capability to use BIM throughout the supply chain- One organisation adopting BIM may well face difficulties in finding others in the supply chain that are capable of working with BIM, a particular issue for smaller SMEs.

Pressures on Early Stages of Projects- The practice of BIM requires more work at an earlier stage than is traditionally experienced in this fragmented industry. This new workflow may take some time to adjust to.

Contracts- The most widely used contracts are still adversarial in nature making the ‘no- blame’ approach that BIM requires difficult to adopt.

Lack of Clarity- Exactly what is required by the various members of the supply chain on a BIM project is often not understood.

Internet Access- May be a major issue for those in rural areas faced with poor connections.

5. Overcoming the Barriers

SMEs are perhaps more susceptible to the perceived barriers to BIM adoption through the lack of available time and resources. Also SMEs, especially at the lower end of the scale, are less able and less likely to seek advice of consultants in order to work towards adoption. While the leading edge of the industry has been comfortably using Level 2 for some time, and is looking towards Level 3, the gap between the leading and trailing edges appears to be widening. Nevertheless, as referred to earlier, there are products now available which may help towards implementation.

While BIM requires the underpinning of the technology, SMEs should perhaps look at the process of collaborative working and information sharing as a step towards BIM. If the software platforms are currently unobtainable, then benefits can be gained from lean and collaborative working. Beginning to use these tools will also allow a familiarity with BIM to develop so that the final step towards Level 2 can be completed with less upheaval.

The NBS Toolkit generates Employers Information Requirements which is eventually developed into the BIM execution Plan, Master Information Delivery Plan and the Design Responsibility Matrix (Hamil 2015a). The Toolkit does seem to have achieved an accessible and user friendly interface; a brief registration and a few details are all it requires to get your Plan of Work started and the information entry screens are presented in an easy to use way and is compatible with the RIBA Plan of Work.

There are now several excellent sources of information about BIM freely and easily available online. For example the NBS and BIM+ (from CIOB) both provide a wide range of articles and guidance on BIM. BIM 4 SMEs exist to support SMEs through the BIM process and many organisations provide free training to members on aspects of BIM, for example, CIOB.

Many firms who have already adopted BIM are offering support to others in their endeavours towards BIM implementation. Many offer advice

on a consultancy basis but larger contractors now are supporting smaller companies by offering training. This may well be out of self-interest as in order to proceed with BIM projects, they require subcontractors who are also understand BIM and are able to operate the necessary technology to fulfil their part of the project. However, this training and support could prove invaluable to a smaller firm and is helping to disseminate BIM throughout the supply chain.

Collaboration tools can be very useful. One such tool is Smartsheet, a cloud based project management tool which can be used to facilitate collaborative working and sharing of information between stakeholders and are relatively inexpensive. An enhanced version of this concept is expected to come to market in the near future. Cloud4Collaboration appears to be a similar tool but will allow the sharing of 3D model files in IFC format. This also provides a solution to the problem of file size as each user retains the data on their own server. It is claimed that this may offer Level 3 BIM (BIM+, 2015) and provide an answer to the legal and intellectual property issues surrounding Level 3 as files are still retained by the originator and remain legally theirs.

Collaborative platforms are provided on a ‘Software as a Service’ basis and are web hosted so there are no significant demands for high specification hardware. While collaborative working is facilitated by this type of product, modelling software is required to produce the BIM model.

Many BIM viewers are available free but are often provided by the software vendors and are therefore proprietary in nature. However, BIM Vision has recently been released which is an IFC based viewer which supports most of the large BIM modelling platforms. Plug- ins are also available which can extend the functionality of the viewer.

6. Conclusions

The undertaking of this study has shown that the adoption of BIM is unlikely to be without problems and for SMEs may be better undertaken in stages rather than a wholesale implementation. Indeed, the large organisation also interviewed as part of this study has had some ongoing issues on their current project, with interoperability as individual models are federated.

SMEs who choose to embrace the BIM concept will find a wealth of support and tools available to assist them in adopting more BIM like work processes. As the technology is refined and more solutions come to the market, it may well be that the costs of implementation of full BIM reduce, and current issues resolved. An organisation, who has already adopted the processes, will then be well placed to adopt full BIM.

As collaborative approaches are adopted, this provides an ideal platform for the sharing of knowledge. As exemplified by the large SME mentioned earlier, assisting others in the supply chain, offering or sharing in training, can only be beneficial to the organisations involved, but also to the industry as a whole. This may result in new business models being adopted as smaller businesses come together under 'one roof' to offer a comprehensive construction service from design to construction and beyond.

The UK government defines BIM as '… a collaborative way of working, underpinned by the digital technologies which unlock more efficient methods of designing, creating and maintaining our assets'. (HM Government 2012 p. 3) This definition highlights the importance of the processes. While issues such as contracts are unlikely to be resolved by any one organisation, SMEs can, by making use of tools such as those above, gradually begin to embed BIM processes in their workflow. This type of approach is more likely to result in the adoption of BIM than an 'all or nothing' attitude. Working collaboratively is an ideal place to start and may well provide many economies of scale which would otherwise be unavailable to SMEs such as training and software purchase. As well as providing an ideal platform for the sharing of knowledge and opinions about BIM. Partners in this process would have to be chosen carefully as it is vital that they share the vision and aim of full BIM implementation.

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Appendix 1

BIM AND SMES QUESTIONNAIRE

Organisation info:
- Name of organisation:
- Respondent's role in the organisation (Architect, project manager…):
- Number of employees:

Does your organisation use BIM?
- If yes, please complete Sections A and C
- If no, please complete Sections B and C

Section A

1. Is BIM used on projects within your organisation? Please specify and give examples where relevant:
   Yes, all projects:
   Yes, some projects. Is this a client driven decision?
   No. Is this a client driven decision?
2. How does workflow differ on a BIM project to a non- BIM project?
3. Do you offer support to sub-contractors on your projects in using BIM? If so, please briefly describe what support is offered.
4. What, if any, benefits to your business have you experienced through the implementation of BIM?

Section B

5. Is your organisation planning to implement BIM in the near future?
6. What do you see as the barriers to BIM adoption?
7. Do you see collaborative working methods as integral to a successful project?
8. What methods do you use to facilitate collaboration?

Section C

9. What in your view could the Government do to assist in encouraging SMEs to adopt BIM?
10. Do you have any further suggestions which may assist SMEs in the implementation of BIM?