THE WIDER IMPLEMENTATION ISSUES OF BIM WITHIN A MULTIFACETED PROPERTY AND REAL ESTATE CONSULTANCY

R. M. Dowsett[1] and C. F. Harty[2]

[1] TSBE Centre, University of Reading, Whiteknights, PO Box 219, Reading RG6 6AY, UK
2 School of Construction Management and Engineering, University of Reading, Whiteknights, PO Box 219, Reading RG6 6AY, UK

The purported benefits of Building Information Modelling (BIM) have resulted in its widespread advocacy across the industry. However, the realities of its implementation are often misunderstood and overlooked. BIM is a complex and unbounded technology, therefore trying to apply it to a project without consideration of the associated organisational changes is likely to end in failure or lower than predicted returns. Factors such as professional development and technical support, the technology learning curve, positive and negative feelings towards the technology, and strategy effectiveness can all help and hinder implementation. This paper draws on a set of interviews with members of a BIM implementation board within a large multifaceted construction company. The purpose of the interviews was to establish the 'as-is' position of the organisation in terms of BIM use, focussing on current practices and cases studies of previous and on-going projects and their utilisation of both BIM processes and sustainable design activities. However, thematic analysis highlighted significant barriers to the successful implementation of BIM within the organisation: lack of top-level support, misunderstanding across the organisation over BIM capabilities, regional differences in implementation support, and a predominant focus on the bottom-line preventing effective resource allocation. It is therefore argued that the organisational context and conditions of technology, process, and actor interaction are a necessary precursor to successful BIM implementation and should be taken into account when assessing performance on a BIM-enabled project, in order to comprehensively inform and support change management initiatives.

Keywords: BIM, implementation barriers, performance measurement.

INTRODUCTION

The realities of BIM implementation are often misunderstood and overlooked; BIM is a complex and unbounded technology, therefore trying to apply it to a project without consideration of the associated organisational changes is likely to end in either failure or higher costs.

A number of studies identify the challenges and risks associated with BIM implementation and execution that are helpful to understand elements of project success and how to improve ROI. These include: data interoperability issues, issues of computable design data, under-developed practical strategies to exchange and integrate information, implementation issues, incomprehensive strategies for

---

[1] r.dowsett@pgr.reading.ac.uk

implementation, exploitation of BIM hyperbole that only considers the quantitative aspects of BIM benefits, learning curve of software, and difficulties associated with changing normal protocol to bring stakeholders in earlier (Azhar, 2011). These difficulties are indicative of a failure to consider the context and extent of 'ICT Diffusion', defined by Peansup and Walker (2006) as 'the process by which an ICT application is adopted and implemented by an organisation until its expected users accept and transfer knowledge of how to use these ICT applications throughout the organisation'. The level of success is in-part dependent on the effectiveness of the organisation's strategic implementation plan, which must consider issues of critical management support, technical support, a supportive workplace environment and users' individual characteristics (Peansupap and Walker, 2006). An effective entrepreneurial leadership role that requires a high level of technical competence is essential to overcome many of the challenges and risks associated with the diffusion of an innovation such as BIM within a construction company, the delegation of which is dependent on the availability of resources and adequate power (Nam and Tatum, 1997). In reality champions of innovations compete with existing operational activities for resources which means the implementation of technologies is achieved through 'learning on the job' (Barrett and Sexton, 2006) when much of the literature regarding the successful implementation of BIM advocates a number of antecedent requirements at an organisational level.

Drawing on a set of interviews this paper explains the 'as-is' position of a multifaceted construction company currently implementing BIM. The data identifies issues inherent to the organisation that are intensified by the implementation of BIM. Analysis of the interview data exposes the existing issues within Company A and supports a more systemic sociotechnical approach to implementation that the literature propose. The paper is structured as follows: the rationale for the research approach is first explained, the findings are divided into thematic subheadings of Insufficient top-level support, Misunderstanding across the organisation over BIM capabilities, Resource allocation, and Regional differences in implementation support, and finally conclusions are put forward.

RESEARCH APPROACH

A semi-structured interview protocol was developed based on the reviewed literature, commonly occurring themes throughout BIM team meetings, and the consultancy's analysis of Company A's as-is position prior the implementation of their services. Nine interviews varying in length from 40-90 minutes were conducted with BIM Team members including regional directors, discipline directors, CAD Managers, the BIM Team coordinator, and the IT Change Manager. The interview protocol focussed on current practice, cases studies of previous and on-going projects, and their utilisation of both BIM processes and sustainable design activities. Questions were specific to four areas: introductory questions regarding roles and responsibilities; sustainable design; the effect of BIM on individuals' roles and interactions within interdisciplinary work; and lessons learnt from BIM utilisation in interdisciplinary work.

For the purpose of providing a baseline case from which to measure the ROI and sustainable design benefits of BIM the data was thematically analysed by review and comparison. The consideration of BIM as a sociotechnical system was developed through the literature review and informed the approach taken to review and analyse the data. This was used to identify specific themes that determined the extent of the

configuration of people, technology and processes and how these affect the success of a project.

Company A is a multi-national multi-faceted Property and Real Estate consultancy with 4,500 staff at 50+ offices in the UK and internationally. They offer a vast range of professional and technical expertise across a number of services. They have committed to adopt Building Information Modelling (BIM) practices and processes as the default method of working throughout the company and have enlisted the services of an IT design solutions consultancy company to support this initiative. In order to facilitate this and to provide a centrally led induction process a BIM implementation team was set up. However, there is no uniform programme of implementation that each discipline or region must adhere to; BIM is being implemented on a project-by-project basis. The team consists of higher-level users of the software who are expected to champion and roll out processes, methodologies, and decisions made within monthly team meetings in addition to their normal role.

Company A at the time of the interviews had a licencing arrangement whereby the accredited IT design solutions consultancy company deliver services on behalf of a software vendor. Services include project, process and software consultancy, implementation and project support, as well as training and technical support. The consultancy company are nonpartisan to the vendor and offer training and consultancy support for other software solutions. The purpose of this study was to capture the team's effectiveness and the wider implementation issues of implementing BIM within an organisation of this kind.

FINDINGS

Insufficient top-level support

Within Company A only a select few people know what BIM is and what it can achieve; those that do not know often misinterpret it is as a bounded software solution applied to existing design processes and practices to increase productivity. However, as the following interview analysis will illustrate the organisational context of Company A forces the technologically deterministic application of BIM at project-level. This exposes the existing communication, collaboration, and cooperation issues at firm level that the technology is supposed to expedite. Conversely the application of BIM, by way of a sociotechnical systems approach that the BIM Team alludes to, relies on organisational restructuring, culture change, and change to embedded practices and processes. Change that is very difficult to implement without support from those who hold the power and authority to make strategic decisions that have an understanding of the underlying principles of BIM. As one interviewee explained:

"… whatever level decisions are made at decisions are made by saying 'well, yes, we understand that we're making this decision because it's going to make the company more money but we're also making this decision because…it's the right way to go forward in terms of the methodologies and processes we have and what we want to then market out as a service'." [BIM Team Coordinator, Consulting Team]

In the case of Company A, the extent of executive management engagement has been the approval to adopt BIM and to fund a licensing and consultancy service agreement that also includes training courses and telephone support. This agreement was based on a business case for higher project-level returns, and a BIM policy statement disseminated company-wide announcing its adoption. However, the executive board have no explicit role in the implementation of BIM. This task is the responsibility of

the BIM Team, which is a group of individuals who have been selected as higher-level users of the software with the necessary technical expertise to train and mentor newer users, and who disseminate the processes and decisions made within the BIM team meetings.

Despite their expertise and their understanding of the type of change management required, their efforts to resource and execute new BIM processes and practices are inhibited by their lack of authority to make decisions regarding changes to localised procedures. For example, the CAD Manager tasked with resourcing and technical support for CAD within the Civils discipline has found his role as a BIM Team member:

"relatively difficult….because I've got no position on our managerial team…the only meetings I go to to do with management of the department is when I go to resourcing meetings where I found out who needs what and that's the only time I found out what [BIM] projects are going on." [CAD Manager, Civil Engineer]

This suggests that the role and extent of the BIM Team as BIM process and practice implementers is misunderstood, inadequately supported and insufficiently embedded. This problem is not exclusive to this discipline and many of the interviewees believe it can be overcome with effective top-level managerial support that propagates the values and principles of BIM methodologies throughout the company.

Currently there is a complete disconnection between top-level management, *"…the ones with the money…"* and therefore the power to effect organisational change, and what is actually happening on *"the shop floor"* where process improvement is impeded by the existing organisational structure and associated processes. The problem being that they cannot effectively support the individuals implementing BIM because they are unaware of the issues associated with the existing managerial structure. These issues are further veiled within the communication channels throughout the managerial structure:

"…the only way the executive board communicate…is through a newsletter…that comes down through the managerial structure…you get a raft of management that pass information back up to the board, but as it gets passed up it gets diluted and it also gets phrased in a way that makes the manager look good…" [IPD Strategist, Architect]

The size of the company and disparity between disciplines and regions inevitably creates value inconsistencies and there is a demand for top-level management to become a visible and proactive entity in the promotion and implementation of BIM throughout the company. The self-preservation of middle management is repeatedly mentioned as a bottleneck to implementation success whereby information about cost centre performance is withheld from the executive board for fear of rationalisation, when rationalisation and restructuring is what is actually required:

"…sometimes you've got to confront the truth in order to take the business on to success, and sometimes if you keep things from people, those people can't actually help you…if the executive board don't know what's going on…how can they manage the business?" [IPD Strategist, Architect]

Interviewees believe the implementation of BIM within the company would be better achieved through executive board leadership and support:

"In this business we need to completely change our attitude in the way that we roll BIM out. It needs to be enforced; it needs to be by dictat…

…this is what you're going to do, and I'm going to help you do it, and that's the difference between success and failure for BIM I believe." [IPD Strategist, Architect]

As it stands many of the BIM team are asked to implement a method of working without the requisite power or support to effect change.

Misunderstanding across the organisation over BIM capabilities

Along with a lack of top-level support many of the issues faced by the BIM Team are associated with a misunderstanding of what BIM actually is, what it entails and the varying capabilities of each discipline and region. The BIM policy statement from the executive board was a broad announcement of the company's aspiration to become a leading BIM-enabled organisation. This has implications for strategy support, the extent of its use at project-level, and creates tension between the capabilities that are promoted when securing bids and the reality of what can actually be delivered.

Interviewees described the problems of senior managers over-estimating the capabilities of the project teams, they have heard that the company is now doing BIM but there is no strategic consideration of what BIM should be delivering, when it should be delivered, or how it should be delivered to realise benefits for both the project and the organisation:

"I think the one difficulty or the one frustration that clients seem to have now is perhaps understanding or clarifying between what we've said we can deliver as a company and what we actually deliver." [BIM Team Coordinator, Consulting Team]

As a result, time, training credits, and resources are used for non-design/construction critical tasks at the request of senior management who liaise with the client and promise outputs that add no real value.

"…they're modelling all sorts of stuff that is on a scheme early stage design, so they're just throwing money away." [Regional BIM Manager, Architect]

This creates additional problems for the BIM team members; frustrating the implementation and use of structured and considered protocol to deliver meaningful and coordinated data by having to use arbitrary processes to meet the advertised BIM deliverables. When asked how this could be improved one interviewee proposed a front-loaded approach with a clear definition of the project's BIM scope to avoid the reactive processes that are currently employed:

"…for me the biggest lesson learnt is trying to get that scope nailed right at the start and getting the senior people who define that scope educated into what they're signing up to…." [Regional BIM Manager, Architect]

There is consensus amongst the interviewees over the need for sincere buy-in to the underlying principles of BIM to give the BIM Team the support and authority they require to navigate through the barriers associated with the current organisational structure. This is difficult when the processes and practices that they are trying to implement have no obvious immediate effect on profit maximisation making it hard to convince users and decision-makers of the benefit of their implementation without some understanding of the change management requirements.

As such, there is no drive to implement a change management initiative to restructure business units or change existing design processes, particularly within the Civils

department previously mentioned. The structure of this department has meant that the anticipated changes to the design culture and processes have not happened as a result of people thinking that BIM is software based since it is only the CAD technicians that are engaging with BIM and then only as a drafting tool:

"...we haven't used the Revit design functionality.

...that hasn't happened principally because the people who are doing Revit designs are former CAD people so they're not switched onto design in the first place and they're not seeing it from a design point of view and our designers are still designing however they designed." [CAD Manager, Civil Engineer]

With regard to the existing procedures for project setup within the same department the interviewee commented on the flexibility of their application and the lack of an authoritative protocol:

"...we have work procedures written internally to tell you how to set up projects. They don't tell you how to set up projects. They advise you how to set up projects. So project managers therefore don't pay a lot of attention to it." [CAD Manager, Civil Engineer]

Consequently, a number of arbitrary folder structures exist that impede design processes and produce duplications and unmanaged data. Despite there being a drive and a need for a structured approach from a managerial level higher up at a Business Management System level procedures are written to compensate for a variety of working procedures. As a result, conflict between operational requirements at project-level and the standard business operating procedures at a higher level exists, which individuals who have the power and influence to prevent any changes to normal operating procedures perpetuate.

These issues come back to the difficulties of trying to implement BIM at project-level within an organisation that is essentially made up of a number of smaller organisations, each with different localised procedures that are impossible to change without top-level support. At the user level BIM team members struggle with the attitudes of staff that do not understand the benefits and are consequently reluctant to change their working methodologies. This is made worse by the support from profit-orientated senior managers who see BIM from a technologically deterministic perspective that concedes it must be an issue with the software, and since targets must be hit users are permitted to revert to traditional methods:

"...it's the attitude of the actual users themselves...."

"...sometimes those people will blame the software and it's believed by the management because sometimes they don't necessarily know any better...and they are trying to hit deadlines and trying to...hit their monthly numbers, and they will push it in a certain way." [Regional BIM Manager, Architect]

One interviewee commented on the miscommunication between the BIM Team and the board of directors and the interpretation of what BIM is and what is required strategically, highlighting this as a contributing factor to poor implementation

"... the two groups were looking at it differently and people flagged up that perhaps that was because the senior management only look at it one way and don't have that, even at a high level understanding of what BIM methodologies and processes are so that they can understand why the [BIM Team] is making the requests they're making..." [BIM Team Coordinator, Consultancy Team]

This problem is perpetuated by the performance data that is used to communicate the progress of the implementation initiative, in a dashboard format, to the board of directors. The dashboard consists of the collective project data from all areas of the business engaged in BIM covering four areas of profit, productivity, sales and staff retention: metrics that are instrumentally rational and prevent meaningful discussion around process improvement strategy.

"...they were looking at it in terms of rather than technically the BIM processes they were just looking at it in terms of is it going to be of benefit to the company." [BIM Team Coordinator, Consultancy Team]

The issues raised within the interviews appear to be an interdependent set of factors that affect project success from both top-down and bottom-up.

Resource allocation

From a technology perspective Company A do not appear to have had any significant barriers in terms of availability; hardware and software has been readily available, as has training. However, throughout the interviews, a significant issue around knowledge and information exchange between cost centres and regions is apparent and this is as result of the organisational structure:

"...it's based on cost centres, the business structure, and each cost centre lives or dies by its own profit and loss account, and its cash flow; it means that there is a lot of internal competition, and it also means that the cost centre politics gets in the way of actually achieving our goals." [IPD Strategist, Architect]

The existence of the BIM Team and the licensing and consultancy agreement become obsolete when the level of the implementation initiative extends beyond the existing organisational operating procedures and normal project setup. Training credits and consultancy services cost nothing in terms of money, however the time it takes to use them is charged to a project. For example, one interviewee discussed the issues with trying to implement BIM on a project when the financing of training and learning new processes is tied up in the normal budget and targets of business as usual. They cannot charge extra time to the project because they very quickly find themselves over budget and in many instances unable to complete the project using the BIM processes and methodologies they initially aspired to use.

"...if you book that to the project the project is over margin before you even start. And then it's almost like 'what's the point?' you're trying to do BIM when it's becoming a money loss. You know, it doesn't work...you need to take the work more now in your own time for the project let alone to learn things." [Designer, Civil Engineer]

These issues exist within the BIM Team itself at an individual level where members are responsible for regions that include a number of disciplines. They are expert in their own disciplines but are also expected to roll out BIM in other areas when they have other roles to complete at the same time:

"...I can cover the architectural side really easily because it's where my background is but when I'm trying to cover M&E, Structures, Civils it's different, it just needs someone else involved in it really to try and cover that side off." [Regional BIM Manager, Architect]

With reference to the effectiveness of the BIM team, many interviewees suggested the need for a more centrally led implementation team to *"drive consistency"*. A select few of the team members who are most advanced in their implementation of BIM are

in high demand across the business to share knowledge and provide assistance but because of the dual roles they now have to fulfil they lack the time to be able to do so. One reason for this is that the BIM Team is not a separate initiative operating outside of normal business procedures, and, as result, project pressures within their own business units become the priority:

"Yeah I mean they obviously spent a fair few quid on the partnership deal but then didn't put, I don't think, the people in place with the resource because they relied on people from cost centres but those people were controlled by their cost centre."

"It should have been a lot better, a lot more resourced." [Project Manager, Civil Engineer]

"Yeah as I could say there's been a lot of outputs but not a lot of outcomes.....I mean lots of training, lots of effort, but not a lot of change." [Regional BIM Manager, Architect]

As one interviewee explained, much of these issues can be attributed to the organisational silos of cost centres:

"There needs to be...a succession plan and infill behind those so that they can be used across the business but whilst you have that in cost centres those cost centres won't release them." [Associate Director, Civil Engineer]

Retention of staff was also a concern associated with the effective resourcing and dissemination of BIM values and skills:

"... we're going to lose them and also if we're not careful others aren't going to learn from them because they're the actual ones still delivering the projects and not mentoring and bringing others through so I think that's something they need to look at." [Associate Director, Civil Engineer]

When asked how the implementation of BIM could be improved all interview participants described a top-level, centrally sourced fund to help make a difference to the way in which resources can be more effectively utilised in implementing BIM across the business:

"... I think it has to be a centrally sourced fund pushing it out because as soon as you send it out to the local cost centres then the first thing that's not spent is that BIM money." [Project Manager, Civil Engineer]

"...I think the only way this will work in terms of our office structure is that the BIM process there's money set aside in the business plan each year to allow for training or self-teaching..." [Designer, Civil Engineer]

All of the interview participants recognise the scale of BIM implementation but are restrained by the organisational structure, which is preventing the effective allocation of time and resource required to embed BIM working methodologies.

Regional differences in implementation support

In contrast to the other accounts of implementing process and technology change, the following interviewee, who is an associate director and profit centre manager, gave a positive account of the transition to a BIM environment:

"BIM came along at an opportune moment really to really drive the need to change the way our IT was setup....neither office did a lot of external work it was mainly for their core clients...That has changed now, as we're five years in we need to build this

business for much more external work and bringing in BIM has forced the issue to move to both offices on to [Company A] systems. It's helped really; this has helped spring a change really in our setup." [Associate Director, Civil Engineer]

At the time of interview, a combination of the restructuring programme, along with the power and influence the interviewee has as a Profit Centre Manager, seemed to have created a favourable context for implementing process improvement. When coupled with the use of a BIM team member who has a specific role as an Integrated Project Delivery Strategist within the architectural discipline the implementation initiative was considered even more successful:

"...I think as far as where we've got to in Oxford I think we've done it the correct way. We had our implementation strategy, we got support to put the BIM Execution Plan in place before the project started, we obtained support from architecture for a consultant to help guide and advise the team to get setup and started and obviously we're using our training and project credits as part of the EBA to deliver support during the early part of the project so I think as far as where we've got to, I mean the support has been really good and I think the issues really for us now are more around the project timescales." [Associate Director, Civil Engineer]

When compared with other accounts across the company this business unit approached the implementation of BIM in-line with much of the literature surrounding best practice. There was a clear understanding throughout that business unit of the impact of BIM on existing practices therefore strategy was developed in consultation with the IT design solutions consultancy, and standardised process and protocol were developed prior to project commencement with assistance from the only member of the BIM Team whose role is defined solely as a strategist. Even though this is an example of success at that particular stage of the implementation process, the interviewee still commented on the difficulty of knowledge sharing from other experts in other disciplines within the BIM Team:

"...there's no sharing, no opportunity to pull other people in from say the M&E team into a regions business to do two weeks of mentoring..." [Associate Director, Civil Engineer]

There is also concern that without a comprehensive strategy that looks at business processes as a whole the value of BIM will only exist on larger projects, despite the potential for its use on smaller projects where standard procedures and protocols make for efficient delivery:

"I think the [BIM Team] isn't successful enough in getting consistent standards across the business, driving consistent process and policy. I think more of that needs to be done."

"...a lot of our smaller projects could be in the 50k to 500k range so you actually might not want to actually knock that project out in the 3D environment unless you can get it working really efficiently.....So our challenge will be....to what level will we drive it down to."

"...you can't leave it to pockets of the business to try and develop it and expect it to come together. It really needs to be driven from the top..." [Associate Director, Civil Engineer]

CONCLUSIONS

Throughout the interviews, the participants were describing the application of BIM as an additional effort to what is already a complicated process. There is tension between existing processes and practices and those that are required to deliver a project in a collaborative and coordinated environment. In this instance the application of BIM as a system to a project was used as a lens through which to examine the inefficiencies of the organisation that already exist and to effectively allocate resources for the purposes of process improvement.

Findings indicated that the organisational context determines the configuration of technology, process and actors within a BIM system and as such, the realisation of the benefits and ROI of a project utilising the system is dependent on these precursory conditions. The successful process improvement initiatives carried out within Company A are a success despite the wider implementation strategy rather than because of it. The interview findings are analogous to the difficulties described in the literature; pockets of expertise and varying levels of power and influence making an even diffusion of BIM capabilities across the organisation difficult to realise. This is an inevitable outcome when the rationality behind resource allocation is based on BIM as a technology rather than BIM as a new collaborative practice requiring effective change management.

Much of the existing literature surrounding BIM implementation is focussed at project-level. But when discussing the difficulties and successes of BIM within Company A the comments almost always resulted in a discussion around the conflict between business objectives focussed on profit, the processes in place to support that, and the investment of time and resource required to implement and manage the changes in process for the purposes of utilising BIM. Therefore, an examination of the process of producing and holding together configurations of different actors, processes and technologies is perhaps a more beneficial contribution to the understanding of the dynamics of BIM in construction, and also in the measurement and realisation of the associated benefits.

REFERENCES

Azhar, S. (2011). Building Information Modeling (BIM): *"Trends, Benefits, Risks, and Challenges for the AEC Industry"*. Leadership and Management in Engineering, (Bazjanac 2006), 241–252.

Barrett, B., and Sexton, M. (2006). Innovation in small, project-based construction firms. *"British Journal of Management"*, **17**, 331–346.

Nam, C. H., and Tatum, C. B. (1997). Leaders and champions for construction innovation. *"Construction Management and Economics"*, **15**, 259–270.

Peansupap, V., and Walker, D. H. T. (2006). Innovation diffusion at the implementation stage of a construction project: a case study of information communication technology. *"Construction Management and Economics"*, **24**(3), 321–332.