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MAKING BIM A REALISTIC PARADIGM RATHER THAN JUST ANOTHER FAD

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There has certainly been progress in the use of Building Information Modelling (BIM) around the world, especially in the last decade. In several countries BIM have been put into practice and employed. The UK industry has not yet fully implemented or made use of BIM but there is a strong drive from the government to adopt BIM Level 2 on all UK public projects by 2016.

However, there is as yet no clear roadmap to ensure the adopting of BIM is accepted and progressed in the correct methods. The complexity and nature of BIM needs to be addressed and outlined to ensure all participants are “BIM ready” before 2016. The aim of this paper is to outline a clear understanding of the barriers and hazards surrounding the use of BIM to give comfortable consideration on the implementation of BIM. First, the current implementation of BIM around the world is explored to outline the process of BIM across different countries and understand their practices. Then the key concept of BIM including advantages and disadvantages within the current AEC industries is investigated. Followed by a comprehensive research on the challenges of implementing BIM and why it is important for all participants to understand these challenges especially within the current timeline of the UK BIM strategy. This research is based on broad literature reviews, along with results of two recent questionnaire and Interviews to present a qualitative illustration of the current situation and the concerns of implementing BIM within the UK.

Keywords: Building Information Model (BIM), Virtual Design and Construction (VDC), n-Dimensional Modelling, Parametric Modelling, Facilities Management (FM).

INTRODUCTION

Technology was first introduced into the industry in the early 1980s under the Virtual Building concept by Graphisoft's ArchiCAD now known as ArchiCAD. This was the start of the software revolution that allowed architects to create virtual, three dimensional (3D) designs of their project instead of the standard two dimensional (2D). Since then, new technologies and updated software were developed and used. However, this use of technology was only limited to the design stage, until the concept of Building Information Modelling (BIM) was introduced. This advanced system was established to assist architects, engineers and construction professionals in storing and communicating all the amounts of datasets such as the building geometry and spatial data as well as the properties and quantities right from the inception of early stages throughout to demolition.

The use of BIM is aimed for much more than just performing a model to see what the building should look like; BIM intend to create a model that contains all kinds of information, from spaces and geometry, to costs, personnel, programming, quantities, specifications, suppliers and other information types. To be well-managed and qualitative this information is contained in such a model where it is all related and built on each other to provide the best solution, enhance decision making, improve production to high level of quality, enhance prediction of building performance, major time saviour, and control the budget in a safer environment within an organised collaborated way of working.

In the last decade BIM stood out as a very beneficial process due to the excellent benefits and the successful use around the world; therefore, later in 2011 the UK government proposed to implement BIM by 2016 to eradicate many inefficiencies within the industry and to bring in a modern way of working to make it a pleasant working atmosphere as well as making shared information easy to visualise and understand, providing greater efficiency and quality. However, this technology on its own cannot provide the final solution as the industry has always been managed by the current "Fragmented" way of working. Therefore, it is essential to initially change the current way of working in order to adapt with the use of BIM. The UK Government has published a BIM strategy plan in March 2011, which outlined the importance of BIM use and implementation contents. However, this strategy cannot be used for implementation guidance. The need for an implementation plan is not only required for the sake of giving a clear roadmap for the industry but also to give viable information on what to be considered before using BIM.

“Change without a plan ultimately ends in chaos. If we fail to plan, we will have squandered the tremendous opportunity that is available to our industry.”

(Henry, I. JBIM. 2009)

CURRENT PRACTICES OF ADOPTING BIM AROUND THE WORLD

BIM have rapidly spread around the world. Many countries around the world have exposed great interest towards implementing BIM within the construction industry but each country has its own arrangements and progressed differently.

BIM in the USA

The USA was the earliest initiator of BIM especially within the public sector. In late 2006 the US General Services Administration (GSA) issued a BIM-guideline outlining an implementation plan to accompany the integration of BIM use within the US AEC sector in general and the Public Building Service (PBS) in particular. Following that, in 2007 the US GSA issued a mandate to obligate all planners to use BIM while applying for GSA's funding schemes (GSA, 14).

In addition to the widely recognised benefits of BIM that the public sector was mainly profiting from, the US AEC sector established BIM's policies by addressing the allocation of risks associated with the implementation of BIM, outlining the roles and responsibilities of each participating party while avoiding any conflicts with the existing construction contracts policies. This has encouraged many stakeholders to use BIM as proved by the American Institute of Architects' report on the Business of Architecture (2010), confirming that 60% of US architects are using BIM throughout their projects.

BIM in Finland

The Implementation of BIM within Europe was initiated later than the USA but showed a faster and wider improvement within the industry especially in Finland (as shown in Figure 1). According to the Finnish ICT Barometer for all architects in Finland (2007), 93% of architects are using BIM in current projects with 33% of that usage at BIM level 3. In the same survey it was observed that nearly 60% of Finland's engineers are using BIM in both the public and private sectors (Kiviniemi, 2007).

This spectacular spread of BIM use within Finland is due to increased interest by the Architectural Engineering and Construction (AEC) and Facilities Management (FM) companies in profiting from the benefits of BIM. Starting from 1st October 2007, they focused on using BIM's model technology within common project works. In 2009, they established detailed modelling guidelines to assist the use of BIM during the design stages. This was used by the governing body of public properties to run several pilot projects, showed a great impact in making decisions for Senate Properties' investment processes and enhanced developments within the private sector (VTT, 2007).

BIM did not only reach the public sector but also the private sector, where several major companies such as 'Skanska Oy' and 'Tekes' have taken the lead in working with BIM (Kiviniemi, 2009). Numerous researches with local Universities such as Tampere University of Technology were also highly involved in investigating the benefits and outcomes of BIM practice within the industry to promote the potential implementation of BIM, developing technical tools and investigating the potential of BIM in providing solutions sustainability within the industry. (Leicht et al. 2007) (Huovila, 2008).

BIM in Singapore

BIM concept was first introduced in Singapore in early 1995 by Singapore's Ministry of National. This gave organisations such as 'Development Construction and Real Estate Network' (CORENET) an early involvement to develop and implement BIM within government projects.

Singapore's government was successful in pushing for BIM implementation and BIM standards on various kinds of projects in the public and private sectors with the help of CORENET's BIM Guideline "Integrated plan checking" (Khemlani, 2005). This has noticeably enhanced the number of public-private initiatives to encourage the use of BIM in a number of large pilot projects.

BIM in India

India's fast growth of population and economy has generated a boost in the building environment which provided the perfect platform to implement BIM. India has a strong workforce of Qualified, Trained and experienced BIM specialists who are not only implementing BIM technology in India's Construction Projects but also assisting on the implementation of BIM in Canada, USA, UK, Singapore and Middle East regions.

BIM in Canada

The Institution of BIM in Canada (IBC) has taken the responsibility to lead and facilitate the full Implementation of Building Information Modelling (BIM) into the Canadian built environment, their main interest is to focus on the primary stakeholders allowing them the right method and pace to understand their roles and responsibilities and to assess their capacity to contribute in this process.

BIM in the UK

The UK Government has already shown their awareness of BIM's benefits in controlling cost, time and quality and the advantages it could offer to everyone involved in the construction industry, including clients, designers, contractors, suppliers and facilities managers. On 31st May 2011 the Government showed its interest in BIM by publishing a construction strategy report that announced that the

Government aims to adopt BIM technologies, process and collaborative behaviors into all stages of the life-cycle of public projects worth more than £5 million by 2016. This is expected to advance the use of BIM as shown in figure 1.

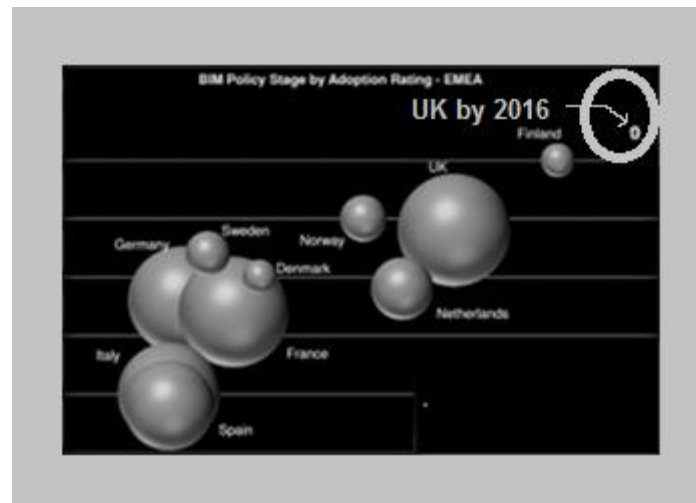
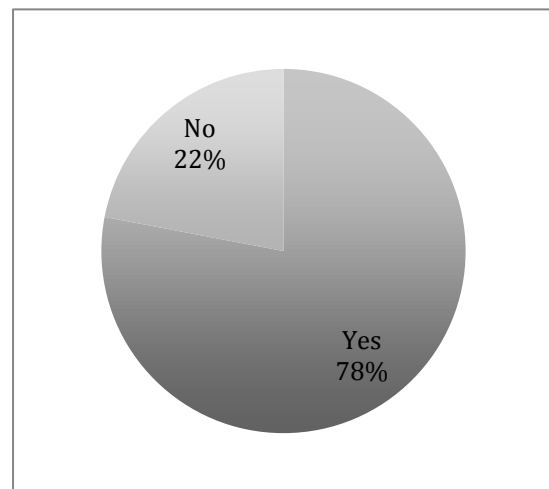
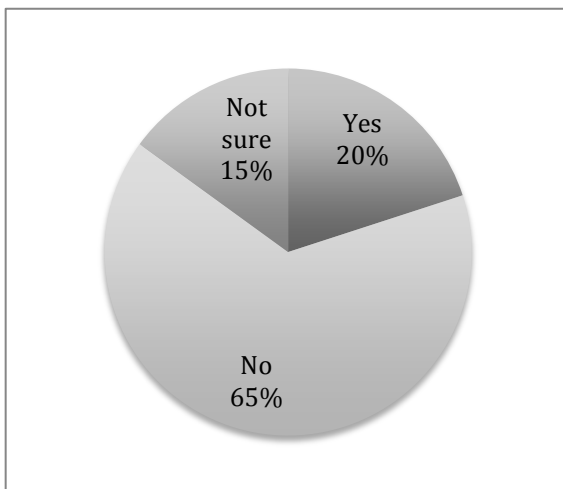


Figure 1: Levels of BIM implementation within Europe

However, to reach these expectations, everyone within the industry will have to step up quickly to reach the required BIM awareness level. Questionnaires were distributed in March/ April 2013 to a large number of professionals in the UK alongside interviews with different Academics. 84 participants flagged the concern of misunderstanding BIM and its concept. The response showing in the graphs below expresses the tardiness of many practitioners and organisations towards BIM understanding and adoption.

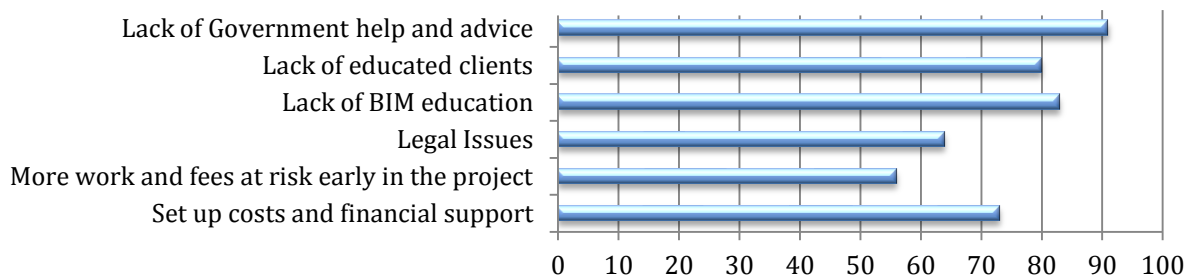
Are you or is your organization aware of the challenges of implementing BIM?

Are you concerned about BIM adoption in your organization?



Those participants who were concerned with BIM adoption were asked an additional question to rate their concerns of BIM adoption challenges. From the results showing below and the comments that were obtained from this research and interviews, an outstanding distress was discovered on the concern of BIM adoption and many professionals seemed to know about BIM but fail to have any knowledge of how and when to adopt it. Also, many realise that adopting BIM is a challenge to many organisations but don't seem to know what the real challenges are. Therefore, a detailed manuscript is required to outline all the challenges of BIM adoption in the UK.

Rank the following BIM adoption challenges



ISSUES OF BIM

No doubt, BIM can be of extreme benefit to the industry and potentially improve the industry; however, the use of BIM in the UK could raise a vast number of issues that deserves serious consideration. In essence, it is only as good as the people using it. Many clients are still hesitant toward the implementation of BIM as they are still uncertain and puzzled on what BIM really is. This is due to the nature of all participants within the industry and the high costs of BIM implementation owing to the required extensive training of the different professionals, cost of technical expertise, costs of organising protocols and managing a network server to store and access the model.

Other issues stopping the Implementation of BIM are the Legal barriers surrounding liability, uncertainties to the Intellectual Property Rights, digital information exchange and ownership of the program, which could all be resolved in time.

These issues might appear to be barriers to implementing BIM but many researchers concluded that these issues could be controlled with the support of the government.

EMERGING PROBLEMS DURING THE IMPLEMENTATION OF BIM

Most of the above mentioned issues would only arise while using BIM level 3. Implementing BIM level 2 should not create significant additional risks; nevertheless some amendments might be required to smooth the implementation of BIM.

BIM level 1 only contains the use of design software feature within the design stage; this level is currently used and widespread within the UK without any major implementation issues. BIM level 2 is an increased method in using software technologies within separate disciplines. Few matters need to be amended and improved before the implementation of BIM Level 2 could take place within projects:

- The great need of intense awareness campaigns and training courses throughout the industry to clear the doubts and debates surrounding BIM and fully training all the professionals towards their responsibilities and roles throughout the use of BIM.
- Level 2 Implementation will require the removal/major amendments to the intellectual property legislation.
- Contractual amendments and software measures to be arranged to protect from Data corruption and software tool failures especially when different stakeholders use particular tools.
- Organisations operating on level 2 BIM might become limited during tenders when level 3 BIM is fully implemented by others.
- BIM protocol is recommended to be set up during the procurement stage to address risk sharing, detailed responsibilities of all users, technology level of each model, level of definition and an exclusion of liability. All to be clearly outlined within the agreements between the Employer and those responsible for the BIM model (Beale and Company Solicitors LLP, 2013).

Level 3 BIM implementation is not just a step up from level 2 in terms of using software tools; it is also an elevation to a new way of working. BIM level 3 will require using 3D, 4D, 5D and 6D tools within one collaborated platform, this will require many amendments and considerations in order to make the industry ready for this evolution. As detailed below:

1. Barriers to implementing BIM on existing buildings

There have been attempts to use BIM for older/ pre-existing facilities. This can only be done if the existing facility was built through BIM or been converted into the form of BIM. However, converting an existing building into a BIM model would require numerous assumptions such as the standards and codes of the existing building design, the used construction methods and the materials used at the time of construction. (Boeykens, S. et al. 2012).

2. Barriers to implementing BIM on New buildings/ Projects:

- Cost – BIM level 3 will require significant investment from those across the industry. Taking into account the costs of BIM's software and hardware as well as other costs, such as the extensive training of the different professionals, cost of technical expertise, costs of organising protocols and organising a network server to store and access the model. These costs raise the concerns of many small/ medium enterprises within the industry. Failure of these enterprises in fulfilling the cost requirements will generate a large gap between them and other BIM using enterprises in terms of work quality, winning tenders, saving time and money etc.
- Industry mind-set - The current traditional way of working will not easily adjust to the high-tech collaborative way of working that BIM offers to the industry. BIM level 3 will completely change the way that professionals approach their day-to-day duties, from the fragmented paper method to having to work within an informational collaborated model that requires regular communication between different participants from early stages. Therefore, all project team members that have responsibilities; duties should be considered and drafted within the contractual documents to ensure services are carried out according to the collaborative nature of BIM.
- Information control - BIM level 3 considerably relies on information technology and software systems. This reliance raises many concerns as to the need of various control procedures in order to limit and control access and inputs, data protect with firewall systems, data backup features in case a corruption of data appears, provide technical support facilities and professionals etc. The BIM model is the core data platform of the project; one error within the model can be very costly and time wasting.
- Ownership - so many debates currently surround this topic; all the stakeholders within the industry are concerned with who should obtain the final version on the model and surrounding data. These debates are mostly due to the misunderstanding of the concept of BIM; if they correctly categorise the model generated by BIM as a product then legally it should only be retained by the buyer i.e. client. However, the data contained within the BIM model is a separate issue. This data is generated from contributions of various team members; they should be authorized to obtain a copy of their contribution for future records. These issues should be considered and discussed by the government to outline and verify the legal regulations towards ownership of the BIM model and surrounding data during and after construction.
- Liability exposure - different professionals from various enterprises contribute toward the BIM model throughout different stages of the product's life cycle

through a collaborative software system, this new way of working may create irregular liability issues. BIM's software system is protected by "blanket limitation of liability" clauses that generate the question of who is liable for any software errors caused by the software. Another concern is who is reliable if works were carried out incorrectly due to inaccurate information given by a different professional in the early stages? This risk should be dealt within contractual protocols and carried out accordingly to distribute risk and liability evenly.

- Insurance - few insurance companies currently offer to insure BIM. But due to the limited use of BIM and doubtful impressions surrounding BIM's benefits and risks, it seems to be incredibly expensive to insure but it is expected to reduce once BIM is successfully implemented within projects. For the time being, it is important for parties to consider taking out the appropriate insurance to cover their engagement in the BIM process to obtain their usual coverage and protect themselves against liabilities and risks.
- BIM within contractual documents – BIM level 3 offers new roles and responsibilities for existing and new professions such as BIM managers and Architects and Draftsman etc. Therefore, all projects should include a detailed brief of these roles and outline the duties of each profession role to suit the use of BIM within projects. Making sure the same set of BIM privileges and requirements are flowing through the different contracts to avoid clashes between the clauses of the principal contract and the legal terms of the BIM protocol.

CONCLUSIONS

It is arguable that the future of the construction industry can benefit from the integration of BIM in order to improve the current fragmented way of working, overtake the overpowering issues and possibly provide potential solutions and advantages to the industry. As of the undertaken literature review and case studies, BIM implementation can possibly provide enhanced products throughout the industry by:

- Reducing errors and omissions, this will make works smoother, reduce RFIs, reduce professional liabilities and insurance costs.
- Provide opportunities to discover errors in early stages, earlier error discovery reduces repair costs in comparison to discovering them once project design progresses.
- Reduce time. Where involved managers, designers and drafters can spend less time developing designs and more time providing creative solutions for clients.

- Have a positive impact on firm's reputations with an increased number, scale and variety of opportunities
- Enhance the reputation of the industry towards sustainability and efficiency
- Increased client satisfaction through visual verification of design intent
- Enhanced way of working with knowledge sharing and virtual Design before construction.

Although these benefits might appear astonishing, they are currently only presented on paper because in reality BIM could just be another idea that could not proceed due to the lack of valuation and misunderstanding. Therefore, detailed implementation plans and arrangements are required to assist with the government's strategy of working with BIM by 2016, which is currently realistically impossible due to the many unclear points surrounding BIM and the obstructions of BIM Implementations. The query of a well-built implementation plan was raised from the research due to finding the necessity of outlining and applying the required procedures throughout all participants within the industry, such as:

- Communicate and enhance the understanding of BIM, this could be done by providing a wide range of seminars, conferences, workshops and training courses to existing professionals in all sectors. As well as promoting the publication of articles and carrying researches on BIM.
- Organise and provide many educational and training sessions to allow the new professionals to have the correct knowledge and skills to blend with BIM applications to ensure the new and old professionals within the industry are ready for the 2016 digital BIM switchover.
- Set up clear definitions of roles and responsibilities of each different participant within the new way of working.
- Locate who is responsible for setting up the level of BIM and model standards applied within a project, and when.
- Outline the required outcomes from the use of BIM within projects.
- Examine the contractual and legal issues to find solutions to ownership, sharing, copyright, IP allocation and Insurance and issue a framework to outline the legal process and procedures of BIM.
- Establish BIM guidelines for the UK that can also be integrated with international BIM guidelines.

These brief bullet points needs to be broken down and investigated to outline a proposal plan to make the implementation process of BIM clearer and closer to reality in the eyes of all involved parties within the industry.

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