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Barry McAuley

Technological University Dublin, barry.mcauley@tudublin.ie

Alan V. Hore

Technological University of Dublin, alan.hore@tudublin.ie

John Deeney

Technological University of Dublin, johnp1979@hotmail.com

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Public / Private BIM: An Irish Perspective

¹John Deeney, ²Dr Alan Hore, ³Barry McAuley

^{1,2 & 3}*School of Real Estate and Economics, Dublin Institute of Technology, Bolton Street, Dublin 1, Ireland.*

E-mail: johnp1979@hotmail.com

alan.hore@dit.ie

barrymcauley@gmail.com

Abstract: *The current economic difficulties have affected most practitioners within the industry and, as a result, many firms and contractors are bidding for fewer projects, resulting in below-cost tenders. It is clear that, many firms and contractors are now operating on thin margins; which makes it increasingly difficult for them to commit to the introduction of new software applications and system upgrades. The transition to Building Information Modelling (BIM) from traditional 2D CAD by Irish firms and contractors has been a relatively slow process compared with our international colleagues. There are many reasons for this, including lack of resources, lack of awareness, ignorance, misunderstanding and adversity. The lack of BIM promotion and BIM training opportunities within the industry has meant that very few people possess the basic requirement to successfully embrace BIM at a level which would be considered efficient. BIM is the new way of operating and it is gaining momentum; the industry simply cannot turn a blind eye to the technology or it will be left behind. The industry must therefore adapt and change current working practices in order to compete with other established and recognized BIM nations. This paper will evaluate BIM in the international context and, investigate if these methodologies can be transferred to the Irish construction industry. This paper will also aim to identify obstacles and drivers for Irish firms, contractors and Government Departments with regard to BIM adoption, as well as the behavioral and cultural elements which are preventing BIM adoption in Ireland. It is hoped that the research findings will demonstrate a business case for the implementation of BIM, for both public and private sector organizations.*

Keywords: Building Information Modelling, BIM Adoption, Private Sector, Public Works, Social and Cultural Change, Education.

I: INTRODUCTION

The Irish Construction Industry is currently at a crossroads, faced with reduced fees, increased responsibilities and higher client expectations. All professionals working in this fragmented and broken industry will need to adapt working procedures in order for the industry to return to prosperity. There is a need to assert new relevancy in today's rapidly changing industry by embracing new technology. This action can replace traditional cumbersome working practices with a virtual model that performs more efficiently, delivers more valuable information and, most importantly, achieves greater cost certainty.

This overall aim of this paper is to suggest a more robust methodology which can be used within the Irish public and private sector to help produce a more intelligent and efficient estate. This involves the implementation of Building Information Modelling (BIM) technology and its associated

tools, to help stimulate the Irish construction industry. The Authors primary data collation methodology will involve the use of a survey, of both the Irish public and private sector. Collected data will be further complimented with a number of semi-structured and structured interviews with leading professionals from both sectors. The Authors also conducted a literature review of journal papers, professional publications and research articles with regard to the application of BIM as a tool for managing public and private sector estates. The literature review focused on four main topic areas, in order to establish the proposed methodology. These are set-out below:

1. BIM in the Global Arena;
2. Can BIM assist the Irish Construction Industry;
3. A BIM Mandate for Publicly-Funded Projects, and
4. BIM: A Driver for Cultural Change.

II: BIM IN THE GLOBAL ARENA

In order to understand if BIM can help the Irish construction industry, it is imperative that an investigation should take place into the performance of BIM in other international countries. If the Irish construction industry were to adapt and embrace BIM, we must examine the transition to BIM undertaken by these countries, in order to determine if we can also adopt their approach and migrate to BIM with minimal disruption.

Research indicates that the US is the main driving force behind BIM in the world and they are actively urging domestic firms and contractors to engage with BIM on all projects. BIM, as an innovative approach to design and construction for pioneering early adopters is now taking its place firmly in the north American construction industry and, will do so in the next twenty-year period, making BIM as important to the industry as Excel is for any office in the US. The McGraw-Hill Construction Report found that the adoption of BIM has expanded from 17% in 2007 to 71% in 2012 [1]. It may appear counterintuitive to increase spending during a recession, though research indicates, that the American construction industry is continuing to invest in a more efficient and productive future by embracing technologies and processes such as BIM [2]. The same report concluded with:

- Adoption has grown from 17% in 2007, to 49% in 2009 and 71% in 2012;
- More contractors (74%) are using BIM than architects (70%);
- Almost 40% of BIM users are using the technology on a daily basis. [1]

China's rapid construction growth and industry modernization presents great challenges and exciting opportunities. By embracing BIM, China's construction industry can catapult beyond the technology adoption and legacy issues that plague many western firms, taking immediate advantage of productivity benefits that surround a digital building methodology, thereby giving BIM users a competitive edge in the midst of the largest construction boom in history.

China is well-positioned to adopt BIM quickly - a fast moving construction industry and significant investment in infrastructure, coupled with strong Government support and a trust-based and pragmatic culture are good foundations for rapid BIM implementation and growth in the region. [3]

In the most recent studies conducted, BIM usage in the Middle East is on the rise and stands at 25%, which means that the region is still significantly behind the US and Europe. [4] A survey on BIM adoption conducted by buildingSMART ME in 2011 characterises this figure as moderate, as the region is in the '*early adoption*' phase when compared with a 36% usage figure for Europe and the near majority 49% in the US. The fear of change is a common motivation for resistance to BIM systems in the ME and, it has a rational basis. In 2008, an Autodesk web survey reported that 83% of respondents reported that BIM had altered their work process. Another survey conducted by buildingSMART ME suggested that:

- Governments in the region need to encourage the AEC industry to adopt BIM;
- The AEC industry in the Middle East must seek to raise BIM capabilities;
- Educational institutions in the region should be encouraged, to be at the forefront of BIM training and support; and
- BIM adoption in the Middle East will need to be swift, as future architectural and engineering feats will be reshaping Dubai and Abu Dhabi into a model for visionary urban development in the 21st century. [4]

The Australian Government is now strongly encouraging architects, engineers, designers and contractors to take up BIM technology. The Australian Government has recognised, that using BIM to provide a 3D model can transform the design process, has begun to change the way buildings are designed, constructed and managed. The push to encourage BIM adoption will see buildings which will be better designed, cheaper to build and safer for future occupants. A study commissioned by the Australian Government's Built Environment Industry Innovation Council has found that BIM improves the productivity of the construction industry significantly. [5]. It was found that, if BIM were widely adopted, it would make a significant difference to the national economic performance. The pace of BIM adoption is gaining momentum and it is important that Australia synchronizes with international influences. It is essential that Australia becomes more pro-active in contributing to this work and thus, derives a truly national economic benefit from the use of BIM in the years to come. The Australian Government's promotion of BIM will ensure fast and widespread adoption. [5]

Scandinavian countries are paving the way for the rest of Europe with regard to BIM adoption. Locum AB represents one of Sweden's largest

property management companies, with a property portfolio of about 2.1 million m² in the Stockholm region alone. Locum AB will develop BIM for most of the Stockholm County Council's property portfolio and the goal is to do it within two years. Locum AB is investing heavily in BIM technology to decrease project times and reduce errors in production, which ultimately results in overall cost-savings. The head of the company believes that their *'clients will truly benefit from this investment, as BIM technology, can create easy-to-understand visualizations of proposed new construction and renovation projects. BIM offers clients greater transparency, greater understanding and the ability to influence the construction process, which are often complex in nature.'* [6]

In a survey conducted in 2007, BIM usage and IFC compliant BIM applications in Finland were estimated to be 33%. In the same survey it was observed that in Finland, 93% of architect firms were using BIM for some parts of their projects whereas engineers' usage was nearly 60%. [7]. Senate Properties which is publically-owned, are running pilot projects using BIM and IFC. Since October 2007, Senate Properties decided to require models meeting the IFC standard for all their projects. They have also drawn detailed modelling guidelines conveying data content requirements for models to participants in the project at each stage of the design. [8] In Finland's private sector, several companies are performing R&D in the area of BIM e.g. Skanska Oy is investigating the integration of project-specific BIM into industrialised building processes and adopting 3D modeling in practice [9]. Finland is a technologically-advanced nation with a small, agile construction industry and a long history of trust and open standards - the perfect environment in which BIM can thrive and flourish.

The civil state client in Norway, 'Statsbygg', has promoted the use of BIM in the last number of years. The Norwegian Homebuilders Association (NHA) has encouraged the industry to adopt BIM and IFC. A number of Norwegian contractors have spent vast amounts of money implementing BIM systems and ICT integration support for their production of a number of mixed-use residential units. [10] In the private sector Selvaag-Bluethink is developing BIM and ICT solutions based on the BIM platform. SINTEF in Norway is the leading organisation conducting research within the field of BIM. It is part of Erabuild which is, a network of national R&D programmes, focusing on sustainable tools to improve construction and the operations of buildings. [11] Norway is among the first few countries to develop IFD (International

Framework for Dictionaries) standard in the building construction regime which is an initiative for global application. At present, 22% of AEC / FM entities throughout Norway have used or have fully implemented BIM or IFC-enabled BIM software. [12]

The overall usage of BIM in Denmark is promising. According to a survey which was carried out in 2006, the most commonly used BIM application among architects was Architectural Desktop, with approximately 35% of the firms using it. It was followed by ArchiCAD, Revit and Bentley Architecture. The survey also showed that about 50% of architects, 29% of QSs and 40% of engineers in Denmark were using BIM for some parts of their projects since 2007. [12] Denmark has a slight edge on other Scandinavian countries in prescribing, for their construction works, specific modelling standards and guidelines. In Denmark, there are at least three public owners who have initiated some work in BIM. These include the Palaces and Properties Agency, the Danish University, the Danish Property Agency and Defence Construction Service. Although Government projects do not represent a large part of the total property area, their impact on the market created by the IFC requirements is significant. Denmark has actively put forth its requirements for using BIM in Government projects. Such requirements from Government are known as 'The Digital Building'. Architects, designers and contractors are now participating in government construction projects, and had to utilize a number of new digital routines, methods and tools since January 2009. [12]

There is a 5 year place within the UK to have BIM implemented by 2016. The Government Construction Strategy published by the Cabinet Office, announced the UK Government's intention to require: collaborative 3D BIM (with all project and asset information, documentation and data being electronic) on its projects by 2016. [13] Essentially the UK Government has embarked, with industry, on a four-year programme for sector modernization with the key objective of reducing capital cost and the carbon burden from the construction and operation of the built environment by 20%. [13]. Central to these ambitions is the adoption of information-rich BIM technology, processes and collaborative behaviours that will unlock new more-efficient ways of working at all stages of the project life cycle. At present, BIM usage in the UK lags behind the US as BIM leaders. According to the McGraw Hill 2010 BIM SmartMARKET report for Europe, only 35% of respondents to their survey were active users of BIM compared to 48% in the US in 2009.

[14] These results could change quite rapidly as the UK Government Construction Strategy is aiming to reduce construction costs by 20% during the current term of parliament. One of the aims of the road map to 2016 is to '*replace adversarial cultures with collaborative ones*', which could have positive implications for the future of all UK construction projects. [13]

In July 2012, the Cabinet Office released the '*One Year-on Report and Action Plan Update*', in which it acknowledges that the strategy was always known to be ambitious and, some elements of the original plan have shifted in the proposed timetable or, are now being dealt with in a different way [15]. With regards to the Government's commitment that it would require fully collaborative 3D BIM on all centrally-procured construction contracts by 2016, a number of strides have already been undertaken and are now in place. Additional Government trial projects have been highlighted. The Ministry of Justice currently has five trials underway and has set itself a target for '*all suitable projects*' to be delivered using BIM by the end of 2013. The Department of Health has identified four suitable projects and the Education Funding Agency has identified one project. The report highlights a number of key milestones so far including:

- The legal, commercial and insurance protocols for BIM are nearing completion;
- The establishment of the Construction Operations Building information exchange (COBie);
- BIM-enabled plans of work;
- Links are being forged for Public / Private sector collaborations;
- The introduction of a national BIM standard, and
- The introduction of regional BIM hubs. [15]

While BIM in the US is mature, the UK is at the start of its BIM journey. The UK may perhaps see the greatest potential gains of BIM at post-occupancy stage. These benefits post-construction are yet to be measured and over the coming years, tangible data can be retrieved, analysed and reviewed.

III: BIM WITHIN THE IRISH CONSTRUCTION INDUSTRY

The Irish construction industry as indicated by Keane faces its seventh year of decline due to a lack of demand and, remains very much in contraction [16]. Public expenditure will also continue to be restrained and, is likely to remain

subdued for some time as the Government strives to reduce the general Government deficit to less than 3% of GDP by 2015 [17]. This has resulted in a new approach been advocated by Forfás, who are Ireland's policy advisory board for enterprise, trade, science, technology and innovation. An action proposed by Forfás is to work with industry organisations to promote the use of ICT such as BIM and develop the appropriate technical skills amongst Irish construction firms so that they can successfully compete in foreign markets. [18] There are organizations within Ireland, as indicated by the Forfás Report, such as the Construction IT Alliance (CITA) who has been responsible for the championing of ICT and BIM in recent years. This has seen a number of workshops organised by CITA and sponsored by professional institutions with the overarching aim of promoting BIM within the Irish AEC/FM industry [19]. However at present, there appears to be a consistency of mixed opinions within the AEC sector, in that BIM holds the potential of better pre-construction co-ordination, reduced conflicts during construction, improves visualization and increases co-ordination of construction documentation. [20]

In order for BIM to become a reality, McAuley et al warn that, the Irish Government must become the main driver in this process and, review current BIM initiatives and barriers in public sector procurement bodies in other international countries. The Authors further detail that, Ireland is still a long way from embracing BIM on public works projects, as a number of departments are requiring "*an act of faith*" for the Irish Government to fully embrace it. The Implementation of BIM will require both vision and determination and, it must come in the form of a top-down strategy from Irish Government in order to ensure its success. [21] However, the reality is that this is highly unlikely, as current construction contracts would have to provide BIM procedures or an execution plan template, as part of their guidelines, which at present seems unlikely due to low tender prices been already achieved. [22]

The very nature of the Irish Construction Industry is one of adversity among its working members, where information is closely guarded and knowledge is seen as power. This confrontational behavior must come to an end if the potential of BIM is to be realized, as open collaboration among design teams is fundamental to the core understanding of the overall BIM solution for the industry.

a) Obstacles in BIM Adoption

Irish construction is based on the premise of adversity, where knowledge in a specific area is generally met with resistance. Knowledge is essential to success and without it; neither the professional nor the industry will achieve excellence. Knowledge is also power and, can be used in many different ways in an organization. It can be used to intimidate and cause fear among individuals at every level. It is the Authors opinion that, many in senior positions may be adverse to change as it may be perceived as a threat to their job security. This resistance is related to the workplace environment and it must be noted that not all working environments in the Irish construction industry are the same. A code of conduct exists for many members of the industry and company policy aims to manage and deal with this kind of adversity at an internal level. It is the resistance to change and the reluctance to move away from redundant methods of working that allows for costly overruns and delays on a project and, it is that behaviour that has become second nature to many in construction firms today.

The Authors have detailed below a number of issues which arose from interviews, with individuals in firms in Dublin, who both agree with and oppose the transition to BIM. The main findings from the interviews are set-out below:

1. With the UK fast-tracking BIM by 2016 on all publicly-funded projects there has never been a better time for Irish firms and contractors to engage with BIM. When the Authors posed this question to a professional in a large quantity surveying firm in Dublin about the possibility of BIM roll-out for his firm, he replied with, *'If our competitor is not getting involved with BIM yet, why should we.'* This view was expressed in a semi-structured interview, by an Associate of the firm, whose work brief contains BIM and IT and represents the views of his colleagues within the firm.
2. Return on Investment (ROI) is a concern for many firms within the industry as technology costs are considerable. A semi-structured interview with an individual from a multi-national organization provided a unique answer to the question of a potential likelihood of a BIM investment for his organization, the reply was, *'An investment for the entire Irish firm could run into tens of thousands if BIM were to be rolled out across our Irish offices, not to mention the cost of licenses and maintenance fees as well as*

equipment upgrades required to run the new software'. The Interviewee went on to suggest that, *'The ROI would be quite low as not many of their current projects would justify the use of BIM software and, therefore, it would not make sense, nor would it be viable for us to invest in BIM in the current economic climate.'* A recent conversation held with a part-director of a leading architectural firm in Dublin revealed this answer to the question posed, as to why there is not much demand for BIM in Ireland yet. The interviewee suggested that *'Not many of his clients fully understand BIM, never mind ask for its inclusion at design phase. We would not have an issue with the implementation of BIM in theory, however, if our clients are not requesting BIM on their projects, we are not inclined to pursue it or indeed recommend it.'*

3. The UK Government decision to mandate BIM on all its publicly-funded projects will soon be a reality. Should Ireland follow suite with the UK and mandate BIM for all future publicly-funded projects. This question was posed to a managing director of a civil engineering firm in Dublin who proceeded to suggest that, *'Of course we should adopt BIM just like the UK – it would be a natural progression for us to do that.'* She also suggested that, *'The rate of change in implementing BIM here in Ireland may take a significant period of time to make the transition a success, as many firms and contractors are completely focused on the traditional method of procurement and construction - there needs to be a cultural shift.'* She also suggested that, *'There should be a widespread publicity campaign outlining what BIM is and its benefits, as many citizens simply never heard of BIM and, by achieving public awareness, clients will start demanding BIM on their projects.'*
4. There is antidotal evidence to suggest that there are two strands of professional willing to openly communicate about BIM. The first strand has some knowledge of BIM, whereby they were interested in BIM but are unfamiliar with the fundamentals of the technology. The second strand did not feel the need to educate themselves on the development of BIM and, they felt BIM was another piece of software, just like CAD, Buildsoft or Excel. When refined, these two strands of professional were from opposite levels of the company demographic. The first strand of professional was the *'worker'* or professional who was engaging with others

on a daily basis. The second strand are professionals at the 'top', such as partners and directors who stand outside the BIM discussion and, generally feel that BIM is premature and, largely underdeveloped for Irish construction. The misunderstanding of BIM as an application and BIM as a tool for "techies" needs to be addressed from the top down as all successful business leaders will need to be fully aware of the potential of BIM sooner rather than later.

5. The aftermath of the property crash and subsequent decline in construction means that there are now more entities fighting for fewer contracts. There is evidence to suggest from structured interviews that a select number of large construction companies may be willing to engage in a project that may only cover the variable costs relating to the project, with little or no contribution towards fixed costs and profit, in order to maintain their workforce and remain in business pending an upturn in the fortunes of the industry.
6. Currently, the construction industry is crippled with the cost of increased bonds for many projects, which have simply become unattainable for many contractors in Ireland. An interview with a director of a large construction management company in Dublin led the Author to believe that, *'Ireland as a nation has gone through austerity to make good, the state's wrongdoing and the construction industry has seen a total and widespread collapse.'* He stated that he is familiar with, *'Instances where the cost of bonds has risen to 12% and 15% in some instances. Increased bond costs just force competitive contractors out of the picture when it comes to contract procurement.'*

IV: A BIM MANDATE FOR PUBLICLY FUNDED PROJECTS

There are many questions surrounding a proposed BIM mandate for publicly-funded projects in Ireland. With this type of data retrieval, there is always going to be a number of BIM champions and BIM skeptics. Below are sample questions and answers to the question of a BIM mandate for publicly-funded projects. These results were obtained from several structured interviews with key individuals in Government Departments, Semi-State Bodies and Agencies who exercised their right to remain anonymous.

1. How is BIM viewed within your department? *'BIM is the new paradigm for which, the construction industry could push forward into a new era and beyond.'*
2. In your opinion, do you think BIM could be promoted in new business start-ups? *'The current recession has had a phenomenal impact on SME start-up businesses within the industry and, that is evident across all sectors, however, we are seeing new areas for growth, and I firmly believe, BIM could play a fundamental part in new business start-ups.'*
3. In your opinion, what are the biggest obstacles facing companies, with a regard to a BIM roll-out? *'Costs are a huge concern, market dominance is another factor - will BIM become a common tool for everybody? There is a requirement to shift away from current methods of doing business which may hamper a potential investment, it may take time, but I think BIM will prove its worth in the long-run.'*
4. In your opinion, how long should it take our Government to mandate BIM on publicly funded projects? *'A BIM mandate for publicly-funded contracts should not take long at all; it just needs to be recognized and promoted by those in power.'*
5. In your opinion, will BIM become prevalent in Ireland as it has in Europe? *'IT within the Irish construction context is going to be very prevalent by 2015 and onwards. We can see that IT has taken center stage throughout Europe, and the industry has to keep up-to-date if it wants to remain current.'*
6. In your opinion, is it possible to slipstream behind the UK approach and mandate BIM on all our publicly funded projects? *'We do not need to follow anybody's footsteps, we create our own opportunities. A recommendation put forward to Government on the grounds that we should adopt a similar path as laid down by other countries will simply not happen as no two situations are the same.'*
7. Has your department formally discussed BIM, with regard to implementation? *'New technology such as BIM has yet to be approved by our department and, as of now, it has not been seen working on any live'*

projects in Ireland. Nobody has witnessed first-hand the benefits of it, nor, has anybody been able to prove its effectiveness. Our department recognizes that BIM is the “buzzword”, but it will be a long time before we see the full adoption of it.'

8. In your opinion, would it be wise for Government to mandate BIM in the current economic climate? *'BIM is a long way off. Right now, it is still viewed as just another piece of technology, which has to be fully “ironed out”. It may be introduced to the industry, but only on a phased basis as it becomes more developed. I do not believe Government will make hasty decisions regarding its roll-out, as decisions like that, take a very long time to get pushed through.'*
9. If BIM were to be mandated, would it be viewed in a positive light by your department? *'Definitely, BIM could offer us a more transparent way of doing business. It would unite our avenues of procurement and it would allow for integration of other third-party services which we also use. We could take full advantage of BIM and its services, if and when it becomes operational.'*
10. If BIM were to be mandated by your department, would there be a need to up-skill in order to become BIM efficient? *'BIM adoption within our department would require full backing from the top down for it to be successful. Currently, there is a need for re-training and a possible organizational re-structure, with that being said, there should not be a problem with its implementation - if it were to happen.'*
11. If an executive order came from Government mandating BIM, would it change the industry? *'A BIM mandate could happen, it would benefit all parties, but it could take a considerable period of time before Government makes that decision, as the industry is fighting its own war.'*
12. If BIM were to be introduced by your department, where would you see its greatest advantage? *'In many cases where planning refusal has occurred, it is often as a direct result of lacking information, obscured information, conflicting information and transparency issues. BIM has the ability for transparency to co-exist with the highest level of information,*

located in one place, on any particular project. It will revolutionize the entire planning and construction process. The construction industry needs BIM in order to shift away from redundant work practices. Colleagues in my department are encouraged by the UK Government's determination to implement BIM and, many believe that BIM should be pursued more aggressively in this country.'

13. In your opinion, how should we leverage BIM in Government, with a view to its mandate? *'A BIM mandate would unify the government's policy to reduce costs and achieve better value. A decision on mandating BIM could be realized if government has the opportunity to see its true potential. An analysis of the UK approach could provide the incentive needed for Government to mandate BIM in the future.'*
14. In your opinion, what are the repercussions facing Government if they do not embrace BIM? *'Within the next 10 years, we shall see a huge uptake of BIM within our domestic market. If the government has not accepted BIM by then, they will be pressured to implement it by external groups. Government would not gain any votes by sitting on the fence when it comes to BIM.'*
15. In your opinion, do you think BIM will revolutionise the Irish construction industry, if Government decided to mandate it? *'BIM will be a natural progression for everybody involved with Irish construction. Sooner or later, everybody involved with the construction process will have to adopt it. It is up to government to take the first initial steps toward BIM, as this will encourage the private sector to follow suit and accelerate the take-up of the technology.'*

V: BIM - A DRIVER FOR CULTURAL CHANGE

BIM, viewed through technological eyes, may appear to have had a limited effect on the cultural change in architecture and construction as a whole. BIM, in general, has enabled quicker communications and design team interactions; however, the adversarial nature of those interactions has not changed at all [23]. It would appear, from discussions, that individuals from the private sector believe that *'BIM may simply serve to speed up the process of reaching*

the point at which the risk of claims and litigation become more prevalent.' Currently, the collection of software platforms commonly used for BIM seems to encourage compartmentalization of design activity and information storage due to commercial drivers. Providing seamless information management outside the domain of an individual software vendor is not a sales-attractive proposition either from vendor or purchaser at the moment and, as a consequence, it tends to reinforce legal separatism and, therefore, hinders rather than supports design and construction interaction [23]. Once this situation is addressed and the importance of the '*BIM manager*' becomes a high priority, then the real benefits of BIM can be fully appreciated. It would appear however; that this is unlikely to change in any significant way until the adversarial nature of the architectural -v- construction interaction changes and, the role of information within that domain is seen as an agent for collaboration rather than an agent for dispute and control.

a) BIM in the Political Landscape

Many Government Departments, Semi-State Bodies and Agencies see the need for BIM in Ireland, they acknowledge its merits and advantages and, yet, they appear skeptical of its inclusion on future publicly-funded projects. Many believe that BIM will not be mandated in this country for many years, at least, until we recover from the current recession, as results for the interview process indicate. Some interviewees indicated that Government would need to see, firsthand, the true benefits of BIM before supporting any proposal from BIM lobbyists. This could be provided in the form of a pilot project, co-undertaken with industry experts, vendors, providers and education officials on a new-build public school or something similar in nature, so that the true benefits of BIM become well established and recognized throughout all Government Departments. The conventional and historic rhetoric from those in Government circles should be superseded by a decisive, simple and well-thought-out strategy for change in the way information is managed in construction. Fragmented structures, statistics, supply chain issues, the adverse nature of the AEC industry, barriers and drivers are well documented, however, now is the time to actually achieve something positive within the Irish construction industry.

b) BIM in Education and Training

Research conducted suggests that the provision of education is an extremely important issue and, it is one of the most important areas of concern highlighted by individuals in both the public and private sector. It is noted that:

- Public and private organizations need to be formally educated on how to obtain proper BIM efficiency and deployment;
- Higher education providers can play their part by integrating BIM principles into the curriculum for professional education and training; and
- Educational bodies such as CITA, Dublin Institute of Technology (DIT), Waterford Institute of Technology (WIT) etc, could provide all professionals, with a full suite of BIM modules designed to further enhance the core knowledge already obtained.

Perhaps the most important groups of people to educate in the future, as a matter of priority, are Government representatives, their associated procurement bodies and Agencies. Historically, CAD was '*left to its own devices*' to find a level of understanding and application and, to a certain extent, with confused and underused effect [24]. If BIM were to be mandated through a Government procurement strategy, then the procurers must have the very best understanding on the range of ingredients that BIM comprises and, how they could be applied within the functional sectors in the public interest, in a variety of ways. Existing mid-career and senior staff in the private sector also require '*crash courses*' in collaborative working and information management if any immediate change is to be achieved. BIM should be an integral part of the higher and further education curriculum for all professionals and trade groups. Universities and Institutes of Technology currently train and educate within the boundaries of their own courses. BIM and co-operative working requires new skill sets, which can only be achieved if there is cross-institutional co-operation on formulating curricula that would transcend these boundaries. Continuing Professional Development (CPD) is another key component in providing existing practitioners, especially at mid-level, with full insights into BIM, if they are to absorb these techniques into their day-to-day business activities and project strategies, then, they will need substantial educational support as soon as possible.

c) Future Proofing BIM for Business

If there were to be a comparison made with a commercial strategy, then any business planning a

major investment would think roughly in terms of making a loss in the first year, breaking even in the second year and making a profit in the third year. This analogy could translate into the Governments thinking on future BIM initiatives. [24]. The Government could provide financial incentives, freedom from litigation, enhanced project insurance or accreditations to companies willing to expend valuable resources in the cause of better professionalism and industry. Firms could be assisted in exploring business-change in terms of different fee profiles across work stages, the establishment of new value-added services and the re-distribution of resources, which a BIM environment would require. The Irish Government would break-even when a critical mass of effort has shown a degree of success in terms of producing benefit from the use of BIM methodologies.

d) BIM: Changing Attitudes

Behavioural change in the Irish construction industry is as important as political or technological change, perhaps even more so, as this paper has identified. Architects, QSs, engineers, contractors, suppliers and other professions have deeply embedded working practices and long-standing delineations of professional responsibility and liability. Currently in Ireland, each industry participant believes that they have optimised their work practices in the way they assemble information within their domain, and the use of their existing technology - be it good or bad [25]. Countless project delivery methods and contractual relationships have created an atmosphere in which it is difficult for the seeds of BIM to be sown and flourish. Demanding project timetables, changing client budgets and changing designs work against typical BIM work methods as a whole. This way of working on projects, both public and private, must come to an end. Information management across the entire project life cycle requires a new skill set and new working attitudes. If BIM were to be successful in future Government aspirations, then future project teams will need people who can display a willingness to adapt and acquire new skill sets, possibly several times within their varied careers. Project team strategists, designers, constructors, operators and users must interchange understanding of their respective work processes, skill sets and knowledge bases if information they produce is to be properly quality-controlled, integrated and trusted as a long-term asset. The future of BIM in Ireland must be built upon the creation of a unified team approach, support for new ideas, a no-blame atmosphere, distributed decision-making, changing leadership focus over time and, amended forms of contract and insurances.

VI: CONCLUSION

This paper was sculpted around the adoption of BIM in Irish firms and where it sits in Government Departments, in terms of an executive order, mandating the use of BIM technology on future publicly-funded projects. Research conducted outlines how far the BIM application has come in terms of its capabilities, benefits and associated work packages, which enable multi-dispersary tasks to be carried out simultaneously. Throughout the interview process, it can be seen, that the issue of BIM for Irish firms is a fragmented area, as many company figureheads feel BIM is just another piece of technology, not worth the investment, while other professionals lower down the ladder feel BIM is the new way of working in the industry and are determined to learn more.

The split in the company demographic needs to merge together, in order for BIM to be fully accepted by company professionals at all levels. It is the Authors opinion that an open, honest forum will help in this regard, as concerns and issues can be voiced and heard from all respective parties. This will encourage unity among staff and provide a certain degree of transparency between management and employee. Further research conducted allowed the Authors to determine the level of BIM awareness among government representatives during the interview stage, and it is the Authors belief that BIM is widely regarded as a '*necessary application*' to provide effective cost-savings on publicly-funded projects, however, most government representatives feel that a BIM mandate for future publicly-funded projects is a considerable distance away. At present, Government will not agree to a BIM mandate while the country is being funded by Europe. The current economic difficulties combined with a fragmented market, lack of projects and shortcomings in the exchequer, has led to a decisive conclusion, in that BIM is indeed, the catalyst for Irish construction, however, there is very little evidence suggesting Government will mandate BIM on any future publicly-funded project in the short-term

VII: RECOMMENDATIONS

There is a requirement for a change in policies, views, opinions and one-dimensional beliefs for the common good of the industry and all its associated professions. There is a need for BIM recognition and familiarity of brand at a regional capacity, as this could spark a faster uptake of the technology in many firms and organisations throughout Ireland. Another recommendation must be in the form of BIM education and training. A self-thought knowledge of BIM is simply not sufficient

to gain a certain level of BIM efficiency. Organisations and Institutes such as CITA, DIT and WIT are ideally placed to offer a comprehensive suite of modules for all levels of BIM user, from BIM basics to advanced BIM, with the additional provision of on-site support, when and where needed, and again, regional familiarity of brand is essential to this success. Government will need constant reporting and consultation in the area of BIM if a future BIM mandate were to happen on all publicly-funded projects. Government representatives will also need BIM training and support in order to achieve maximum BIM efficiency, and again, CITA and a select number of 3rd Level Institutes are ideally positioned to provide both consultation and training to Government once BIM becomes a priority.

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