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Creating Interactive Facilities Management Capabilities through Building Information Modelling as a tool for Managing the Irish Public Sector Estates

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Abstract – The Irish Government manages estates that are faced with increased pressure on their greenhouse gas emissions, as well as, poorly managed assets that leave it increasingly difficult for an effective Facilities Management (FM) process to be operated. The FM processes represents the most costly stage in the life-cycle of a building and must now take priority in the design process, as the operating and maintenance costs can be up to five times the capital costs, with the business operating costs reaching up to two hundred times the capital costs over the life of the building. In order for Ireland to realise a smarter and better equipped public estate that can respond to increased staffing demands, it is critical that a new dimension of FM be explored through Building Information Modelling (BIM). BIM could benefit decision-making in FM task by task and can be used as an FM tool specifically in relation to public estates to integrate “digital descriptions” of a built asset. BIM can increase performance, utilisation and financial information in the maintenance phase, as all the design and built asset information is still present in a single BIM model. The data collation methodology adopted by the authors in this paper included the use of a questionnaire survey that was designed and distributed in collaboration with the Irish Facilities Property Management sector. In addition the UK Government’s BIM and Soft Landings Policy will be investigated together with its applicability in the Irish AEC / FM sector. The research findings will strongly advocate that BIM can ensure a unique FM approach which can reduce life cycle costs and provide the Irish Government with a more enhanced estate.

Keywords – Building Information Modelling, Facilities Management, Public Works, Government Soft Landings Policy, UK BIM Strategy

I INTRODUCTION

The Irish Construction sector as indicated by Keane faces its seventh year of decline due to a lack of demand and remains very much in contraction [1]. 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 [2]. Despite these threatening times there has been

hope provided through the Government’s plans for an additional €2.25 billion investment in job-rich public infrastructure projects in Ireland. The projects included in this package will be delivered through Public Private Partnerships (PPP) securing value for money for the Exchequer while delivering private sector innovation and commercial and management expertise to the benefit of the State. PPPs allow the spread of the cost of financing infrastructure over the lifetime of

the asset which means a number of projects can be developed simultaneously as the capital costs can be spread over the longer term. They also allow the allocation of risk as outlined by Howlin to the party that can manage it best and at least cost [3]. This stimulus package offers the opportunity for the Irish public sector to ensure that it builds assets that will ensure the long term productivity needs for its people long into the future. The Irish Government have implemented a number of frameworks in tandem with this stimulus package, so as to bring Ireland's public sector in line with a number of proposed reforms that include the Capital Works Management Framework (CWMF) [4] and Public Service Reform Plan (PSRP) [5]. The Irish Government's National Energy Efficiency Action Plan (NEEAP) for the period 2007 – 2020 is also designed to steer Ireland towards a new and sustainable energy future; one that helps increase security of supply, makes energy more affordable, improves national competitiveness and reduces GHG emissions [6]. Though it is acknowledged by West et al. that these frameworks and reforms are a step in the right direction there are no key criteria detailed, in either plan, in regards to future and current Facilities Management (FM) regulation and procedures, so as to ensure that public sector estates are being maximised to their potential [7].

This purpose of this paper is to suggest a more robust methodology that can be used within the Irish public sector in conjunction with the recently announced stimulus package and outlined frameworks. This involves the use of Building Information Modelling (BIM) technologies to support the FM process, to ensure a more enhanced and intelligent Irish public estate.

II Literature Review

The authors conducted a literature review of journal papers, professional publications and research articles in regards to the application of BIM as a tool for managing public sector estates. The literature review focused on the three main areas detailed below in order to establish the benefits of using BIM on public sector estates in Ireland:

- The need for change to ensure a more efficient Irish Public Sector Estate
- A move towards a more efficient and intelligent Public Sector Estate.
- Learning from the UK BIM Policy and GSL Policies

a) The Need for Change to Ensure a More Efficient Irish Public Sector Estate

The NEEAP outlines how the Government has committed to achieving by 2020 a 20% reduction in energy demand across the whole of the economy through energy efficiency measures. Recognising that Government must lead by example, the public sector has been challenged to achieve a 33% reduction in public sector energy usage over the same period [6]. Nobody can escape from the challenges faced as a country to restore the public finances to a sustainable footing as explained by Wyatt. This statement is further elaborated on by the author explaining that Ireland needs a public service that can lead our economic recovery and meet the needs of people in the years ahead [8]. It is now incumbent that the Government find a means to engage the public sector in a positive manner to deliver real reform of the service. This is important to ensure the on-going quality of services but also to provide a means to positively engage with the public sector workforce and ensure they remain committed, motivated and focused on service delivery [9]. To achieve this it is imperative as stated by Teicholz that the public sector has an enhanced physical environment to operate from. The physical environment can either enhance or impede worker productivity, therefore contributing to its bottom line profits [10]. Despite the limited research available as stated by Scully et al. on the position BIM holds in the construction industry in Ireland, there appears to be a consistency of views. BIM holds the potential of:

1. Better pre-construction coordination;
2. Reduced conflicts during construction;
3. Improves visualization;
4. Increases of coordination of construction documentation. [11]

If the Irish Government is to reach the figures made in recent reports then it is imperative that it begins to explore a more advantageous process of commissioning and maintaining public assets. The authors advocate that a more dynamic approach to FM could be achieved through the utilisation of BIM technologies and a partnering soft landing approach, in which could bring about a more efficient management of building stock.

b) A move towards a more efficient and intelligent Public Sector Estate.

Tracking and managing facilities effectively are difficult owing to the various facilities as claimed by Su et al. Real time maintenance management may be necessary and helpful to control and

manage effectively the maintenance working the building facilities [12]. This has resulted in the FM process as outlined by Shen et al. having seen a rapid advancement of information and communication technologies, particularly Internet and Web-based technologies during the past 15 years. [13] The effective maintenance and management of buildings could significantly reduce the \$15.8B annual costs associated with inadequate interoperability, as reported by a NIST study [14]. Though a number of software tools exist in the Irish FM sector at present e.g. CAFM, CAD, CMMS, IWMS, etc., there is no FM software powerful enough to provide a complete FM package for the public sector [7].

This complete FM package can come through BIM and FM integration. BIM as described by Hijazi and Aziz allows for progressive collection of building data and could play a key role in streamlining the data collection process. BIM has the potential to be used as a platform to research and publish information by engaging a variety of stakeholders due to its user-friendly 3D visualisation [15]. BIM technologies as outlined by Sabol offers Facility Managers and building owners a powerful means to retrieve information from a visually accurate, virtual model of a physical facility [16]. The figure below as detailed by Teicholz shows some of the common benefits of FM and BIM integration

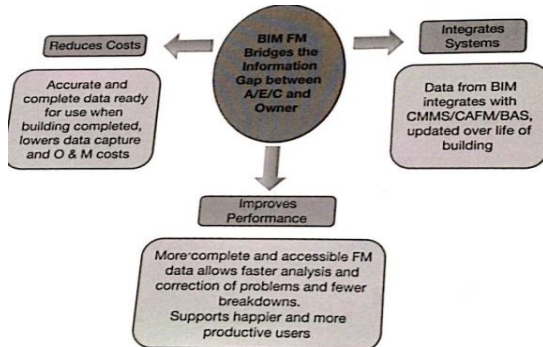


Fig 1 Summary of the main benefits that can be achieved from BIM FM integration [17].

Arayici et al. further details through referencing a number of documented case studies the perceived benefits to be realized through the use of BIM in FM:

- Ensuring that procurement decisions are made on the basis of whole-life costs, cultural fit and not solely short term financial criteria,
- Ensuring that purchasing will be coordinated between departments where possible.

The same authors warn that there is still a lack of clear evidence on whether and how BIM could benefit decision-making in FM task by task [18]. Sabol outlines further barriers that include current BIM software not being useful to a broad portion of facility workers, the BIM model being overloaded with information and maintaining the currency of BIM files over time will be an issue for consideration. Sabol further warns that the best way forward may be the use of multiple applications with specific targeted capabilities for developing and utilising BIM data. [16]. There are a number of existing schemas in circulation for extracting data from the BIM model, with the Construction-Operation Building Information Exchange (COBie) schema proving to be the most popular. COBie provides an open framework for the exchange and delivery of construction handover information. The COBie is being used by the UK as the standard method to capture and record project handover data. However, if BIM and COBie are adopted as detailed by McCormack et al., we need to not only streamline the flow of information between programmes, we need to address the interface for facility services crews, so they too can leverage these new datasets [19]. There are a number of vendors in the process of integrating COBie and CMMS systems, which is an on-going process. Other packages in which export facilities data from the model include FM: Systems, Archi FM, Bentley Facilities, Onuma System, EcoDomas and Graphic systems. These are sets of FM software packages which integrate with the model and allow advanced options in space management, strategic planning, asset management, etc.

The use of BIM for FM has seen a rise within recent pilot projects that include Sydney Opera House, Texas A&M Health Centre, University of Chicago Administration Building Renovation, Cookham Wood, etc. The tools as detailed above are radically more sophisticated than what is in place in the Irish public sector and can offer the opportunity to realise a more intelligent estate. McAuley et al. believe that in order for the Irish Government to successfully guarantee a more reliable method of cost certainty and greater value, that the Irish Government move towards the mandatory use of BIM on public works projects by following a similar methodology to that adopted in the UK [19].

- Accurate geometrical representation of the parts of the building.
- Faster and more effective information sharing.
- More predictable environmental performance and life cycle costing.
- Better production quality — documentation output is flexible and exploits automation.

C) Learning from the UK BIM Policy

There is a plan for a phased five-year development within the UK where public works projects will be required to use BIM techniques from 2016. This plan was devised around a hypothesis which defined a scenario in which the Government client would have an estate that was smarter and better equipped to face a low carbon economy, with associated reductions in delivery and carbon emissions. The UK have also redesigned their RIBA stages of work to be focused around BIM activities at each work stage, where key data drop points are identified within the overall project process. The aim is to assist design and construction teams in using BIM to provide a more efficient, intelligent and cost effective design process and to offer enhanced services to clients, particularly in relation to the whole life value of buildings [20]. It is expected as outlined by Kuma from all the information available at the moment, that it would appear that the minimum expectations for all stakeholders participating in public sector projects are:

1. COBie UK 2012 Data set;
2. Level 2 BIM Models;
3. 2D PDFs of the drawings. [21]

Figure 2 below shows the road map to be adopted by the UK in the development of level 2 BIM and the GSL policy. This road map details the maturity level expected from the initial Ministry of Justice pilot project up to 2015, where all Government Departments will be implementing 100% Level 2 BIM leading to a digital Britain in 2016. This includes over a four year period the development and piloting of subsequent COBie drops, development of Government Soft Landings (GSL) objectives, automating BIM data to FM, etc. [22].

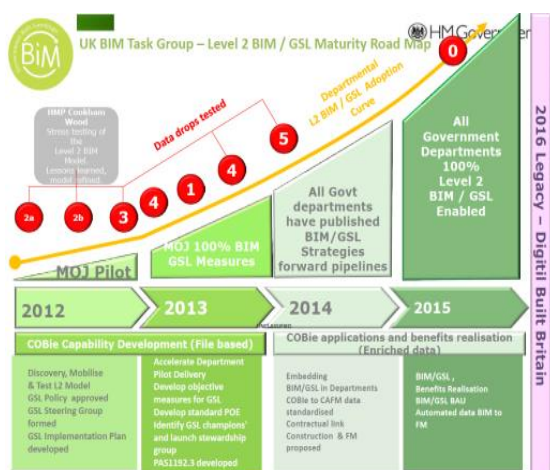


Figure 2 UK Road Map.

A large part of this road map is to enhance FM practices within the public sector. Tancred explains that BIM might have emerged from the construction of the built environment sector, but it must not be ignored by the FM industry [23]. This is further enforced by Rowlands in that there are many benefits that BIM can bring FM by aligning the construction and design to the operational use of the asset. This is a real opportunity to make a difference to the way projects are managed in working collaboratively with the construction and design industry [24]. One of the current frameworks now in place to capitalise on this opportunity, as further detailed by Rowlands is the GSL approach, which provides a process to ensure BIM is embedded and adopted into future developments in a way that supports facilities managers and will be mandated in 2016 alongside BIM level 2. The purpose is to create the following objectives:

- GSL will be a key element of the design and construction process, maintaining the 'golden thread' of the building purpose, through to delivery and operation.
- Early engagement of the end user and inclusion of a GSL champion on project teams during the design/construction process.
- Combined with BIM it will provide a fully populated asset data set to feed into CAFM systems and modelling will enable planning modifications. This data will need to be maintained throughout the building life cycle.
- Post Occupancy Evaluation will be used as a collaborative tool to measure and optimise asset performance and embed lessons learnt. [21].

In a recent workshop held by the Construction IT Alliance (CITA) titled "Integrating Construction Technologies and Process" keynote speaker Deborah Rowlands examined GSL in more detail. She explained that through wrapping GSL around BIM one ends up with a better business model with clear outcomes, engaging the client and Facilities Manager early on, to map out improved functionality of the building before construction commences. The value proposition detailed in Figure 3 represents the value that can be harnessed by truly understanding where the majority of life cycle costs come from and in making decisions early on in the design process that can help reduce these costs, therefore resulting in an enhanced business outcome[21].

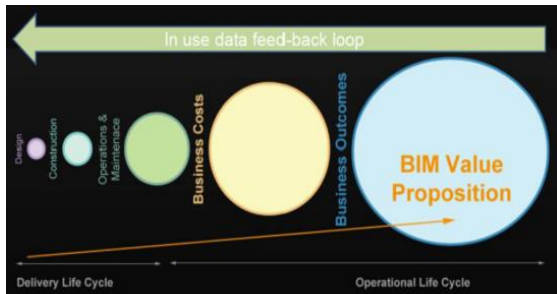


Fig 3 BIM Value Proposition.

By integrating GSL and BIM the following opportunities can be realised:

- Collaborative working through construction, design & FM throughout the project lifecycle.
- Operational input and challenge to construction and design to ensure that operational costs are maintained and impact to change assessed.
- BIM provides a fully populated asset data set into CAFM systems and therefore reduces time wasted in obtaining and populating asset information.
- 3D modelling to assist with on-going planning modifications to building use and impact on asset lifecycle. [22].

GSL will be measured through the following key areas from the early stage of design into post occupancy, as they pass through the whole BIM process. These measured outcomes as detailed in Figure 4 will be fed back, which will assist in constant review. These measures are as follows:

- Environmental: The measurement of energy usage pre and post occupancy.
- Financial Management: The Operational expenditure.
- FM and Commissioning, Training & Handover: Establishing a process and making sure the right people are brought on at the right time.
- Functionality and Effectiveness: What was achieved at the end of it the whole process and for what purpose. [21].

GSL Powered by BIM

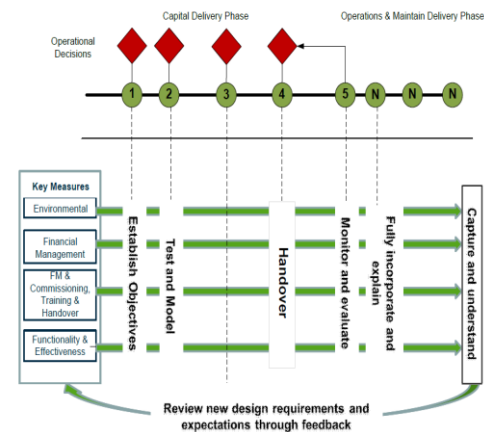


Fig 4 GSL Powered by BIM

In the same workshop there was a series of round table discussions where it was discussed where Ireland currently are in respect to BIM adoption by Government, key stakeholders, education, industry and individual professions. There was a resounding agreement that the Irish Government should follow the UK Government's decision in mandating the use of BIM on public sector projects. The legal mandating of BIM can be a driver to make the industry more technically aware and could provide the tools for Irish Construction firms to compete in International markets [22]. Despite the obvious benefits that the implementation of BIM and the GSL would bring in re-engineering the FM sector in Ireland, there is at present no current sign of the Irish Government embracing either. The reality is that this is highly unlikely, as the GCCC contracts would have to provide BIM procedures or an execution plan template, as part of the CWMF guidelines, which at present seems unlikely due to low prices been already achieved [25]. The Irish construction industry as stated by Hore et al. appears unaware or disinterested, lagging far behind in the adoption of these technologies and working procedures. This puts our industry at serious risk of becoming irrelevant in the global market, particularly at this crucial time when we need to export services and expertise [26].

III Methodology

The authors primary data collation methodology involved an extensive survey that was designed and distributed in collaboration with the Irish Property and Facility Management Association (IPFMA), in order to gauge the level of support for the introduction of BIM to assist in managing the public sector estate. An online questionnaire was created with 15 questions, which was originally piloted by its Board of Directors. The

questionnaire was broken into the following three sections

- **Early FM involvement:**The purpose of this part of the survey was to ascertain the opinion of the respondents with respect to the early involvement of the Facility Manager in the design and construction process.
- **FM and Information Communication Technology (ICT) working together:**The purpose of this section is to ascertain the current position of the respondents in regard to the importance of ICT and in particular, as a future tool to support FM services not just at the handover stage but throughout the entire project lifecycle,
- **ICT as a FM tool in managing the Government's state facilities:** The purpose of this section was to explore current views in respect to the Facilities Manager and ICT / BIM helping to better manage both newly and existing public sector facilities and structures.

After a number of changes were incorporated, it was then distributed to the IPFMA member database, as well as posting the survey link to a number of Irish FM and BIM working group webpages. This generated a total of 38 company responses from a mix of small to large enterprises. The responses to the survey will complement the papers research aim as it provides a snapshot of the current Irish FM sector and the technologies that are now commonly in place within the private and public sector. This will provide the platform for the authors' recommendation of advancing the Irish public sector estate through the implementation of BIM.

IV Irish Property and Facilities Management Association BIM Survey

The first part of the survey was to ascertain the company respondent's opinion with respect to the early involvement of the Facility Manager in the design and construction process. Only 11 % of the respondents had routinely observed early Facility Manager involvement in the design and/or construction phases of a project, with 55% claiming that there was none too little involvement of the Facilities Manager. Despite this, 61 % believed that if the Facilities Manager was involved from an early stage, that he/she could play a major role in improving sustainable construction potential, as well as providing a new cost focus for the building life cycle. There was a belief that the Facilities Manager should have an advisory role within the design and construction phases, as they can eliminate non required items and advise on the best "fit" for the

occupants, as well as enhancing accessibility from a maintenance point of view. By getting an insight from the Facilities Manager in the early construction / design stages could highlight areas that could be changed to improve the running costs of the building, making it perfect sense to utilise their expertise in the design and construction of the building. The Facilities Manager can help streamline the design briefing process through their knowledge of facility operations, such as scale and type of product, amount of people working, support facilities in the building, spatial needs, etc. There are concerns that incorporating the Facilities Manager into the design / construction stage would result in an unnecessary impact on the Architect and would provide too much interference within the Design team. There is also a concern that they may lack the technical and materials costs skills in certain aspects.

The purpose of the second part of the survey was to investigate the importance of ICT as a future tool to support FM services not just at the handover stage but throughout the entire project lifecycle. 79% of respondents still used paper based or a digital copy on a CD or DVD to provide O&M information to their company, with only 21% using WebFM or an O&M system. There were a number of companies that cited BMS and Computer Aided Facilities Management (CAFM) as the main source of transferring information, as well as spreadsheets. One company within the survey responses are using a Revit model and noted that this offered the opportunity to provide a model which is interoperable with FM tools such as Artra, if adopted by contractors during the construction stage. Another company who were also using a Revit model stated that this tends to be overly complicated to be used effectively by FM teams. 86 % of the respondents are very to somewhat aware of the current interest and debate in respect to BIM, with 23% of that number having used a BIM model for Facility Operation and Maintenance. Some of the responses include the use of BIM to model structural alterations in existing buildings to ensure that utilities can be maintained or diverted where necessary, and the use of CMMS system to control schedules and maintain the building and subsequent equipment. Encouragingly one company is currently undertaking in-depth reviews of how to best promote the use of BIM systems on future projects which will investigate BIM from both the construction and FM perspectives. Despite the lack of uptake of BIM in regards to FM there are signs that a number of the respondent companies have significant knowledge when it comes to ICT in improving the overall FM process. Some of these include real-time CAFM systems, RFID tags,

augmented reality of utilities, Helpdesk systems, handheld technology keeping information and billing up to date and BIM for FM packages such as ARTRA, which allow construction models to be populated with as built information, as it becomes available during the installation stage of a project. ICT can be successfully deployed to address a number of inefficiencies that exists in the construction process before the Facilities Manager must try and rectify after handover of the building, these include the use of integrated BIM systems throughout design, construction and maintenance of the building. By using an integrated package from the start, one can only help to minimise deficiencies and aid cost reduction during the running of a building.

The final part of the survey aimed to explore current views in respect to the Facilities Manager and ICT / BIM in helping better manage both new and existing public sector facilities and structures. A total of 69% of the respondents claim that the Irish government should take a similar stance to the UK and mandate the use of BIM. A total of 22% of the respondents have experience working within the public works sector in regards to facilities or property management of existing government assets. Some of the inefficiencies within Irish public sector facilities identified in this section of the survey include decisions based on short term costs, and not life cycle, as well as a lack of coordination between designers, constructors and operators. Some of the respondents indicated that the Facilities Manager if introduced in a consultant role at the beginning of the project can help the Irish Government meet its carbon targets and high energy savings, by ensuring energy efficient systems are installed and are designed to maximise their efficiency through their understanding of how the building will be used. The Facilities Manager can not only provide information about the buildings and the service within, but also the occupiers actions and, to a great extent, they can influence these actions to be more sustainable.

The results from the survey show that there is little involvement of the Facilities Manager during the early stages of construction, despite a strong claim to the significant benefits that they would bring to the construction team. There was a belief that the Facilities Manager should have an advisory role within the design and construction phases, as they can help streamline the design briefing process through their knowledge of facility operations. This however, may cause further interference within the design team. There has been little move towards cutting edge technologies from the Irish FM sector in order to streamline maintenance and further enhance lifecycle management. Encouragingly there is significant knowledge demonstrated by some respondents when it comes to ICT in improving the

overall FM process which includes the use of an integrated BIM package to minimise deficiencies and aid cost reduction during the running of a building. There is a strong call for the implementation of BIM on public sector projects which can help Facility Managers reduce environmental impacts and operating costs.

V Conclusion

There is strong evidence to suggest through the literature review and survey findings in answering the authors research objectives, that following in the UK's footsteps and implementing BIM and a similar soft landings framework, could help create a more interactive and intelligent Government estate. The current suite of frameworks promoted by the Irish Government do not focus strongly enough on long term life cycle costs and fail to satisfactorily put standard FM procedures and best practice in place. The UK Government have shown the way through their ambitious BIM programme, which will focus on the end users by enhancing the public assets long into the future. The Irish FM sector though stagnating shows encouraging signs of companies who wish to grow through adopting ICT and BIM related technologies. These technologies along with earlier Facility Manager involvement, could help reshape future public assets, as well as the adoption of a similar GSL framework to ensure there is a golden thread between all stages of the life cycle. In order for this to become a reality, it is crucial there is strong leadership from the Irish Government as well as learning from the UK's successes and mistakes. This will offer a chance for the Irish construction and FM sector to become a driver internationally and export their skills to the international market.

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