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Pat O'Sullivan

Grangegorman Development Agency, pat.osullivan@ggda.ie

Avril Behan

Dublin Institute of Technology, avril.behan@dit.ie

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What Lessons Can Be Learned From The Delivery Of The First Building On The Grangegorman Campus Using Building Information Management (BIM)?

Pat O'Sullivan¹ and Avril Behan²

¹Grangegorman Development Agency, Dublin Ireland

²School of Multidisciplinary Technologies, Dublin Institute of Technology, Dublin

E-Mail: pat.osullivan@ggda.ie

Abstract: There is an acceptance that BIM, via data management, can be integrated with FM to reduce costs during the Operations and Maintenance stage of a project. However, what has not been documented is the 'on the ground' reality which can be reviewed as a lessons learnt exercise to improve the implementation of BIM FM for future projects. This case study sets out to explore the realities of a client's adoption of BIM based upon the actual experience of the Greenway Hub. Rather than relying on anecdotal evidence the research was based upon the real practices and experiences of the Dublin Institute of Technology's (DIT) own project team who were tasked with the delivery of BIM and were recorded via interview and 4th Generation Evaluation. The outcomes were cross-referenced against the literature and it was found that the experience aligned well with similar "first project" situations in other educational and public sector projects. Important findings included the need for BIM training to be delivered to end users at a level appropriate to their ultimate needs, for early and frequent engagement between the project delivery team and the end users, and for the temporary appointment of an experienced BIM FM champion to represent the client, to mentor the Institute's own staff and to oversee the development of the Institute's BIM Implementation Plan and associated strategies. .

Keywords: BIM, FM, BIM Champion, Business Plan & Vision, BIM Training



Figure 1: Greenway Hub (source; author)

I INTRODUCTION

In October 2015, a directive was issued by the Grangegorman Development Agency (GDA) regarding the adoption of BIM in conjunction with the DIT as the delivery process for all 'Programme Three' new build projects on the Grangegorman campus [1]. The directive included both the CAPex and OPex stages. Prior to this date, as part of 'Programme One', BIM was used with limited client input during the CAPex stage to deliver the first new building on the campus (Greenway Hub). The opportunity now presents itself as part of a 'lessons learned' exercise to, firstly evaluate the client's actual role and responsibility in delivering the new campus using BIM given the Institute's initial experiences and secondly, to overcome the situation where future

Asset Information Models (AIM) are left idle during the Operation Expenditure (OPex) stage, as initially occurred for the Greenway Hub.

The Institute's stated desire, in a competitive market, is to create a first-class sustainable teaching facility at Grangegorman. The fact that BIM is taught in the College of Engineering and Built Environment within the institute is an opportunity for the academic side of the Institute to liaise with the practical implementation of BIM both for project delivery and future operations.

In order to deliver excellent FM services it is necessary to explore the theoretical and practical gap regarding BIM FM integration and to overcome the additional gap that exists between the existing state and the desired state of FM services [2]. The Institute has a unique opportunity to address these two observations and to operate in an iterative environment, thereby developing the Institute's knowledge of BIM with every project. The desired outcome should be a coherent model and database that can be used for future projects [3] which can 'derive significant improvements in cost, value, and carbon performance through the use of open shareable asset information' [4].

The adoption of BIM for the Greenway Hub was more by default rather than by design. It should be noted that there was no obligation upon the

contractor's project delivery team to deliver a BIM Level 2 model at handover. At the outset, other than a desire to use BIM, no client's EIR was compiled to specify the Institute's requirements for the operational stage of the building life cycle. BIM was driven by the design and build contractor during the CAPex stage and was used as a testing ground for their own procedures when delivering a project via BIM [5].

For the purposes of this paper FM encompasses both the Institute's Information Services (IS) and Estates Departments.

II LITERATURE REVIEW

a) Theory Versus Practice: Current Gap Between BIM & FM

BIM is seen as the missing link between projects and maintenance but will not be fully realised for many years [6]. Those at the forefront of the integration of FM and BIM are of the opinion that the BIM FM link can only work when FM is involved [7]. The Institute's own academic staff have presented papers advocating the use of the United Kingdom's Government Soft Landing (GSL) initiative and are cognisant of the need for early FM involvement to enhance the end users' understanding of a project's delivery and operation of a building [8]. Key for BIM FM is the 'continuation of information rather than the separation of information between project and maintenance life-cycles' [6].

It is accepted that the FM industry needs to further integrate with the BIM delivery process and a change in culture is needed to address this challenge [9]. Ultimately FMs will be in a better position to represent their clients' requirements and inform their Employer's Information Requirements (EIR) if they do so [10].

III METHODOLOGY

A mixed research methodology based upon the principles of a 4th Generation Evaluation [11] template was used to elicit responses and analyse the data in response to the research question. The research was undertaken in two parts. Part 1 was a literature review of academic papers, industry standards, guidelines and recent publications to identify best practice for BIM FM. Part 2 was qualitative, inductive and relied upon semi-structured, individual and confidential interviews. The first sub-section of the interview process consisted of an independent multiple choice questionnaire comprising ten questions which sought to identify in advance an interviewee's experience of BIM FM. The second sub-section was a semi-structured interview which used interviewees' responses to the preliminary survey results to guide the interviews to maximise the interviewees' respective experience.

The interviews were conducted with ten representatives of the departments tasked with the delivery of the Greenway Hub, two each from Campus Planning, Estates, IS, GDA, with one representative from senior management and academic staff respectively. The interviews lasted approximately 45 minutes, were recorded digitally and the interview data analysed using a thematic approach to identify the lessons learnt in order to propose recommendations for future projects adopting BIM FM for the operations phase of a project.

The case study approach was selected because it represents the most appropriate investigation for those adopting new technologies/process. The intention was to triangulate the resulting research data, creating a clear understanding of the problem and overcoming the deficiency of a single strategy [12] when restricting the interviews to a small scale cohort of interviewees. The interviews were structured to provide an in-depth collection of the opinions from those interviewed, with reference to actual events. The demography was split 80:20 between men and women.

Personal interviews were deemed to have two significant advantages. Firstly, they enabled the author to determine the expectation of BIM at handover and the usage of BIM during the Operation & Maintenance (O&M) phase. Secondly, they helped to identify the barriers and challenges to implementing BIM specific to the Institute's own FM Department. It should be noted that the number of participants invited to interview was based upon a small pool of individuals. Consequently any generalisation of the research findings is limited.

With the written consent of the interviewees, interviews were recorded anonymously and digital copies have been securely filed on-line.

IV QUANTATIVE ANALYSIS

The initial multiple choice questionnaire, identified a clear distinction between those with BIM knowledge and those without. The two key facts which emerged and led to further detailed discussions during the semi-structured interviews were:

1. A lack of knowledge amongst the majority of the interviewees of the client's role in relation to BIM as set in the PAS 1192 suite of documents.
2. A collective acceptance that BIM has something to contribute to FM and the need to involve FM personnel from the outset of a project.

V QUALITATIVE ANALYSIS

a) Client's Role and Responsibility

The literature review revealed that current industry surveys suggests that approximately seventy-five percent of clients using BIM could be deemed to be 'passive' [13]. Passive clients according to Saxon are those, 'willing to use BIM but are not able to play, the

client role in their BIM use'. These clients receive some benefit but not the major benefits accruing to clients deemed to be 'active' BIM users [13]. The responses to the interview questionnaires identified that, although there was an appetite to use BIM for FM purposes within the Institute, the 'passive' description of the Institute as a BIM user is more apt.

During the interviews, the need to be better informed and involved was accepted by the majority of the interviewees as important to implementing BIM. There was an overall willingness for the Institute to become more 'active' and informed to meet the mandate and their own BIM internal directive.

b) BIM Vision and Business Plan

One of the key initial requirements in BIM adoption is an organisation's vision of BIM [14]. Equally critical is the financial standing of any organisation embarking on BIM adoption [14]. BIM is a disruptive business process and needs to be carefully considered [15]. The first question to be addressed by senior management when considering BIM adoption should be why BIM is an important corporate goal [14]. According to Love et al. (2014) [16], BIM should not be seen as a technology but as a 'business change program' that impacts upon obtaining value from investing in BIM.

The timeframe and criteria for monitoring the implementation of BIM needs to be established, monitored and defined at the outset [14]. These, along with a risk assessment, will identify the goals to define the client's corporate strategic aims in relation to BIM. The corporate strategy should offer three competitive advantages [2]:

1. professional commitment to the needs of the end user;
2. provide effective and financially efficient services;
3. an organisational culture which enables the continuous drive for excellence.

The Institute's drive for excellence was expressed by one interviewee when addressing the Institute's own need to be attractive in a competitive market. One interviewee stated that the Institute's senior management is not adverse to adopting BIM FM and is keen to fully understand the value of BIM, not just its monetary worth but for the environmental and sustainability goals required to deliver the Institute's vision of a 'green' campus and by implication lifecycle management. The main buy-in by senior management surrounds the possibility that BIM can be used to realise these objectives during the move to the Grangegorman Campus. The interviewee in question pointed out that the Institute is a third level educational institution operating in a competitive market where there is a constant challenge to provide better facilities for students and staff. The opportunity to work and study in an active BIM environment could be a differentiator. Reference was made to the

Institute having a unique selling point which must revolve around education and a vision of a digital campus to support the aspiration of being an internationally renowned Institute at the forefront of BIM implementation and training. Furthermore, two interviewees identified that a corporate strategic plan is required to avail of the opportunity to focus on other revenue streams through commercialisation via leveraging of the Institute's assets during a 'third term' and maximising the potential that is currently lost within the Institute's real estate assets.

The interviewees all confirmed that there was no Business Plan, Corporate Strategy or BIM Implementation Plan for BIM adoption despite the Institute and the GDA's directive in 2015 to incorporate BIM. Collectively, the interviewees welcomed the publication of a BIM Implementation Plan which would outline a clear vision for BIM adoption. The Plan should be used to generate support, and to encourage participation to transform the idea into reality. Time should be set aside to implement this. A number of interviewees confirmed that there is an in-house focus group addressing items which would traditionally have been part of a business plan. The focus group, tasked with delivering a 'smart campus', has representatives from across the institute's Senior Management, IS, Estates, academic departments and the GDA.

There are pitfalls that the Institute needs to avoid when adopting BIM. Williams et al. [17], highlighted that owners lacked the full understanding of the long-term operational savings and the Capital Expenditure (CAPEX) to OPEX divide. As a result, costs can push owners to evaluate BIM for FM out of projects [17]. It is important that 'return on investment' (ROI) studies demonstrate a return over the whole life of a project rather than just the CAPEX stage [10]. Key performance indicator (KPI) matrices are needed to monitor the ROI and measure the outcomes. Clients need to be aware that the investment in BIM is considerable and needs to be spread out over time to ensure a positive return [18]. The investment is not just technology based but relates to training people, amending work processes and continuous improvement in relation to emerging technological trends, all of which incur costs [18]. In one interview the issue of ROI was discussed and the interviewee stated that "the Institute was taking a longer view".

In addition the Plan needs to consider potential risks which include interoperability issues, learning curves, user resistance and disruption to business activities [16]. The client's Plan should from the outset, include budgets for investing in hardware and software as well as investment in the FM team [19]. There is a concern within the industry regarding the costs of implementing BIM and the ROI [20]. Project budgets constraints are often a reason for the failure to implement BIM for FM [21]. However, the impact of implementing BIM increases exponentially the

further along the project lifecycle that BIM is initiated [22].

There is a theory that a relevant methodology in conjunction with a valid baseline is required to evaluate the benefits of BIM from a business perspective [23]. According to Barlish & Sullivan [23], this is currently difficult to achieve with BIM, given the varying nature of documented case studies. In addition there is the dilemma an owner faces when making a decision based upon speculative benefits that capture both monetary and managerial outcomes. Furthermore, the 'latter is a prerequisite of the former' for owners who are seeking to adopt BIM 'as a tool once it has been proven effective' [23].

It was confirmed in the interviews that the Institute has taken the initial first step by issuing a directive and subsequent formation of a Smart Campus Group to implement BIM in December 2016. Akin to Birmingham City University, this initial step was seen as a '*leap of insight*' [24] taken by the Institute's senior management that did not rely on quantifiable proof for projects where the benefits and investments for an entire organisation cannot be measured prior to acceptance [23]. Essentially, the Institute is relying upon unknowns as highlighted by Bakis et al. [25] where 'many management decisions are based upon instinct and intuition and the investment in information systems should not be an exception'.

c) Existing FM Procedures

Currently the Institute's FM (Estates) is primarily concerned with 'soft' FM. In contrast 'hard' FM is contracted out via outsourced third party maintenance contracts. In one interview, concerns were raised about the external service aligning with the Institute's BIM strategy. Reservations were expressed regarding ongoing training of external service providers' personnel and the continued updating of the AIM given the ongoing challenge facing clients when procuring external FM consultants and maintenance contractors on five-yearly contracts, which are then open for renewal. This echoes other published documentation that identifies this as a barrier and there are issues when new providers are procured which results in the poor handover of FM information between FM consultants and maintenance contractors [9].

It was confirmed during the interviews that the Safety File for the Greenway Hub was issued on a compact disc at the request of Estates. This reflects the literature review which indicated that, firstly, throughout the AEC industry, Safety File documentation is still issued in 2D format and, in over seventy percent of cases surveyed, the 3D model and Construction Operations Information Exchange (COBie) files were not presented [26] and secondly, it is at handover, when the AIM is transferred to the client organisation, where traditionally the integration

of post-occupancy data between BIM and FM has been tedious and error prone [19].

According to Schley [27], even though barriers remain, the integration with FM is gaining greater traction. This was acknowledged by a minority of interviewees who made reference to the UK Government's mandate for Level 2 BIM and the requirement to adopt GSL to provide opportunities to extract the information from the data rich AIMs for FM management. However, the software needed to accomplish this is only emerging [27].

To facilitate the handover of the AIM, it was proposed during the interviews that a phased adoption of BIM should be considered. The discussion proposed undertaking a pilot study. In general, pilot studies were viewed positively. One interviewee suggested starting with the project Safety File and using that as the initial entry into BIM. This aligns with research that advocates defining a lowest level of BIM that should apply to all projects [28].

d) Resources & Organisational Structures

Research has revealed that clients considering the adoption of BIM for FM need to be aware of the implications of proceeding with BIM technology. Transferring to a BIM related FM requires a cultural change within the client's organisation [9]. The task according to Skripac [19] can be onerous but collaboration with consultants with the requisite experience can provide direction to accomplish the transfer to a digitised facility management. Ideally this partnership should have the necessary experience to aid in the understanding of the technologies and the most appropriate ways of integrating with the organisation's existing management systems [19].

People are a fundamental requirement to the successful implementation of BIM FM and buy-in across the Institute is key. It starts with a clear business plan that ties in with the vision and goals of the Institute and which sets out a clear strategy that is clearly communicated to the end-users. To work it requires coordinated changes in work processes, integration of people into new roles, and alterations to the existing exchange information protocols across an organisation [29], [30].

A review of the existing staffing resources and the time required to learn about BIM were cited collectively by those interviewed as key requirements for the successful implementation of BIM. This included the identification of BIM Champions within the Institute. Williams et al. [17] identified that BIM and FM rely not only on collaborative work practices and processes, but a strong emphasis on the 'fusion of people, process and technology'. People are key to implementing BIM FM, especially given that people-centred issues can pose a threat to BIM adoption [30]. According to Liu & Issa [31], it is the lack of knowledge of BIM amongst FMs that hinders the leveraging of BIM throughout a building's lifecycle. In addition, Skripac [19] writes, in relation to hospital

management that one person alone cannot manage BIM's integration across the organisation and it requires the support of the whole organisation to do so.

The appointment of a client representative is a requirement of BS 8536 'Briefing for Design and Construction. Code of practice for facilities management (buildings infrastructure) [32] and in April 2016 the GDA, who are the Institute's agents for delivering the campus, appointed an internal BIM Information Manager to assist with the delivery of BIM across the campus.

e) BIM Champion

The appointment of a BIM Champion or BIM Information Manager is critical at the start of a project and this person needs to be 'integrated fully into a client organisational structure' [14]. 'Someone to sit above all of this and integrate those systems to the benefit of the people using the buildings and that is the role of FM' [33]. The Institute's own academic staff have advocated the need to ensure that the right people were brought into the BIM delivery process at the right time for commissioning, training and handover [8] The majority of those interviewed supported and reiterated this view.

The question was asked indirectly if the appointment of a GDA BIM Information Manager was seen as the Institute complying with BS 8536. Alternatively, the interviews were asked if there was an additional need for a dedicated in-house FM manager to oversee the implementation of BIM or was there a desire to appoint an external third party FM consultant. The initial question directed to the interviewees raised the possibility of new roles and the capability of existing resources in the Institute to participate in the delivery of BIM. A second related question was asked with regard to the GDA appointment. All but one interviewee stated a preference for the temporary appointment of an external third party FM consultant to advise and represent the Institute. A number of interviewees voiced their preference that the consultant should have experience of delivering BIM FM for universities/education. Ideally the consultant would work closely with an existing staff member under a coaching programme to become BIM-literate. When explored further, the main reasons for this was the belief that the person best suited to understand the existing needs of the FM department would come from within the current FM resources. This reflects previously published papers that state that a facility manager should be 'ideally placed to understand the organization's needs in terms of culture, corporate strategy, vision, mission and objectives' [10]). The temporary consultant, FM individual and the GDA BIM information manager should write a BIM Project Execution Plan at the outset of a project that essentially would be a road map for the delivery of the project [14] [34].

f) Client Training Road Map

It was clear from the interview responses that a knowledge divide exists between the people who operate the facility and the project team charged with delivering the campus. One interviewee mentioned that it is essential that the training would be relevant to an individual's tasks to avoid any negative perception or lack of interest in BIM adoption. In general, the following was accepted amongst those interviewed:

1. Training is needed to prevent the AIM becoming redundant for future projects.
2. All FM staff need to be upskilled in relation to BIM processes and technology.
3. FM operators need to be aware of their critical roles and responsibilities in delivering BIM in order to achieve a BIM Level 2 maturity.
4. Custom-designed, 'role'-specific training modules should be put in place for those involved with the design process during the Project Information Model's (PIM) development.
5. Separate training is required for those involved with the operation phase, commissioning, validation at handover, AIM, Computer Aided Facility Management (CAFM) and Computer Maintenance Management Systems (CMMS).
6. Training should also address 'soft landings' Post Occupancy Evaluations (POE) and related KPIs.

To date, the Institute's agents have used generic EIR templates for the Institute's initial BIM projects. Ashworth's [10] assertion that EIRs need to become more bespoke, project-specific and client-based has been acknowledged by interviewees with BIM experience. Therefore the initial FMs training module should concentrate upon the client's Organisations Information Requirements (OIR) and Asset information Requirements (AIR). Ashworth et al. [35] have identified the key documents that clients and their facility manager need to familiarise themselves with when developing a BIM Strategy. Known as the pillars of BIM, these documents will assist in developing better, well-defined OIRs and AIRs.

g) CAFM

Although, the majority of those interviewed had no experience of a CAFM or CMMS, the discussions revealed that a key element of adopting BIM for FM is the need to make a decision about which software and platform to use in the future.

During the interviews, reference was made to 'silo' management in relation to the management of assets within the Institute. This is supported by the fact that across the Institute's various departments, fifteen active enterprise systems are currently in operation. One interviewee confirmed that currently nine of these are managed by Estates and that Estates use one Building Management System (BMS) to integrate three of these systems. It was revealed

during three interviews that both IS and Estates are reviewing their own asset management strategy independent of BIM with Estates focusing on a new generic CAFM software.

Interoperability and the use of Industry Foundation Classes (IFC) came up in two interviews. One interviewee expressed the need that before adopting a BIM for FM software, a decision needs to be taken in relation to proceeding with 'open systems' versus 'proprietary software' assessing the advantages and disadvantages of both. However two interviewees need to be convinced that a full open systems is achievable. Kassem et al. [9] noted that the preference for open standards is required in order to overcome the issue regarding the disparate growth in the lifecycle of BIM technology versus the lifecycle of FM technologies. This was raised in one interview where the Institute's decision to proceed should be based upon the awareness that the lifecycle for BIM technologies is twelve to twenty four months whereas FM technologies can last up to fifty years. The Institute needs to take a long-term view, in excess of five years, whereby the FM operators should be willing to work with differing standards and not align themselves to one particular technology [9], [36].

VI RESULTS

An analysis of the interviews revealed a number of key concerns.

1. Communication is needed to develop and implement a co-ordinated BIM FM vision and BIM Implementation Plan that reflects the different stakeholders' expectations of BIM. There was a concern that the "ship has sailed" and that the opportunity to realise the full benefit of BIM has passed.
2. For those charged with delivering the Grangegorman project and running the operation there are no set guidelines or Project Delivery Standards (PDS) in place.
3. Existing Estates & IS resources are stretched. This needs to be reviewed in order to implement BIM for operational use. There is a desire to buy-into BIM but critically, key personnel need to be identified, trained and positioned within the organisational structure to look after the Institute's requirements. The need for a third party external consultant procured on a temporary basis was seen as essential to deliver BIM.
4. Training is needed to address the limited knowledge of BIM.
5. Time is needed to implement a gradual roll out of BIM FM across the FM.
6. There was lack of understanding among the majority of the interviewees of BIM terminology, BIM standards and the definition of an asset under PAS 1192. This knowledge gap is a serious concern, given the potential for the Institute to continue to procure and pay for the delivery of an

AIM via the BIM process which, in reality, they may not be willing to spend time understanding the potential benefits of an AIM.

7. There was a general lack of knowledge of CAFM, CMMS and Integrated Works Management Systems (IWMS) for BIM FM.
8. Pertinent security questions relating to the Institute's vulnerabilities of third party access to the AIM were raised in two interviews. The requirements of PAS 1192-5 should be included in the Institute's BIM Implementation Plan to protect the project information on sensitive assets or systems.

VII RECOMMENDATIONS

a) Vision & Business Case

People are a fundamental requirement to the successful implementation of BIM FM and buy-in across the Institute is key. It starts with a clear business plan that aligns with the Institute's Corporate Strategic Business Plan to implement BIM which includes a bespoke Asset Management Strategy that ties in with the vision and goals of the Institute that is clearly communicated to the end-users. To work it requires coordinated changes in work processes, integration of people into new roles, and alterations to the existing exchange information protocols across an organisation [29]. The Plan should include reference to security in relation to the protection of sensitive information and systems. Once these are aligned, the roadmap set out in the plan must be followed to achieve compliance via continuous guidance, processes and a training programme. KPI metrics should be produced that form part of the POEs. Strong leadership is required and the organisational structure needs to be reviewed in order to identify key roles and responsibilities. It is the Institute's responsibility to identify the correct personnel from the existing staffing resources to deliver BIM FM, to recruit resources where necessary and to appoint a BIM champion on the Institute's side.

To become an 'intelligent client' the Institute needs to become an 'active' rather than a 'passive client' [37]. The Institute should aspire to implement a practical corporate strategy, such as BIM that requires 'information as the rational basis for guiding the purchase, use, maintenance and disposal of every asset that an organisation needs in order to maintain and develop its business' [14] In order to achieve the aforementioned objectives, the Institute, as a client, needs to identify if there is a need for external third party FM consultants, to advise the Institute on setting up a delivery standard and monitoring its delivery throughout the project or, alternatively, appoint an in-house FM BIM champion who has an overall brief to manage all of the Institute's assets.

As part of the interview analysis, it was noted that there was an appetite amongst those interviewed to make contact with other universities who are deemed

early adopters of BIM FM and who have their own BIM implementation roadmaps and PDS in place. Delivery standards are required to realise the potential of BIM for FM and should align with a campus wide asset management system to manage the data contained within an AIM. Contact should be initiated and a request made to visit these organisations. This would give the FMs the opportunity to talk directly to those carrying out the same roles and tasks. The discussion should address the impact both positively and negatively of BIM by way of benefits, cultural change and disruption, in order to get a rounded view of BIM implementation. The Institute should consider negotiating for a temporary placement of an experienced BIM FM Manager from one of the aforementioned universities to act as an advisor and assist in the delivery of BIM for FM.

b) Market Responsibility

BIM Level 2 needs to be fully defined within the AEC industry and communicated to clients. What is needed is ‘intelligent clients’; who are willing to ‘spend more time understanding their own requirements’ [38]. However, as Saxon [13] writes, a client’s understanding of BIM does not need to be extensive and nothing like the understanding that designers, contractors and product makers need to have. Clients can, as Saxon [13] outlines, be supported by advisers ‘to define and get all the outputs they need’. This is supported by Ravenscroft [38] who suggested that it is at the start of the journey where the client should be getting ‘the quality advice they really need to understand their own part in this journey’.

The tag line ‘Start with the end in mind’ [39] is often used by the BIM community as a way of ensuring early involvement. This needs to be promoted within the Institute.

c) Training

Key to implementing BIM is a bespoke BIM FM educational training programme that ensures that the Institute’s FM staff receive the correct training, which is role-specific and tailored accordingly. Initially training is needed that will assist the Institute’s stakeholders achieve a clear understanding of the Institute’s needs in relation to the OIR and that an OIR drives the identification of the AIR, and not just the built assets. This is an area that a ‘lessons learned’ exercise is likely to have the most impact on the ongoing use of the AIM post hand over given that it is the Institutes OIR and AIR that will determine the content of future AIMs and by extension aid building operations.

d) AIM & CAFM

Training will overcome the confusion that existed in a number of interviewees’ perceptions regarding the function of an AIM. At present, AIMs use a CAFM process that is normally a web-based interface which can be automatically implemented remotely to collate

data to specific, bespoke needs which BIM can deliver at handover [40]. However, it is the subsequent desirable CAFM integration with an organisation’s other management systems that needs to be further researched by the Institute’s FMs [37]. The major benefit of CAFM is the ability to harvest data about the facility from the model and assets within it for further interrogation [40]. CAFM has typically been used to accommodate the management of Space Planning, Assets, Maintenance and Facility Operations. In the short term the integration of CAFM and CMMS, combined across multiple software platforms, should be seen as the logical first step on the journey towards a modular IWMS [41]. The Institute should be aware that this does not answer fully the requirements of a facility’s overall asset management. Once upskilled, the Institute’s FMs will need to control the transfer of data, own the data and maintain the data [40].

VII SUMMARY AND CONCLUSION

Research has revealed that the Institute’s experience post-handover of the AIM for the Greenway Hub is consistent with published papers. The literature review highlighted that it will take time to roll out a BIM implementation programme and to become an ‘active’ and ‘intelligent’ client.

The final objective of this research related to identifying the ‘on the ground’ reality concerning BIM FM integration based upon the Greenway Hub experience. The underlying factor that came to the fore during the semi-structured interviews was the realisation that the Institute is the most important stakeholder in driving BIM FM adoption. Furthermore, in order to succeed with BIM FM, the temptation to persevere with the status quo must be avoided. Senior management must focus on the long term gains in order to bring immediate goals into better focus and to become an ‘active’ and ‘intelligent client’. In order to maximise the potential of BIM, a change to work practices and the skills of participants is required. This can be achieved immediately by adopting an educational programme and by appointing a third party BIM consultant. There are huge benefits to be accrued but care must be taken that this is rolled out in a manner that recognises the time, resources and technology required to change the FM culture within the organisation. Ultimately, given the scale of the Institute and the property port-folio, a clear strategy needs to be drawn up which takes cognisance of the needs of all parties from senior management to general operatives.

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REFERENCES

- [1] G. Casey, *Personal Communication*, Dublin, 2015.
- [2] D. Kavrakov, "Performance Management in Facility Management. Top Key Performance Indicators in FM," *Insight*, no. 32, pp. 4-5, 2015.
- [3] M. Johnson, "BIM Commissioning: Collaboration in Data Management," *Journal of the National Institute of Building Sciences*, pp. 20 - 24, 2014.
- [4] N. Tune, "UK BIM Programme," 7 - 10 October 2013. [Online]. Available: <http://iug.buildingsmart.org/resources/itm-and-iug-meetings-2013-munich/itm-plenary/uk-bim-programme>. [Accessed 2017].
- [5] M. Murphy, "Construction Team Working without Defined Requirements," in *A Public Sector BIM Adoption Strategy Update*, Dublin, 2017.
- [6] C. Lindkvist, "Contextualising learning approaches which shapes BIM for maintenance," *Built Environment Project and Asset Management*, vol. 5, no. 3, pp. 318 - 330, 2015.
- [7] P. Wilkinson, "Where is FM in the BIM Conversation," 15 August 2016. [Online]. Available: www.fm-world.co.uk/features/feature-article/where-is-fm-in-the-bim-conversation/. [Accessed 20 September 2016].
- [8] B. McAuley, A. Hore, R. West and D. Rowland, "Creating Interactive Facility Management Capabilities through BIM as a tool for Managing the Irish Public Sector Estates," in *CITA BIM Gathering 2013*, Dublin, 2013.
- [9] M. Kassem, G. Kelly, N. Dawood, M. Serginson and S. Lockey, "BIM in facility management applications: a case study of a large university complex," *Built Environment Project and Asset Management*, vol. 5, no. 3, pp. 261 - 277, 2015.
- [10] S. Ashworth, M. D. Tucker, C. D. Druhmman and M. Kassem, "Integration of FM expertise and end user needs in the BIM process using the Employer's Information Requirements," June 2016a. [Online]. Available: https://www.researchgate.net/publication/301776764_Integration_of_FM_expertise_and_end_user_needs_in_the_BIM_process_using_the_Employers_Information_Requirements_EIR.
- [11] E. Guba and Y. Lincoln, *Fourth Generation Evaluation*, Newbury Park, CA: Sage Publishing Inc, 1989.
- [12] P. Kulkarni, "What is triangulation of data in qualitative research? Is it a method of validating the information collected through various methods?," 25 December 2013. [Online]. Available: https://www.researchgate.net/post/What_is_tiangulation_of_data_in_qualitative_research_Is_it_a_method_of_validating_the_information_collected_through_various_methods. [Accessed 21 April 2017].
- [13] R. Saxon, "We need to welcome clients into BIM," 2 November 2016b. [Online]. Available: www.bimplus.co.uk/people/welc6ed-welc60me-clie5nts-bim/. [Accessed 27 January 2017].
- [14] D. Shepherd, *BIM Management Handbook*, Newcastle Upon Tyne: RIBA Publishings, 2015.
- [15] R. DePalma, "Getting Over the First Hurdle: Developing a Business Case for BIM Integration in Your Company - Part 1," 18 September 2015a. [Online]. Available: <https://www.linkedin.com/pulse/getting-over-first-hurdle-developing-business-case-bim-rich-depalma>. [Accessed 12 December 2016].
- [16] P. Love, J. Matthews, I. Simpson, A. Hill and O. Olatunji, "A Benefits Realization Management Building Information Modeling Framework for Asset Managers," *Automation in Construction*, vol. 37, pp. 1-10, 2014.
- [17] R. Williams, H. Shayesteh and L. Marjanovic-Halburd, "Utilizing Building Information Modelling for Facilities Management," *International Journal of Facility Management*, vol. 5, no. 1, pp. 1-19, November 2014.
- [18] R. DePalma, "Getting Over the First Hurdle: Developing a Business Case for BIM Integration in Your Company - Part 2," 2 October 2015b. [Online]. Available: www.dpw-group.com/category/business-case/. [Accessed 4 January 2017].
- [19] B. Skripac, "The next step BIM's role expands as facility managers take ownership," 1 August 2013. [Online]. Available: <http://www.hfmmagazine.com/articles/307-the-next-step>. [Accessed 4 November 2016].
- [20] J. Deeney, A. Hore and B. McAuley, "Public/Private BIM: An Irish Perspective," in *Proceedings of the CITA BIM Gathering*, Dublin, Ireland, 2013.

- [21] M. Read and J. Harris, "Ready For Work," 15 September 2016. [Online]. Available: www.fm-world.co.uk/features/feature-article/ready-for-work/. [Accessed 20 September 2016].
- [22] B. Longstreet, "Finding the right solution to create an as-built BIM of," October 2010. [Online]. Available: <http://www.leica-geosystems.us/en/ScanningPDX.pdf>. [Accessed 5 February 2017].
- [23] K. Barlish and K. Sullivan, "How to measure the benefits of BIM - A case study approach," *Automation in Construction*, vol. 24, pp. 149-159, 31 March 2012.
- [24] A. Malone, "BIM Post Handover," 22 September 2014. [Online]. Available: <https://www.fgould.com/uk-europe/articles/bim-post-handover/>. [Accessed 20 September 2016].
- [25] N. Bakis, M. Kagioglou and G. Aouad, "Evaluating the business benefits of information systems," in *International Salford Centre for Research and Innovation (SCRI) Research Symposium part of the 3rd International Built and Human Environment Research Week, 3 -7 April 2006.*, Rotterdam (Netherlands), 2006.
- [26] R. Eadie, M. Browne, H. Odeyinka, C. McKeown and S. McNiff, "BIM implementation throughout the UK construction project lifecycle: An analysis," *Automation in Construction*, pp. 145 - 151, 2013.
- [27] M. Schley, "BIM: Revolutionizing Building Life Cycle Management. The evolution of Building Information Modeling (BIM) and its implications for FM," 2014. [Online]. Available: <http://fmlink.com/articles/bim-revolutionizing-building-life-cycle-management/>. [Accessed 7 October 2016].
- [28] H. Lindblad and S. Vass, "BIM Implementation and organisational change: A case study of a large Swedish public client," *Procedia Economics and Finance*, no. 21, pp. 178 - 184, 2015.
- [29] D. Holzer, "BIM's Seven deadly sins," *International Journal of Architectural Computing*, vol. 9, no. 4, pp. 463-480, 2011.
- [30] A. Porwal and K. Hewage, "BIM partnering framework for public construction projects," *Automation in Construction*, no. 31, pp. 204 - 214, 5 January 2013.
- [31] R. Liu and R. Issa, "Issues in BIM for Facility Management form Industry Practicioners' Perspectives," in *Proceedings form Computing in Civil Engineering*, Los Angeles, California, 2013.
- [32] BSI, *BS 8536-1:2015 Briefing for design and construction – Part 1: Code of practice for facilities management (Buildings infrastructure)*, London: British Standards Institution, 2015.
- [33] N. Martindale, "The Smart Future of FM," 15 September 2016. [Online]. Available: www.fm-world.co.uk/features/feature-article/the-smart-future-of-fm/. [Accessed 20 September 2016].
- [34] B. Wallbank, "BIM For Clients," October 2014. [Online]. Available: https://thebimhub.com/2014/11/02/bim-for-clients/#.V_piFeArLIU. [Accessed 20 September 2016].
- [35] S. Ashworth, M. D. Tucker and C. D. Druhmman, "The Role of FM in Preparing a BIM Strategy and Employer's Information Requirements (EIR) to Align with Client Asset Management Strategy," in *15th EuroFM Research Symposium*, Milan, Italy, 2016b.
- [36] D. Jordani, "FM Smart: Information technology for the facility life cycle," *Journal of the National Institute of Building Sciences*, pp. 40 - 42, 1 February 2015.
- [37] R. Saxon, *BIM for Construction Use*, Newcastle Upon Tyne: RIBA Publishings, 2016.
- [38] T. Ravenscroft, "Technical Talking at BIM Round Table," 2016. [Online]. Available: www.bimplus.co.uk/people/4technic5a1-talking-bim-rou6nd-table/. [Accessed 27 January 2017].
- [39] BIM4FM, "BIM4FM says Start With The End In Mind," April 2016. [Online]. Available: <https://bsria.co.uk/news/article/bim4fm-say-start-with-the-end-in-mind/>. [Accessed 20 September 2016].
- [40] R. Fairhead, *RIBA Plan of work 2013 Guide; Information Exchanges*, Newcastle upon Tyne: RIBA Enterprises, 2015.
- [41] Imperial College London, "Computer Aided Facilities Management," 2017. [Online]. Available: <https://www.imperial.ac.uk/about/leadership-and-strategy/provost/operational-excellence/ef/cafm/>. [Accessed 11 April 2017].