# Integration of FM Expertise and End User Needs in the BIM Process Using the Employer's Information Requirements (EIR)

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## Abstract

Projects in the construction industry typically involve complex information flows from early design, through construction, to facility management (FM). Building Information Modelling (BIM) tools and workflow processes are considered key enablers for collaboratively managing such information across phases of the project lifecycle. With the increased adoption of BIM by the construction industry, there are heightened expectations for increased engagement of facility managers (FMs), users and clients in the BIM process. This is based on the proposition that BIM can benefit the operational phase of a building, which contributes the most to the building lifecycle in terms of overall cost, sustainability and usability. The study aim was to investigate current levels of understanding and adoption of BIM by facility managers in practice. Three research questions were investigated: (a) *How client and FM engagement with BIM workflows can be improved through early contemplation of their requirements*; (b) *what are the perceptions about BIM and its potential impact on the FM industry from an FM, user and client perspective* and (c) *what information is required by FM from the BIM process to maximum optimisation of assets in the operation phase*.

Mixed research methods, including: a literature review of academic and industry publications (e.g. case studies, industry best practice, standards and guidelines), an online survey of FM professionals and focus groups, were used to address the posed research questions. The findings highlight the need for further education regarding BIM guidelines and standards. In particular, new and more FM/client-focussed BIM strategy documents, EIR and other templates are required. Many existing templates (e.g. EIR) are not focused on client's needs. Guidance is required on developing BIM strategies based on understanding the client's Organisational Information Requirements (OIR) and Asset Information Requirements (AIR) in order to develop an EIR that specifies what, when and how information should be delivered. This will improve timely decision making during design and ensure that the right and correctly structured information is delivered to clients at handover for their Asset Information Model (AIM) to help optimise the operation of their assets.

**Keywords:** Facility Management (FM), Building Information Modelling (BIM), Employer`s Information Requirements (EIR), Asset Information Model (AIM)

# 1. Introduction

BIM is driving rapid change throughout the design and construction (D&C) industry and increasingly is becoming the chosen process across Europe and the wider world for the planning, D&C of buildings and infrastructure projects. Many D&C professionals have already gone through the paradigm change required to adopt and implement BIM. However BIM has not yet had a significant impact on the FM industry. This is creating a growing knowledge gap about BIM between the D&C and FM industries. The BIM workflow process when managed properly should start with a clear specification of the client's asset operation and maintenance (O&M) information needs in the EIR. At present, this is not happening, as many clients and FMs do not yet have adequate knowledge and experience to fully engage in the BIM process. If this problem is not addressed many potential benefits of BIM may not be fully realised.

# 2. Literature review

There is growing recognition that BIM can deliver significant economic, social and environmental benefits in the creation, O&M of assets and buildings, especially when value is considered over the whole life cycle. The UK Government for example recognised the added value BIM can deliver in its 2011 Construction Strategy as an aid to ensuring "the country gets the social and economic infrastructure it needs for the long-term" (Cabinet Office, 2011). With respect to ROI and who benefits most in the BIM process; the *SmartMarket Report* (McGraw Hill Construction, 2014) reports "three quarters of all contractors' surveyed report a positive ROI on their investment in BIM". However the key beneficiaries of BIM are ultimately clients and end users (Eastman, et al., 2011). Other research looking at ranking stakeholder financial benefits in relation to BIM has indicated that clients benefit most financially from BIM followed by FM (Eadie, et al., 2013). This is because BIM models and their associated information can be used throughout the whole lifecycle of buildings, infrastructure and assets (BSi, 2013). This is critical to understanding the most significant savings and benefits can be realised over the longer operational use phase.

In relation to whole life costing, research shows up to 80% of the O&M cost of an asset can be influenced in the first 20% of the design process (ISO, 2008). FM operational expertise and input is thus critical in the early stages of design to avoid expensive decisions which can have long lasting implications (Ashworth, 2013). Other research shows that FM and the O&M of a building equates to 60% of the overall costs of a project (Akcamete, et al., 2011). They suggest significant financial gains can be achieved by specifically targeting this aspect of a project. Clients, in particular, can achieve worthy benefits on their construction projects by adopting BIM technologies and workflows to guide their delivery process to higher quality and performance for a whole building life cycle (Eastman, et al., 2011). Research also shows 39% of contractors assign greatest value in projects to adding O&M data to models for the owner (McGraw Hill Construction, 2014). However, research shows that BIM adoption in the O&M phase is currently less than 10% and potentially significant unrealised benefits could be achieved if more focus was given to the impact of BIM in the O&M phase (Eadie, et al., 2013).

To help stakeholders the UK government has put in place a framework of BIM standards and guidelines for the BIM process. PAS 1192-2 (BSi, 2013) states the start of the BIM process should be a "clear understanding of the client`s OIR and AIR" and that one of the "fundamental principles of level 2 information modelling is the provision of a clear EIR". It defines the EIR as a "pre-tender document setting out the information to be delivered, and the standards and processes to be adopted by the supplier as part of the project delivery process" and that the "EIR should be incorporated into tender documentation to enable suppliers to produce an initial BIM Execution Plan (BEP)". The Government has provided an EIR template for stakeholders (BIM Task Group, 2015), however the author believes that a more client focused template is required.

PAS 1192-3 (BSi, 2014) describes the ultimate purpose of the BIM process is to "provide information into the client Asset Information Model (AIM)" which should be "the single source of approved and validated information related to the asset(s)". BIM can provide a fully populated asset data set for CAFM systems and therefore reduce the time needed to obtain and populate asset information. This enables FMs to achieve optimum performance more quickly, reduce running costs, and refine target outcomes (BIM Task Group, 2015). The data should include: "data and geometry describing the asset(s) and the spaces and items associated with it, data about the performance of the asset(s), supporting information about the asset(s) such as specifications, operation and maintenance manuals, and health and safety information". However clients/FMs are the only stakeholders that ultimately understand the client needs, and can specify these for the EIR at the start of the BIM process. BS8536 (BSi, 2015) aims to help, promoting "the early involvement of the operations team or FMs and by extending the commitment of the D&C team to post-handover asset aftercare to ensure its correct, safe, secure and efficient operation in line with environmental, social, security and economic performance targets". Thus to ensure the BIM process works fully, the client/FM have to be included early.

With respect to FM knowledge and awareness of BIM; surveys such as the BIM4FM survey (A working group of BIM Task Group) have tried to understand the perception of BIM by FM, end users and clients. The survey found that "although people are aware of BIM there is still a significant audience that is unsure of how BIM is used within the built environment" (BIM4FM, 2013). 63.2% of respondents were "unsure of whether their organisations plan to use BIM in the future". The NBS National BIM Report 2015 (NBS, 2015) also provides some useful insights from the construction industry perspective on BIM: 50% said they were currently using BIM and 95% of respondents believe "they will be using BIM within 5 years". However 67% also reported that "the industry is not clear on what BIM is yet". Other research work has shown that many D&C professionals (93.6%) agree with the UK Government's BIM strategy decision to mandate level 2 BIM on all public sector projects by 2016 (Eadie, et al., 2015).

# 3. Methodology

A mixed method approach was used; 1) a literature review to identify issues and to design the online survey form, 2) A survey conducted through two Swiss FM associations with the aim of understanding and establishing a benchmark of the understanding and adoption of BIM and how it will impact on the FM industry (399 people accessed and 68 completed the survey), 3) A

focus group workshop titled "*FM and BIM in Research and Practice*" using results from the questionnaire to select topics for discussion. Three separate focus topics were discussed with the aim of establishing the information needs/outputs to inform the creation of a more FM client-orientated EIR. Topics were: (a) *FM operational:* information needed for space management? (b) *FM financial*: information needed for decision making? and (c) *FM personnel*: training/skills needed to be able to engage with the BIM process? A final focus group with all attendees then discussed, reflected and summarised the individual group findings.

Twenty participants engaged in the focus groups with stakeholders across the whole life cycle. International representation came from; UK, Switzerland, Germany, Denmark, Norway, Netherlands and the US. Participants were from professional bodies; IFMA, the Danish FM Network (DFM), the Norwegian FM (NBEF) and the British Institute of Facility Management (BIFM) Soft Landings team. FM and D&C practitioners attended from; BAM UK, BAM Deutschland AG, Mace Macro, ISS, Halter AG, eneco, Robertson FM, FES FM, Auwiesen Immobilien AG, UniversitätsSpital Zürich and Glasgow Life. Academics attended from; Zurich University of Applied Sciences (ZHAW) and the Netherlands Hanze University, Groningen.

# 4. Survey findings

There were 68 fully completed online questionnaires, a response rate of 17.04% from the 399 people who opened the survey. The respondents included stakeholders over the whole life cycle of a building: 18 planning consultants, 15 internal FM providers, 14 building owners/agents, 9 external FM providers, 3 CAFM[1] suppliers, 2 architects, 2 investors/clients, one building contractor, one procurement manager, one data manager, one surveyor and one government administration officer. The profile of company size by no of employees is shown in Figure 1. The majority, 38.2% of respondents were from companies with 1000+ employees.
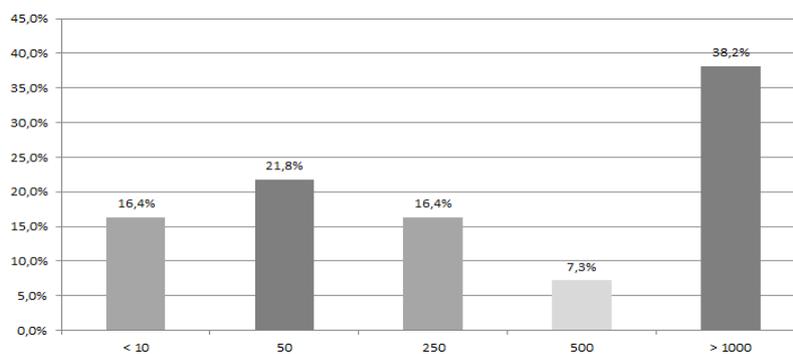


Respondents        *Figure 1: Size of company by number of employees*     down of the type and size is shown in Table 1.

*Table 1: Type and size of real estate managed by the respondents*

| Type of space | Total m2 (Gross) | Average m2 (Gross) |
|---|---|---|
| Office / administration | 7,707,293 | 296,434 |
| Laboratories / industry | 2,395,407 | 140,906 |

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[1] CAFM: Computer Aided Facility Management

| | | |
|---|---|---|
| Residential / flats | 2,008,700 | 223,189 |
| Retail | 1,818,500 | 363,700 |
| Public offices and buildings | 1,805,025 | 361,005 |
| Other | 1,759,500 | 351,900 |
| Hospital / care home | 1,730,000 | 173,000 |

They were asked about general knowledge/experience of BIM and how they perceive BIM will impact on the FM industry. With respect to experience: 41.2% had no experience with BIM, 33.8% had some, and 25% gave no answer. The majority of respondents (55.4%) as shown in Figure 2 believe BIM will have a significant impact on the FM industry within 5 years.
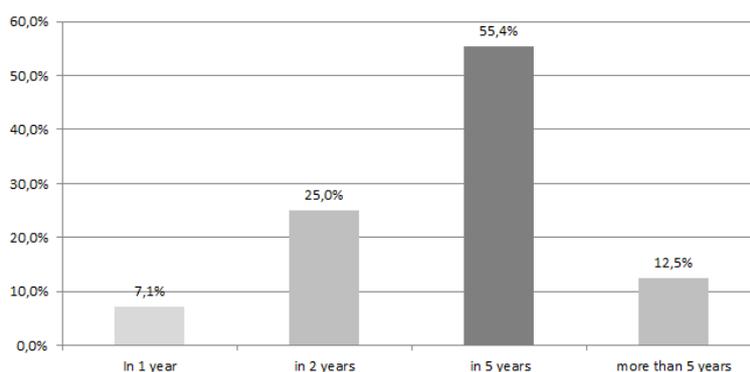


*Figure 2: Timescale for BIM to impact on the FM industry*

The respondents were then asked about their perception and understanding of BIM with a series of questions (previously used in the NBS survey). Table 2 shows their responses. A Linkert scale was applied and the mean score calculated using the numerical values (1=disagree, 2=somewhat disagree, 3=somewhat agree and 4=agree). The table scores were ranked according to the mean score.

*Table 2: Perception and understanding of BIM*

| Question/statement | Agree % | Somewhat agree % | Somewhat disagree % | Disagree % | Mean score |
|---|---|---|---|---|---|
| The FM industry is not sure what BIM actually is (n=54) | 33.3 | 57.4 | 7.4 | 1.9 | 3.22 |
| BIM is all about real time collaboration (n=53) | 26.4 | 41.5 | 17.0 | 15.1 | 2.79 |
| BIM is all about software (n=54) | 3.7 | 13.0 | 53.7 | 29.6 | 1.91 |
| BIM is for new buildings not existing buildings (n=55) | 3.6 | 14.5 | 27.3 | 54.6 | 1.67 |
| BIM is simply a synonym for 3D CAD drawings (n=55) | 0 | 7.3 | 16.4 | 76.3 | 1.31 |

Respondents were asked about their familiarity and knowledge of the Governments BIM guidelines and standards as well as the Swiss BIM guideline "SIA Merkblatt 2051 BIM" which is currently in development. The answers are shown in Table 3:

*Table 3: Knowledge and familiarity with BIM guidelines and standards*

| Guides and Standards | % |
|---|---|
| Swiss guideline SIA Merkblatt 2051 BIM (In development) | 25.0 |

| | |
|---|---|
| ISO 15686 Building and constructed assets – Life cycle costing | 13.2 |
| Other: (See below for details) | 7.4 |
| PAS 1192-2: 2013: Capital/delivery phase of construction projects using BIM | 7.4 |
| BS 1192-4: Fulfilling employers information exchange using COBie: code of practice | 5.8 |
| PAS 1192-3: 2014: Operational phase of assets using BIM | 4.4 |
| ISO 55000: 2014 Asset management | 4.4 |
| CIC BIM Standard Protocol for use in projects using Building Information Models | 2.9 |
| CIC Guide for Professional Indemnity Insurance when using BIM | 2.9 |
| CIC Outline Scope of Services for the Role of Information Management | 0 |

Other guidelines and standards the respondents were familiar with were; the Swiss "KBOB Guideline for Building Documentation in Buildings", the "Penn State BIM Planning Guide for Facility Owners", the "NATSPEC" document suite and the German "Research Initiative ZukunftBAU". Respondents were also aware of various online forums promoting BIM best practice such as the UK BIM Task Group, BuildingSMART, COBIM from Finland etc.

Respondent's perceptions of the potential benefits of BIM to FM are shown in Table 4. A Linkert scale was applied and the mean score calculated using the numerical values (1=disagree, 2=somewhat disagree, 3=somewhat agree and 4=agree). The table scores were ranked according to the mean score.

*Table 4: Potential benefits of BIM to FM*

| Potential benefits of BIM to FM | Agree % | Somewhat agree % | Somewhat disagree % | Disagree % | Mean score |
|---|---|---|---|---|---|
| Direct data transfer to FM CAFM/other systems (n=50) | 50.0 | 44.0 | 2.0 | 4.0 | 3.72 |
| Simulations e.g. energy use, fire evacuation etc. (n=51) | 47.1 | 37.3 | 15.6 | 0 | 3.61 |
| Improved transition construction to operation (n=55) | 56.4 | 30.9 | 7.3 | 5.4 | 3.58 |
| Visualisation of buildings for customers/investors (n=55) | 49.1 | 40.0 | 9.1 | 1.8 | 3.56 |
| The use of BIM may improve profitability (n=42) | 26.2 | 50.0 | 19.0 | 4.8 | 3.55 |
| Faster cost and life cycle cost estimation capability (n=51) | 41.1 | 39.3 | 15.7 | 3.9 | 3.47 |
| Improved space management (n=53) | 41.5 | 37.7 | 18.9 | 1.9 | 3.43 |
| Improved asset maintenance response times (n=52) | 36.5 | 44.2 | 11.6 | 7.7 | 3.37 |
| Reducing the cost of insurance for buildings (n=40) | 7.5 | 25% | 52.5 | 15.0 | 2.90 |
| Improved health & safety for operational FM tasks (n=47) | 10.6 | 29.8 | 42.6 | 17.0 | 2.74 |

Respondents were asked how they thought FMs could make best use of BIM to help FM. The results were ranked based on frequency of mentioning and are shown in Table 5. Respondents also identified other potential uses as: exact planning during construction, quantity surveying, data-imports for CAFM tools, business continuity and service and maintenance optimisation.

*Table 5: Ranking of possible uses of BIM by facility managers*

| Possible uses of BIM by FMs | % Response |
|---|---|

| | |
|---|---|
| Life cycle costing | 28.85 |
| Cost savings | 26.92 |
| Increasing operational efficiency | 26.28 |
| Reduction of carbon emissions and energy savings | 12.82 |
| Other | 3.21 |
| I don't know how facility management will use BIM | 1.92 |

The respondents concerns with respect to the adoption and implementation of BIM were ranked based on frequency of mentioning as shown in Table 6. Other concerns identified were: legal liabilities, early FM involvement, uncertain ROI, stakeholder buy in, familiarisation with BIM, data management and the danger of BIM creating a "data cemetery".

*Table 6: Concerns regarding BIM and FM*

| Concerns regarding BIM | % Response |
|---|---|
| The cost of implementation (time and resources) | 19.61 |
| Data management | 19.61 |
| Availability and knowledge about BIM guidelines and specifications | 15.03 |
| Basic BIM knowledge/training and its benefit to our operation | 14.38 |
| The incorporation of BIM into contracts and legal concerns | 12.42 |
| Unfamiliar technology and integration with CAFM tools | 10.46 |
| Other | 8.50 |

Respondents were asked about their perception of possible barriers to the adoption and implementation of BIM. Their responses were ranked based on frequency of mentioning and are shown in Table 7. Other possible barriers included: fear of change, people wanting to stick to traditional work practices, if we can really achieve collaborative working, needing to change existing fee systems, lack of BIM standards, ROI on BIM, lack of coordination regarding implementation of BIM in the FM industry and ongoing management of BIM models and associated data in the operational phase.

*Table 7: Possible barriers to the adoption and implementation of BIM*

| Possible barriers in the adoption and implementation of BM | % Responses |
|---|---|
| Lack of internal expertise | 23.48 |
| Costs | 21.74 |
| A lack of demand from clients | 20.00 |
| Other | 18.26 |
| BIM is not always relevant to our projects | 9.57 |
| The projects we work with are too small | 6.96 |

## 5. Focus group findings

The findings of the three separate focus groups with respect to the selected FM topics are summarised in the subsequent three sections. These are followed by key issues raised during the whole group's review of the findings and observations.

## 5.1  FM operational requirements for space management

*Space reporting*: FMs need information which allows the quick generation of tailored reports identifying all building and asset spaces by: name, type, size, volume, finishes and materials and where appropriate ownership. The space information should be delivered in a hierarchical manner with a unique and agreed "space naming system" specified by the customer. Space should be appropriately zoned to allow zoning for fire, security, rental and other purposes. Space flexibility information should be included for potential future change. The information should allow FMs to understand the quality level of the space and demands to be made on it. Ideally BIM models should link directly to CAFM tools to allow visualization of spaces and assets within the CAFM software. This will save on time in visiting spaces to address problems.

*Space inventory and cost data*: The information should include data/information on all assets within each space. Each asset should then have attached information detailing: asset/serial no, cost, life expectancy, warranty period, service costs, manufactures maintenance requirements etc. as well as who is responsible for each asset (in terms of purchase, replacement and servicing). This information should be available well ahead of building handover to allow transition planning and FMs to calculate detailed operational and replacement costs and the ability to benchmark costs and future performance, tenders and for managing projects.

*Space concepts, logistics and use*: FMs need to have a clear understanding of the design logistics planning concepts for the movement of people/equipment, access routes and space for changing pieces of plant and equipment at the point they need to be replaced. FMs need all relevant information for the planned use of buildings/assets/spaces at handover as well as how each space could be used in the future. This should include how easily spaces can be reconfigured to accommodate flexibility and change of use.

## 5.2  FM financial requirements

*Asset and life cycle cost data*: the BIM model should include all cost information for assets i.e. replacement and installation costs, life expectancy, service/maintenance costs etc. This will benefit FMs for both daily operational management as well as forward financial planning for asset replacement or refurbishment. This data should be available at the relevant data drops in the established design process (RIBA stages and COBie drops). Ideally this information should be migrated into the chosen CAFM tool by the construction contractor well before handover.

*Commercial model data*: It was acknowledged that there could be sensitivities around the issue of commercial information, but having full transparency of the builders procurement cost data will allow FMs to better understand and build their FM operational and asset replacement programmes faster and more accurately for clients.

*Cost sensitivity and design efficiency*: FMs should work closely with other stakeholders during the process as outlined in BS8536 from initial development of the EIR to identify information and concepts in the BIM process ensuring that site/building specific issues such as transport,

logistics etc. are thought through from an FM operational perspective. This will help ensure cost accuracy, less change requests and provide regular feedback mechanism for more accurate sensitivity analysis with checks made as appropriate at every stage/phase.

## 5.3  FM personnel: training and skills requirements

*BIM training*: The group reported most FMs have heard of BIM but have little or no practical experience. Members of the BIFM Soft Landings team reported that BIFM are currently working on guidance documents to help FMs develop an EIR and fully engage with the soft landings process. The FM staff should have training with respect to the BIM process and management of BIM models and associated data to ensure they can access, manage, amend and update data during the transition and operation phases. A key issue discussed was the need for FM to understand how the data will feed into CAFM / BEMS (BMS) and other FM systems. It was felt there was a risk that many of the potential benefits may not be realised due to poor training and a lack of understanding as to how the models can be used to FM advantage. If FMs are not able to interrogate BIM models there was concern about models being kept up to date.

*A FM handover training roadmap*: should be a requirement in the EIR to ensure FM teams are fully involved with commissioning at the right time and receive appropriate pre-handover training. The group reported that adequate funding, resource and time for training are often lacking in projects and regularly squeezed into unrealistic timeframes at the last minute as D&C teams struggle to meet project deadlines. The FM team need to acquire BIM skills but also should have a different attitude and approach to embrace the possible benefits of using BIM models. The FM team should have adequate training and involvement during the design process whilst the models are being developed to allow them to give their clients feedback and suggested improvements as well as becoming familiar with the models and developing the skills to use them for visualisation and other uses.

*Post Occupancy Evaluations (POE)*: FM staff should be included in the planning of POE for the Soft Landings process to ensure they understand how the BIM process and models will be used to help verify that the building is performing as per the design criteria and to understand any variations that may occur due to occupant behaviour or other factors.

## 5.4  Focus group discussion on the impact on the EIR

*Defining FM information needs/outputs*: the whole group agreed it was difficult to tie down the required information needs/outputs and when they would be needed in the BIM process.

*Guidance and templates:* the whole group felt it would be beneficial to have specific guidance and templates to help clients/FMs draft and complete an FM/client-orientated EIR.

# 6. Discussion

With respect to research question (a) *How clients and FMs engagement with the BIM workflow process can be improved through the early contemplation of their requirements*?: the research confirmed a key issue impacting on both the D&C and FM industries is both are still not sure what BIM actually is. The research found that 57.45% of FMs and clients (somewhat) agree with this. This broadly aligns with the BIM4FM survey reporting that 63.2% of FMs were uncertain if their organisations had plans to use BIM. The 2015 NBS survey shows the D&C figure even higher at 67%. The research focus group feedback highlighted "most FMS have little or no practical experience of BIM". This was backed up in the survey which indicated 41.2% have little or no practical experience of BIM. Other research from the D&C industry reports less than 4.05% use of BIM for FM operations with 54.05% never using it for FM (Eadie, et al., 2015). This is not surprising when we consider these figures together with the fact that most FMs have not yet had any significantly exposure to BIM projects and although many FMs have heard of the raft of Government BIM standards and guidelines, many have a poor understanding of the detailed content. This aligns with the focus group feedback that "as a community FM is on a sharp learning curve with respect to understanding how the BIM will impact on their FM operations".

The NBS 2015 survey reports a general increase in D&C knowledge and adoption of BIM with 75% of respondents aware of the UK Government defined levels of BIM and 59% claiming to be already achieving level 2. Other research found this figure to be 53% (Eadie, et al., 2015). Not surprisingly the RIBA Plan of Work (RIBA, 2013) was noted as the most common BIM standard/publication used by D&C organisations. PAS1192-2 (BSi, 2013) is also well known. Other research (Eadie, et al., 2015) found the most common standard was BS 1192-7. However with respect to the support of FM in the operational phase the NBS figures did not look so good. Only 12% in the D&C industry have passed on "the model to those responsible for continued management of the building". Also the use of COBie (which is essential for capturing data for FM CAFM systems) decreased slightly on the previous year with less than 1 in 5 respondents using COBie. The top 4 barriers to using BIM were (74%) lack of in-house expertise, (67%) lack of training, (63%) no client demand and (56%) cost. However "contrary to what the literature about the potential of BIM for FM, current state suggests it is rarely used with a very low figure (4.05%) (Eadie, et al., 2015). This all indicates FMs and clients need to educate themselves about the BIM process and understand how BIM standards and guidelines can be used to their own advantage in generating FM/client-orientated BIM strategies and EIRs.

With respect to research question (b) *what are the perceptions about BIM and its potential impact on the FM industry from an FM, user and client perspective?:* the time scale of 5 years seems to be a common figure. The research showed 55.4% of FMs feel BIM will have a significant impact on FM industry within 5 years. According to NBS, 95% of the D&C industry believe they will be using BIM on projects in 5 years. The figure of 5 years also ties in with other research indicating that "although BIM usage will have increased by 2016 it will not have reached the 100% level 2 stipulated by the Government" (Eadie, et al., 2015). With respect to the general perception and understanding of BIM, the focus groups and survey highlight that

although a detailed knowledge of BIM guidelines and standards is lacking most FMs were general informed about BIM basics with (41.5%) somewhat agreeing BIM is about real time collaboration. Regarding software; (53.7%) somewhat disagreed that BIM is all about software and the majority of FMs agreed BIM is not only applicable to new buildings (54.6%) and also the majority (73.6%) believe BIM is not simply a synonym for 3D CAD drawings.

Concerning the main uses of BIM by FMs the research broadly aligns with the previous BIM4FM survey findings. Life cycle management was ranked top in both research surveys. Making cost savings was ranked 2nd in the research (3rd in BIM4FM survey) and increasing operational efficiency was 3rd in the research (2nd in the BIM4FM survey). Carbon reductions were in 4th place in both surveys. Regarding the key concerns there was some alignment with the cost of implementation ranking number 1 in both surveys. However the BIM4FM survey ranked integration with current technology and CAFM as 2nd whilst this was 6th in the research survey. Training and knowledge concerns were ranked 3rd in the BIM4FM survey and 4th in the research. Data management was ranked 2nd in the research and 3rd in the BIM4FM survey.

With respect to research question (c) *what data/information is required by FMs from the BIM workflow process to maximum optimisation of assets in the operation phase;* this was more difficult to address. A few FMs were aware of the Government EIR templates but most did not have a detailed understanding. Those that did commented that the templates are not FM/client-orientated. The individual and whole group feedback demonstrated how difficult it was to identify specific FM information/outputs in a clear way that would allow succinct wording for an EIR document. It was felt further research work is required in this area and it was hoped the development of new templates for BIM strategies and EIR documents by BIFM and Government bodies will help FMs in creating "client-orientated" EIR documents.

# 7. Conclusions

The research indicates that although BIM is rapidly becoming the norm in the D&C industry, the majority of FMs and clients do not yet have a thorough knowledge of the available BIM guidelines, standards and workflow processes and few have any practical experience of BIM. There is a need to further educate the FM industry to address the potential growing knowledge gap between the D&C and FM industries. To help achieve this further research should investigate the development of FM/client-focused BIM strategies and EIRs. FMs should engage early in the D&C process, and assume ownership of the EIR on behalf of their clients to ensure client and FM information needs are adequately addressed. This will help ensure the right information is delivered and structured in the right way to use in existing FM CAFM systems. There is a real danger that if these issues are not addressed many of the potential benefits of BIM may remain unrealised in the operational phase, especially if information from the BIM process ends up in a data cemetery due to a lack of BIM knowledge and skills in the FM industry.

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