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## **Critical success factors for facility management employer's information requirements (EIR) for BIM**

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### **Abstract**

**Purpose:** This paper aims to describe the development and testing of an employer's information requirements (EIR) template and guidance document designed to meet client and facility management (FM) needs in the building information modelling (BIM) process.

**Design/methodology/approach:** A qualitative design approach was used and triangulation of methods which included a focus group with the British Institute of Facilities Management (BIFM), semi-structured interviews with the case study Glasgow Life Burrell Renaissance Project who trialled the EIR and peer-reviews and interviews with BIM/CAFM experts from the BIM Academy and FM180.

**Findings:** Specific guidance to help clients and facility managers prepare key BIM documents like the EIR are needed. They are aware of industry BIM standards and guidance but often not in detail. The Glasgow Life case study illustrated the EIR as a useful collaboration-tool to bring together stakeholders in early planning stages to understand client information needs.

**Social implications:** Assets and buildings account for most of the energy and material use in society. A well-structured EIR will help ensure the right information is available to enable optimisation of running costs and utility-use over their whole life, thus contributing to long-term sustainability.

**Originality/value:** This paper provides a new EIR template and guidance document ideal for practitioners in industry as a practical starting point to plan the client information requirements for BIM projects. It can be downloaded at <https://www.iwfm.org.uk/professional-development>

**Keywords:** Facilities management, Building information modelling, Operational information requirements, Asset information requirements, Employer's information requirements, Asset information model

## 1. Introduction

The building industry is the second largest in the world after agriculture and buildings and assets are fundamental to the success of society (Brand, 1995). He observed they contain our lives and all civilisation and office buildings are now the largest capital asset of developed nations and employ over half of their workforce. Consequently, achieving buildings and assets, which perform well offers the potential for countries to realise significant value in economic, environmental and sustainable value terms (Ashworth, 2013).

The adoption and use of BIM by the construction industry across the world has snowballed in the past few years. It is clear BIM will change the way we procure, design, build and operate our facilities and premises across the world. According to National Building Specification (NBS) in the UK construction, industry awareness is near universal, with 97 per cent people now aware of BIM (NBS, 2017). Professionals from the disciplines of architecture, construction and design (AEC) and FM are moving beyond seeing BIM as a technology, or a process, and instead are seeing it increasingly as a mind-set for the entire built environment. In the bigger picture, it is clear that facility managers have a crucial role to play, as they are responsible for managing such assets when handed from construction to operation. This recognition has brought the role of FM in the BIM process more into focus with the appreciation that early involvement is crucial for the success of delivering long- term sustainability in the built environment.

The role and utilisation of BIM within the FM industry is a hot topic of debate. Findings by Ashworth and Tucker (2017) in the BIFM survey '*FM Awareness of BIM*' highlights disparities across specific organisations, business sectors, industries and indeed countries regarding the level of sophistication and maturity with respect to BIM and its adoption and use. The findings show positive perception of BIM; 91.7 per cent of respondents "had heard of BIM", 83.5 per cent "believe BIM will support the delivery of FM" and 74 per cent "believe BIM will have a significant impact on the FM industry". However, 72 per cent also indicate the "FM industry is not really clear what BIM is" and 67.7 per cent disagree or strongly disagree that "the FM industry is well prepared to deal with BIM projects".

With respect to important documents such as the EIR in the BIM process, this presents a challenge. People are often unclear where to start and report feeling overwhelmed by the amount of information they need to read to get to grips with the fundamentals and clearly understand their role. This might be reflected in facility managers often not been integrated into projects early and reflects findings from Tucker and Masuri (2016, p. 341) "FM has been given a low priority in the property development industry, resulting in facilities managers being inadequately integrated into the development process".

Figure 1 indicates the numbers of people who have practical experience or knowledge of writing or implementing key documents required at the start of the BIM process, i.e. asset management strategy, the OIR, AIR and EIR is generally low. This indicates more work needs to be done to ensure people are better prepared for engagement in BIM projects and raises wider concerns in terms of BIM education and training for FM professionals, who should be representing the client's needs and driving the creation of an FM orientated EIR with clients at the start of BIM projects.

RESPONDENTS WERE ASKED IF THEY HAD ANY EXPERIENCE OF PREPARING OR USING A RANGE OF KEY DOCUMENTS USED IN THE BIM PROCESS. FEEDBACK WAS AS FOLLOWS:

	HAVE WRITTEN AND IMPLEMENTED	HAVE IMPLEMENTED BUT NOT WRITTEN	KNOW OF BUT NOT IMPLEMENTED/WRITTEN	NO EXPERIENCE
Asset Management Strategy (e.g. ISO 55000 or other)	12.2%	8.3%	38.2%	33.1%
BIM Strategy	17.3%	9.4%	34.6%	30.3%
Organisational Information Requirements (OIR)	15.0%	9.4%	33.1%	34.3%
Asset Information Requirements (AIR)	18.9%	12.6%	31.5%	28.7%
Employers Information Requirements (EIR)	20.1%	10.2%	26.4%	35.0%
BIM Execution Plan (BEP)	12.6%	8.7%	30.7%	39.8%

8.3% of respondents did not answer this question

Figure 1. Experience of key documents in the BIM process (Ashworth and Tucker, 2017, p7)

This paper addresses a key element of this pressing problem: providing guidance on preparing a client and FM orientated EIR. The aim was to publish an EIR Template and Guidance document in partnership with the BIFM, Liverpool John Moores University and the Institute of Facility Management at Zurich University of Applied Sciences, Switzerland to help FM and other professionals starting to draft an EIR. The process and key lessons learnt from developing the EIR and testing it in a case study are presented. The research and final EIR is now available to the 14,000 BIFM worldwide members and downloadable from their website.

## 2. Facility management and building information modelling

Research by Eastman et al. (2011) and Eadie et al. (2013) indicate the main beneficiaries of BIM are ultimately clients and end users. The operational phase of the whole life cycle (WLC) offers the largest opportunity for delivering value in terms of cost savings, sustainability and usability of assets cost of assets. Akcamete et al. (2010) note that the operational costs of a building equate to 60 per cent of the overall costs of a project and the potential benefits of using BIM for facility operations are compelling. Another good reason is waste. Gallaher et al. (2004) estimated potential annual savings in the US facilities industry of \$67m with respect to wasted time recapturing and transferring information provided by architects, engineers and contractors and \$613m with respect to the automated transfer of information into available CAFM tools.

Real estate (RE) sector clients are becoming more aware of the possible benefits to their operation and strategic planning if their RE portfolio could be digitised. Meslec et al. (2018) note that BIM also has great potential to improve sustainable buildings when integrated with life cycle costing and life cycle assessment methods. Tucker and Masuri (2018) also note BIM can support FM and sustainability by identifying the most effective opportunities for improving the implementation of green buildings and carbon reduction.

BIM also has the potential to deliver real value in relation to whole life costs as up to 80 per cent of the operational cost of an asset are influenced in the first 20 per cent of the design process (ISO, 2017). Including FM expertise in the early stages of the BIM process can also help avoid expensive mistakes, which can have long lasting operational implications (Ashworth, 2013). This would seem to indicate FM and client involvement should be obvious. However, Akcamete et al. (2010) highlight a worrying trend; utilisation of BIM during building operation and maintenance is falling behind the BIM implementations for design and construction. If clients and facility managers do not engage and define their requirements clearly in the BIM process, many of the potential benefits and savings may not be fully realised in operation.

An often-quoted expression when hearing people talk about BIM is to “start with the end in mind”. This could be thought of as thoroughly understanding the organisations needs before starting. BIM has the potential to deliver models, data and information in a way that will add real value to support clients in the ongoing management of their assets. This information can be used to optimise assets to support the organisations wider vision, mission and strategic objectives. However, as Holzer (2015) notes if clients and facility managers do not give the project supply chain clear and well-communicated deliverables this may lead to clients feeling they did not get what they expected from BIM.

Wills et al. (2018) note that when BIM has the potential to significantly help both the AEC and FM industries to meet common sustainability objectives. In 2011, the UK Government recognised BIM as a key element of its Construction Strategy (Cabinet Office, 2011) to help achieve wider economic and sustainability targets and decided to mandate BIM for all UK government projects as of April 2016. Their strategy also sets out challenging reduction targets in their Construction 2025 Industrial Strategy (HM Government, 2013), namely:

- 33 per cent reduction in the initial cost of construction and the whole life cost of built assets;
- 50 per cent reduction in overall time, inception to completion, for newbuild and refurbished assets;
- 50 per cent reduction in greenhouse gas emissions in the built environment; and
- 50 per cent reduction in the trade gap (total exports/imports) for construction products and materials.

With respect to how these will be achieved, the NBS believe “BIM and data will continue to play a large part in sector transformation and the achievement of these goals” (NBS, 2017, p. 4). Ashworth and Tucker (2017) highlight the FM industry perspective; 66.1 per cent of respondents believe BIM will help the cost target and 54.3 per cent the overall time target. However, the respondents were less confident about the sustainability (40.2 per cent) and trade targets (20.9 per cent).

Digitalisation of the built environment sector is now key to government construction strategy; “all central government departments must now tender with suppliers to demonstrate collaborative 3D Level 2 BIM maturity through defined and compliant information and data on projects” (BSi, 2016a, 2016b). The Construction Strategy 2016- 20 notes:

“advances in digital technology have created opportunities for increased productivity and efficiencies in construction and the operation of assets. Utilising digital technology has been shown to facilitate collaborative approaches to drive innovation and reduce waste (The Infrastructure and Projects Authority”, 2016, p. 6).

Ashworth et al. (2016a) suggest a key success factor in achieving the expectations from BIM is that clients and facility managers are actively involved early in the BIM process. This is essential to define what they really need at hand over and to manage expectations. One of the key challenges is the BIM process itself, which involves many acronyms: OIR, AIR, EIR, PLQ, AIM, etc. Understanding what they all mean and how they come together can at first seem a bit confusing and daunting. When thinking about ‘starting with the end in mind’ the authors like to use the analogy of completing a jigsaw puzzle. One needs to have all the pieces and a strategy to bring them successfully together to be able to see the big picture. The strategy and jigsaw pieces are like the various “information requirements” in the BIM process (OIR, AIR, EIR, etc.) and it is important to understand their interdependencies. These are well illustrated in the Figure 2 below taken from the standard PAS 1192-3 (BSi, 2014a, p. 9) which shows the “relationship between elements of information management”.

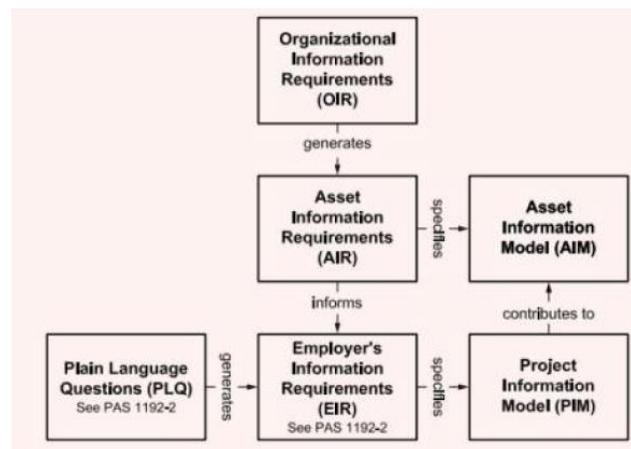


Figure 2. Relationship between elements of information management (Bsi, 2014a, p9)

Dawood and Vukovic (2015, p. 1) describe the need to think about information over the WLC noting “WLC information flow is defined as the steady and continuous evolution and use of BIM information and knowledge from the design stage, through the construction stage, to the facility management stage”.

One of the fundamental jigsaw pieces and principles of achieving BIM level 2 information modelling is the provision of a clear EIR. The PAS 1192-2:2013 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” (BSi, 2013, p. 4). It also notes the “EIR should be incorporated into tender documentation to enable suppliers to produce an initial BIM Execution Plan (BEP)” (p. 10). The aim is to ensure user’s information needs are clearly defined at the start of the BIM process. It also provides a mechanism for collaboration allowing project stakeholders to communicate, manage and deliver client’s requirements. Hafeez et al. (2016, p. 199) note a successful BIM project requires a clear EIR that sets the processes and standards to be adopted by the suppliers throughout the project life cycle. This sets out why the EIR is so important. However, Dawood and Vukovic (2015, p. 6) note that “lack of in-house expertise is one of the key barriers to BIM adoption”. Mayo et al. (2017) also observe that a critical success factor to the increasing use of BIM is acquiring a competent workforce that will have the desired BIM knowledge, skills and abilities (KSAs) to perform the required job tasks.

There is a gap in research specifically addressing the important issue of the role of facility managers and clients in ensuring their organisations have the fundamental elements in place at the start of the BIM process, namely, the OIR, AIR and EIR. Research needs to focus on establishing how support can be given to clients and facility managers to help them develop well thought through OIR, AIR and EIR which align with their wider asset management strategy. If well communicated this will ensure the design and construction supply chain can deliver the right information to meet their needs.

### 3. Methodology

The research design used a qualitative approach, triangulating several research methods. The authors decided this was appropriate as the project required different research methods for separate parts of the research. Saunders et al. (2009, p. 146) also observe “Triangulation refers to the use of different data collection techniques within one study in order to ensure that the data are telling you what you think they are telling you”. Denzin (1970) suggested that using the strategy of triangulation in the early stages of research was becoming more common to try to ensure more secure results. Creswell (2014, p. 201) also suggests triangulation can be used as a validity strategy by examining “evidence from different sources and using it to build a coherent justification for themes. If themes are established based on converging several sources of data or perspectives from participants, then this process can be claimed as adding to the validity of the study”.

#### 3.1 Research design

The overall research design and methodology approach is shown in Figure 3. A brief description follows of the selected methods and justification for their use for the development and testing of the EIR.

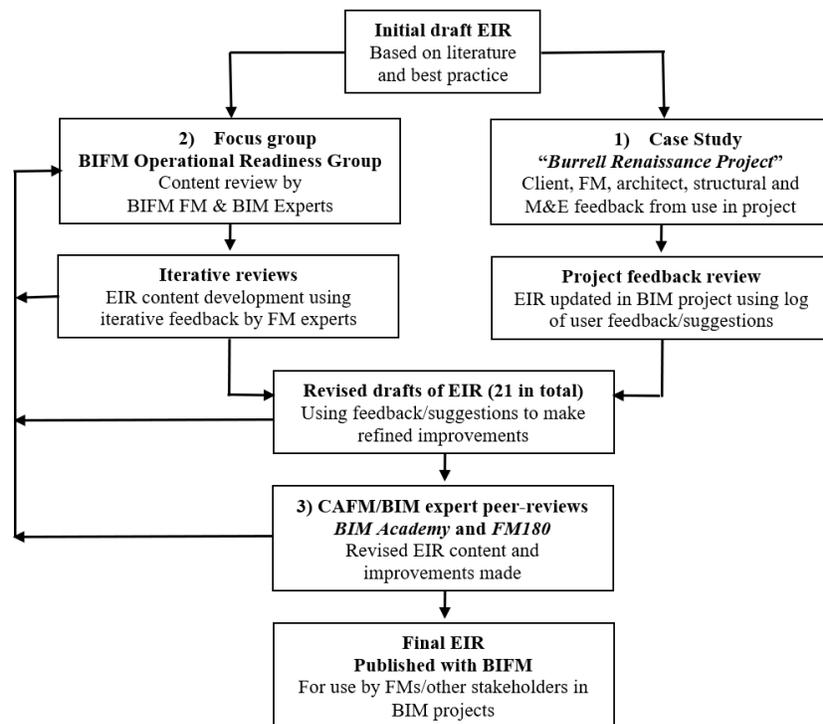


Figure 3. Methodological approach to developing the EIR

During the process, a series of “key topics” (themes) were identified. Against each, the key “issues raised” and “actions taken” were mentioned for each method; the focus group, case study interviews and the peer-reviews were then recorded. These are shown respectively in Tables II, III and IV.

### 3.2 Team members and interviewees

A total of 15 people were involved as shown in Table I. In total, seven interviews were held; five from the case study, one FM consultant from BIFM and one BIM/CAFM expert.

Table 1: Team members and interviewees by stakeholder group

Stakeholder group	Key role	Focus Group (8)	Case Study (5)	Peer review (2)	Interviews (Total = 7)
Client/FM	Client – asset/information needs	1	2		2
FM Consultants	FM - information needs	5			1
Architect	Design - architectural input		1		1
Structural Engineer	Design - structural input		1		1
M&E Engineer	Design - M&E input		1		1
BIM/CAFM Expert(s)	BIM/CAFM - compliance			2	1
Academic/researcher	BIM/EIR/FM - research input	2			

### 3.3 Literature review

A review of literature, relevant industry BIM standards and guidelines focussed on the role of facility managers in the BIM process and their role in production of the EIR. Publicly available EIR examples were reviewed including the BIM Task Group’s EIR (BIM Task Group, 2013), the NHS Scotland EIR for BIM (NHS Scotland, 2015) and University of Cambridge EIR (University of Cambridge, 2015). However, the authors felt they all were not particularly orientated towards the needs of clients and facility managers. It was decided to draft a new EIR template and guidance document focussing specifically on the needs of the client and test this in a case study BIM project.

#### 3.3.1 Focus group reviews.

Levy (2015, p. 380) suggests focus group discussions (reviews) can be a “useful method commonly used to gather data, especially when the researcher is interested in the outcomes of brainstorming sessions and is not worried about the effect of others in a small group in influencing”. Eight members from the BIFM Operational Readiness Steering Group made up the members of the focus group. Their task was to jointly develop the EIR draft content and then make suggestions for improvements through a process of iterative reviews. Regular focus group meetings were organised (by conference call, moderated by the authors) to review feedback/suggestions for improvement. New EIR versions were issued between meetings allowing time to review amendments and provide further comments using the MS- Word track-changes function.

### **3.3.2 Semi-structured (non-standardised) interviews.**

Saunders et al. (2009, p. 321) suggest data collected from interviews can help to “not only reveal and understand the ‘what’ and the ‘how’ but also to place more emphasis on exploring the ‘why’”. They also note interviews offer the opportunity “to collect a rich and detailed set of data” (p.3 24). Marshall and Rossman (1999) note findings derived from using non-standardised research methods are not necessarily intended to be repeatable since they reflect reality at the time they were collected. However, to help the research procedure an interview guideline procedure was designed in line with recommendations made by Saunders et al. (2009, pp. 318-359) which helped structure data capture in an organised way. They note the use of semi-structured interviews as a good way to “probe answers, where you want your interviewees to explain, or build on, their responses” and that “the result should be that you are able to collect a rich and detailed set of data” (p. 324).

Interviews were held with various project stakeholders (see Table I) to capture ongoing feedback on the EIRs usability. These were then fed into the focus group reviews. Interviews included key members from the client and design and construction teams in the case study “Glasgow Life Burrell Renaissance BIM project” who had trailed the EIR in practice. Prior to interviews the client/FM team circulated the draft EIR to the design team for initial feedback and suggested changes were tracked in a change-log. These suggestions were then discussed in the interviews and also passed to the focus group for review, discussion and incorporated into the ongoing EIR development as appropriate.

### **3.3.3 Peer reviews/debriefing interviews.**

Creswell (2014) suggests this approach as a validity strategy. It involves having “a person (a peer debriefer) who reviews and asks questions about the qualitative study so that the account will resonate with people other than the researcher” (p. 202). This was done using subject matter experts from two well respected organisations with experience of BIM projects and CAFM applications, the BIM Academy based in Newcastle and FM180 based in Harrogate.

## **3.4 Triangulation**

All feedback was triangulated in an iterative process to further refine the EIR document. A final review was then carried out with the focus group. In total, 21 iterations were reviewed over a nine-month period whilst the research project was running. The EIR document was then finalised and was officially published by the BIFM as part of a suite of BIM guidance documents for FMs in August 2017.

## **4. Findings**

The key topics, issues (critical success factors or CSF) raised and the actions taken to iteratively improve the EIR via the three various methods are summarised in the following Tables II to IV.

Table 2: Focus group feedback and issues raised

Key topics	Issues raised	Action taken
FM/Client orientated EIR	Group members agreed there was a clear need to develop an FM/client orientated EIR to address their needs.	The EIR was written and developed from the perspective of the client and FM with the aim of meeting their needs in a BIM project.
Need for guidance on use of the EIR and other BIM guidance documents	Early versions had a mix of general guidance and template text.  Also, there was a feeling additional general BIM guidance documents should be provided to help FMs and clients understand how to engage in a BIM project and prepare/use the EIR.	The EIR template was restructured to move all guidance to a guidance section at the start which can be removed on formal issue.  The BIFM also now plan further support documents to help get an overview of the BIM process. These are in development and listed in the conclusion section.
Use and reference to existing BIM standards/guidance	In order to be successful, the group agreed the “EIR should make reference to existing BIM standards/guidance” and not attempt to “re-invent the wheel”.	BS and PAS BIM standards as recommended by the BIM Task group were used throughout the development of the document and are listed in Appendix B.
Level of Definition (LOD)	There was confusion regarding the term LOD used in the BIM process and if the D referred to Definition, Detail or Development.	It was agreed to use the NBS “Level of Definition” reference as this is actively being used in industry as best practice guidance. The NBS LOD are included in appendix E.
Viewing BIM models and Training	How will FMs view BIM models and get training to understand how to access and use the data in practice.	The EIR includes explicit sections to address how BIM models will be viewed. Training requirements is also addressed as a key topic
Asset Data	How to present the client’s needs over the RIBA stages with respect to asset data. Early versions had long lists of tables for each RIBA stage. This was seen as useful but expanded the document considerably.	The decision was taken to remove the tables and use an Excel sheet for the “Information delivery schedule for maintainable assets”. The MOJ publicly available example was suggested as a good reference (appendix C).

#### 4.1 Generalisations and observations regarding the critical success factors and actions taken

Referring to feedback during the interviews, the following generalisations were made. There were varying levels of direct BIM experience; the case study client had none, whilst the facility manager had worked on one BIM project – Glasgow Life’s Kelvin Hall. Interviewees all agree BIM will have a significant impact on the FM industry but the time period for this impact to be felt by the FM industry varied between “it is having a significant impact now” up to “the real impact will be felt over the next ten years”. All the case study stakeholders agreed there is some way to go before all parties are up to speed on the BIM process. However, it was interesting that for both the focus group and case study, the EIR was seen by all stakeholders as a collaborative tool, which could be used to help a project team get up to speed on the BIM process. There was also no clear idea of what content should be in an EIR. This reflects findings by Ashworth and Druhmman (2015, p. 50) who note “communication is key and that more education is needed about BIM across all stakeholders with better case study history, especially with respect to ROI and the range of benefits for FM”.

“Having a good understanding of BIM standards”, “early and active engagement with the BIM process” and “understanding how the EIR should be used at the start the BIM process” were seen as key issues that

need to be addressed if real value is to be delivered in the operation phase. There was general agreement by all interviewees that the EIR would help benefit not only FMs and clients but also design teams and contractors by giving clear direction to the supply chain regarding the client's information needs. However, they also indicated that clients would need to take the time to create a quality EIR and not use the template with a "copy-paste mentality".

#### **4.2 Final EIR template and guidance**

The document runs to 69 pages and is available at [www.bifm.org.uk/bifm/knowledge](http://www.bifm.org.uk/bifm/knowledge). Table V shows an overview of the level of detail and topics covered by the final document with the overall structure of the FM and client orientated EIR. A lot of general information was also moved to eight concentrated appendices (not shown below) to help make the document easier to read.

### **5. Discussion**

The research findings helped identify critical success factors during the interviews. These indicate that facility managers generally perceive BIM as potentially delivering significant benefits to the FM industry. This aligns with the findings of the "FM Awareness of BIM" survey, which found that 74 per cent of respondents believe "BIM will have a significant impact on the FM industry" (Ashworth and Tucker, 2017). However, the introduction of BIM has not been without its challenges. The interviews revealed some practitioners (across various disciplines) were sometimes struggling to familiarise themselves in depth with all of the BIM standards, terminologies and clarity around roles and responsibilities in the overall BIM process.

Table 3: Case study feedback and issues raised

Key topics	Issues raised	Action taken
EIR template used as a starting point for client and FM to develop EIR and define roles and responsibilities of stakeholders	The client and FM had little BIM experience. Initially they thought they could simply “ask for a BIM level 2 project and the supply chain would deliver what was needed”. They were “unsure how to start the EIR” and “having a template was great help to kick-start the process”. It “helped them define roles and responsibilities”.	The EIR template has been structured to offer FMs, clients and other stakeholders a starting point to create an EIR. However, it makes clear the client needs to tailor the EIR to their own BIM project. The guidance makes it clear that the client should start by understanding their own OIR, AIR and using PLQ to help prepare an EIR at the start of the BIM process.
Complexity and ease of reading	The early EIR draft used in the case study was seen as trying to provide guidance and also a template. This was seen as helpful but also potentially confusing as it was not clear what to leave in and take out.	The EIR was reorganized to include a guidance section at the front of the EIR template. This can be later removed after the draft has been developed and is ready for formal issue in the BIM project.
Appendices	The early draft was seen as good but it was suggested it could be made better by moving some elements to the appendices.	Eight appendices (A-H) were implemented to help make the document easier to read. These can also be edited out if required.
Knowledge and use of existing BIM standards/guidance and	Some people felt it seemed like “walking through a minefield” trying to “understand all the BIM standards/guidance”. Simpler and more specific guidance was seen as needed to help FMs and clients engage. Surprisingly BS 8536 was not referred to at all by stakeholders in practice.	The EIR is one of a suite of documents being worked on by BIFM to help FMs get guidance which focuses specifically on their needs.  The EIR points clients/FMs towards using BS 8536 and other useful standards/guidance which are listed in appendix B.
BIM terminology such as OIR, AIR and EIR	The project team refer to the EIR but do not use the terms OIR and AIR. They refer to a project Master Plan.	The terms OIR and AIR are explained in the EIR and guides are planned to provide practice examples by BIFM in 2017.
COBie and the transfer of data to CAFM systems	COBie <sup>1</sup> was understood by all stakeholders as “a key part of the plan to transfer data into Glasgow Life’s management systems” (including yet to be defined CAFM). However, there was concerns regarding the LOD with respect to COBie data to be provided by the design team in the early design stages.	The EIR includes COBie as part of the strategy for data transfer. Stakeholders are advised to use BS 1192-4 (BSi, 2014b). Guidance notes advise the client to consider in the EIR how the LOD is developed for COBie drops and tailored to individual project needs. (as these could change specific to a project).
BIM as a collaborative tool.	The EIR was generally very well received and is being used as a tool to encourage collaborative working as everyone gets up to speed with BIM.	The EIR can be issued as a draft document for discussion with stakeholders. Questions and issues can be raised and addressed before a final version is formally issued.
Alignment with the RIBA PoW	The initial EIR did not fully align with the RIBA stages which caused some confusion.	The EIR was revised to ensure full alignment with the 2103 RIBA Plan of Work and use the industry standard approach.
Multiple stage EIR	There was some debate as to if two EIRs would be issued. One to the design team and then one for main tendering purposes.	It is recognized that depending on the project procurement route the EIR might be tailored to suit a specific project requirement.

Table 4: External peer review feedback and issues raised

Key topics	Issues raised	Action taken
Clarity and complexity of the EIR	The EIR was seen as “good but fluffy”. As a “document issued as part of a contract the EIR needs to be clear and specific”.	The EIR was reviewed to remove any unnecessary wording or sections which were considered ambiguous.
Guidance vs. Template	Early versions were seen as trying to provide too much guidance whilst at the same time attempting to be a EIR template	Guidance notes were moved to a single section at the front of the template which can be later deleted prior to contract issue.
Client responsibility to define expectations	Initial drafts did not put enough emphasis on the client responsibility to provide the supply chain with clear requirements which were unambiguous.	The EIR was amended to emphasis the need for clients to take ownership of the EIR and ensuring clear requirements for the supply chain to use for BEPs and tender pricing.
Model ownership	The CIC BIM protocol <sup>1</sup> should be used as an industry recognized best practice document to address model ownership.	The EIR section on model ownership was amended to point clients towards using the CIC BIM protocol as part of the EIR.
Using best practice public domain documents	It was recognized that best practice should be referred to where possible. The MOJ released some examples of support documents for the BIM process were recommended as reference documents.	The EIR appendices point to using the MOJ references for both a list of the “PLQ” and a development table “information delivery schedule for maintainable assets”.

A survey of ‘*BIM and FM in Switzerland*’ by Ashworth and Bryde (2015) found there is a need for further education and training to allow FM and other stakeholders to fully acquaint themselves with the BIM process. Ashworth and Tucker (2017) in their research noted 91.3 per cent of respondents strongly agree or agree that “facility managers would benefit from more BIM Familiarisation to help clearly define what they want in terms of outputs from the BIM process”. With respect to key concerns relating to BIM adoption and use respondents highlighted training as a key issue, 71.7 per cent were concerned about “BIM training and how facilities managers will access data in 3D models at handover” and 68.1 per cent about “lack of training and cost of training associated with BIM”.

To try and help industry, the government has supported the development of freely available standards and guidance available through websites such as the ‘*Centre for Digital Built Britain*’ (hosting the old BIM Task Group content) and “BIM Level 2”. However, the findings from the interviews and the case study indicate that people are often overwhelmed by the sheer volume of information and do not know where to start when they need to prepare an EIR. This was evident in the worrying lack of reference to key “soft landing” documents to FM in the BIM process, i.e. BS 8,536 documents: Part 1 (BSi, 2015) and Part 2 (BSi, 2016a, 2016b) for briefing for design and construction (FM and asset management). This aligns with other survey findings; the National BIM Report 2017 reports just 11 per cent of organisations using the BS 8536 series and the FM Awareness of BIM survey by Ashworth and Tucker (2017) reported 40.6 per cent of respondents were not aware of Part 1 and 45.3 per cent were not aware of Part 2. This need for training and upskilling is reflected as a key requirement of the Construction Strategy 2016-20, “to realise the full benefits of BIM Level 2 departments need to develop the skills, experience and capability around BIM” (The Infrastructure and Projects Authority, 2016, p. 7).

Interviewees also noted an issue around the lack of reference document examples underpinning the BIM process, namely, the OIR, AIR and EIR. The lack of understanding around these documents is a significant problem as both PAS 1192-2 (BSi, 2013) and PAS 1192-3 (BSi, 2014a) note that the BIM process should start with a clear understanding of the client's OIR and AIR. The bottom line seems to be that people are aware they need to plan for what information is needed at the point of handover but do not know how to start. This aligns with research from Dawood and Vukovic (2015, p. 2); they note a framework is required to enable the "whole lifecycle information flow underpinned by BIM". However, it is not just about information as they observe the success of BIM depends on four pillars: processes, technology, policy and people.

The research will help the process pillar in terms of providing an EIR Template and Guidance document, which practitioners can easily use and adapt. A critical success factor highlighted by the research was it is the people and their knowledge of the process, which is key to success of the BIM process. Dawood and Vukovic (2015) sum this up as the people pillar, which requires training, competency assessment standards for both, people and organisations leadership, teamwork, etc. They observe that the people pillar cuts across all three other pillars, as technology, processes and policy will not operate properly unless well trained and developed human resource are available. The people pillar also includes "knowledge" as highlighted Carbonari et al. (2015, p. 65) suggesting "in order to maximise operational time and cost savings and deliver the potential cultural benefits facility managers and other key stakeholders need to bring the benefit of their knowledge into the process in to deliver maximum added value".

## **6. Conclusion**

The main lessons and critical success factors from the research project are summarised as follows:

- Trying to fully understand and comprehend the BIM process is not easy due to the amount of information individuals need to read, understand and internalise.
- BIM requires a paradigm change in thinking by all stakeholders with a focus on improved planning of client future information needs right from the start of a project.
- Many stakeholders are not sure where to start when it comes to preparing an EIR.
- The FM industry would benefit from a framework of easily digestible guidance documents specific to FMs and client needs.

For the BIM process to deliver the benefits, clients and facility managers want well thought through OIR and AIR need to be in place from the start, which are clearly linked to the organisations asset management strategy. This will allow the successful production of an EIR, which genuinely addresses the organisation's needs. It is critical that facility managers and clients acquire the skills to fully engage in the BIM process and create an EIR that clearly states their information needs and which the supply chain can act on. A key finding from the research with respect to preparing an EIR is that practitioners are looking for good reference examples and guidance. The research has provided such a document and has tested in a real-life BIM project as a case study. Based on the findings further BIM guidance is now being developed and provided by the researchers and other BIFM members through a suite of BIM guidance documents available at [www.bifm.org.uk/bifm/knowledge/resources/BIM](http://www.bifm.org.uk/bifm/knowledge/resources/BIM).

The interviews revealed the need for such guidance and interestingly also referenced the UK Ministry of Justice which has produced a similar framework of BIM documents (Ministry of Justice, 2016). This indicates there is a significant audience who are waiting for such reference examples specifically with their needs in mind. This also aligns with observations by Tucker et al. (2017, p. 390) who note “there is a need to establish a set of guidelines that explain the qualities required to enable the facilities manager to be regularly involved in the property development industry and consequently optimise the value of FM in all stages of the development process”. Ongoing research work is planned with the BIFM in 2018 to consider guidance documents for practitioners for preparing the OIR and AIR. The authors also recommend that further research might consider looking at contractually issued EIRs with their respective BEPs to see how they align and to consider further reviews with practice to help improve the current BIFM template.

## References

- Akcamete, A., Akinci, B. and Garrett, J. (2010), Potential Utilisation of Building Information Models for Planning Maintenance Activities, Nottingham University Press, Nottingham, pp. 8-16.
- Ashworth, S. (2013), “Added value of FM know-how, in the building whole life process”, 12th EuroFM Research Symposium, Prague, Czech Republic, available at:  
[https://www.researchgate.net/publication/273258095\\_Added\\_Value\\_of\\_FM\\_Know-how\\_In\\_The\\_Building\\_Whole\\_Life\\_Process](https://www.researchgate.net/publication/273258095_Added_Value_of_FM_Know-how_In_The_Building_Whole_Life_Process)
- Ashworth, S. and Bryde, D. (2015), “BIM and FM in Switzerland: a survey of the perception of BIM by FM professionals in Switzerland”, available at:  
[https://www.researchgate.net/publication/278675722\\_BIM\\_and\\_FM\\_in\\_Switzerland\\_A\\_survey\\_of\\_the\\_perception\\_of\\_BIM\\_by\\_FM\\_professionals\\_in\\_Switzerland](https://www.researchgate.net/publication/278675722_BIM_and_FM_in_Switzerland_A_survey_of_the_perception_of_BIM_by_FM_professionals_in_Switzerland) (accessed 13 December 2017).
- Ashworth, S. and Druhmann, C. (2015), “Integration of FM and asset management expertise in digital 3D building models”, 7th International Facility Management Congress, Vienna, available at:  
[https://www.researchgate.net/publication/279036681\\_Integration\\_of\\_FM\\_and\\_asset\\_management\\_expertise\\_in\\_digital\\_3D\\_building\\_models](https://www.researchgate.net/publication/279036681_Integration_of_FM_and_asset_management_expertise_in_digital_3D_building_models)
- Ashworth, S. and Tucker, M. (2017), “BIFM FM awareness of building information modelling (BIM): august 2017”, available at:  
[https://www.researchgate.net/publication/319159345\\_FM\\_Awareness\\_of\\_Building\\_Information\\_Modelling\\_BIM\\_August\\_2017](https://www.researchgate.net/publication/319159345_FM_Awareness_of_Building_Information_Modelling_BIM_August_2017)
- Ashworth, S., Tucker, M. and Druhmann, C. (2016a), “The role of FM in preparing a BIM strategy and employer’s information requirements (EIR) to align with client asset management strategy”, 15th EuroFM Research Symposium, Milan, available at:  
[https://www.researchgate.net/publication/301776904\\_The\\_Role\\_of\\_FM\\_in\\_Preparing\\_a\\_BIM\\_Strategy\\_and\\_Employer%27s\\_Information\\_Requirements\\_EIR\\_to\\_Align\\_with\\_Client\\_Asset\\_Management\\_Strategy](https://www.researchgate.net/publication/301776904_The_Role_of_FM_in_Preparing_a_BIM_Strategy_and_Employer%27s_Information_Requirements_EIR_to_Align_with_Client_Asset_Management_Strategy)
- BIM Task Group (2013), “Employer’s information requirements: version 07 28.02.13–core content and guidance notes”, available at: [www.bimtaskgroup.org/wp-content/uploads/2013/04/Employers-Information-Requirements-Core-Content-and-Guidance.pdf](http://www.bimtaskgroup.org/wp-content/uploads/2013/04/Employers-Information-Requirements-Core-Content-and-Guidance.pdf) (accessed 17 November 2017).
- Brand, S. (1995), How Buildings Learn; What Happens after They’re Built, Penguin Books, New York, NY.

- BSi (2013), “PAS 1192-2:2013 specification for information management for the capital/delivery phase of construction projects using building information modelling”, available at: [www.bsigroup.com](http://www.bsigroup.com) (accessed 4 December 2017).
- BSi (2014a), “PAS 1192-3:2014 specification for information management for the operational phase of assets using building information modelling”, available at: [www.bsigroup.com](http://www.bsigroup.com) (accessed 4 December 2017).
- BSi (2014b), “BS 1192-4:2014 collaborative production of information. fulfilling employer’s information exchange requirements using COBie”, Code of practice, available at: [www.bsigroup.com](http://www.bsigroup.com) (accessed 4 December 2017).
- BSi (2015), “BS 8536-1:2015 briefing for design and construction. code of practice for facilities management (buildings infrastructure)”, available at: [www.bsigroup.com](http://www.bsigroup.com) (accessed 8 December 2017).
- BSi (2016a), “BS 8536-2:2016 briefing for design and construction. code of practice for asset management (linear and geographical infrastructure)”, available at: [www.bsigroup.com](http://www.bsigroup.com) (accessed 8 December 2017).
- BSi (2016b), “New BIM level 2 website launches”, available at: [www.bsigroup.com/en-GB/aboutbsi/media-centre/press-releases/2016/april/New-BIM-Level-2-website-launches](http://www.bsigroup.com/en-GB/aboutbsi/media-centre/press-releases/2016/april/New-BIM-Level-2-website-launches) (accessed 19 December 2017).
- Cabinet Office (2011), “Government construction strategy”, available at: [www.gov.uk/government/publications/government-construction-strategy](http://www.gov.uk/government/publications/government-construction-strategy) (accessed 18 December 2017).
- Carbonari, G., Ashworth, S. and Stravoravdis, S. (2015), “How facility management can use building information modelling (BIM) to improve the decision making process”, 15<sup>th</sup> EuroFM Research Symposium, Milan.
- Creswell, J.W. (2014), *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage Publications, Thousand Oaks, CA.
- Dawood, N. and Vukovic, V. (2015), *Whole Lifecycle Information Flow Underpinned by BIM: Technology, Processes, Policy and People*, Teeside, ResearchGate.
- Denzin, N.K. (1970), *The Research Act*, Aldine, Chigago, IL.
- Eadie, R., Browne, M., Odeyinka, H. and McKeown, C. (2013), “BIM implementation throughout the UK construction project lifecycle: an analysis”, *Automation in Construction*, Vol. 36, pp. 145-151.
- Eastman, C., Teicholz, P., Sacks, R. and Liston, K. (2011), *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors*, 2nd Ed., Wiley, Hoboken.
- Gallagher, M., O’Connor, A., Dettbarn, J. and Gilday, L. (2004), “Cost analysis of inadequate interoperability in the US capital facilities industry”, available at: [www.nist.gov/node/583921](http://www.nist.gov/node/583921) (accessed 5 December 2017).
- Hafeez, M.A., Chahrour, R., Vukovic, V., Dawood, N. and Kassem, M. (2016), “Investigating the potential of delivering employer information requirements in BIM enabled construction projects in Qatar”, *Inderscience Online*, Vol. 9 No. 3, pp. 198-218.
- HM Government (2013), “Construction 2025: industrial strategy: government and industry in partnership”, available at: [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf) (accessed 12 December 2017).

- Holzer, D. (2015), *The BIM Manager's Handbook, Part 4: Building up a BIM Support Infrastructure*, John Wiley and Sons, Chichester.
- ISO (2017), "ISO 15686-5 Buildings and constructed assets. Service life planning. Life-cycle costing", available at: [www.bsigroup.com](http://www.bsigroup.com) (accessed 19 December 2017).
- Levy, D. (2015), "Qualitative methodology and grounded theory in property research", *Pacific Rim Property Research Journal*, Vol. 12 No. 4, pp. 369-388.
- Marshall, C. and Rossman, G.B. (1999), *Designing Qualitative Research*, 3rd ed., Sage, Thousand Oaks, CA.
- Mayo, K.M., Wu, W., McCuen, T. and Smith, D. (2017), *The BIM Body of Knowledge (BOK) for Facilities Management Building Information Modeling*, International Facility Management Congress, Houston.
- Meslec, M., Ashworth, S. and Druhmman, C. (2018), "Integrating life cycle sustainability analysis with BIM", 17th EuroFM Research Symposium, Sofia, Bulgaria.
- Ministry of Justice (2016), "Public files: viewpoint for projects", available at: <https://download.4projects.com/document/publicfiles.aspx?DocumentID=e01e5cc7-bf8e-4673-9003-367509058169&VC=true> (accessed 12 December 2017).
- NBS (2017), "National BIM report 2017", available at: [www.thenbs.com/knowledge/nbs-national-bimreport-2017](http://www.thenbs.com/knowledge/nbs-national-bimreport-2017) (accessed 12 December 2017).
- NHS Scotland (2015), "Employer's information requirements for building information modelling (BIM)", available at: <https://bimportal.scottishfuturetrust.org.uk/uploads/2017/3/nhsscotlandbim-eir-template.pdf> (accessed 12 December 2017).
- Saunders, S., Lewis, P. and Thornhill, A. (2009), *Research Methods for Business Students*, 5th ed., Pearson Education Limited, Harlow.
- The Infrastructure and Projects Authority (2016), "Government construction strategy 2016-20: March 2016", available at: [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/5510354/Government\\_Construction\\_Strategy\\_2016-20.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/5510354/Government_Construction_Strategy_2016-20.pdf) (accessed 18 December 2017).
- Tucker, M. and Masuri, M.R. (2018), "The development of facilities management-development process (FM-DP) integration framework", *Journal of Building Engineering*, Vol. 18 No. 18, pp. 377-385.
- Tucker, M. and Masuri, M.R.A. (2016), "The rationale to integrate facilities management into the development process", *Property Management*, Vol. 34 No. 4, pp. 332-344.
- Tucker, M.P., Masuri, M.R.A. and Cotgrave, A. (2017), "Critical strategic issues for the integration of facilities management into the development process", *Property Management*, Vol. 35 No. 4, pp. 380-393.
- University of Cambridge (2015), "Employer's information requirements (EIRs) for university of Cambridge", available at: [www.em.admin.cam.ac.uk/files/1\\_uoc\\_eir\\_v1.2.1.pdf](http://www.em.admin.cam.ac.uk/files/1_uoc_eir_v1.2.1.pdf) (accessed 12 December 2017).
- Wills, N., Ponnewitz, J. and Smarsly, K. (2018), "A BIM/FM interface anylysis for sustainable facility management", 16th International Conference on Computing in Civil Engineering, Tampere.

### **Further reading**

- Ashworth, S., Tucker, M., Druhmman, C. and Kassem, M. (2016b), "Integration of FM expertise and end user needs in the BIM process using the employer's information requirements (EIR)", *CIB World Building Congress 2016*, Tampere, available at

<https://www.researchgate.net/publication/301776775> Integration of FM expertise and end user needs in the BIM process using the Employers Information Requirements EIR

Carson, D., Gilmore, A., Perry, C. and Gronhaug, K. (2001), *Qualitative Marketing, Research*, Sage Publications, London.

CIC (2013), “Building information model (BIM) protocol”, available at: <http://cic.org.uk/publications> (accessed 6 January 2016).

Druhmann, C. and Ashworth, S. (2016), “Rating systems in conjunction with BIM deliver outstanding possibilities for sustainable construction”, *Journal of Civil Engineering and Architecture Research*, Vol. 3 No. 10, pp. 1711-1717, available at: <https://www.researchgate.net/search.Search.html?type=publication&query=Rating%20systems%20in%20conjunction%20with%20BIM%20deliver%20outstanding%20possibilities%20for%20sustainable%20construction>