The use of building information modelling by Quantity Surveyors in facilities management roles

Abstract

**Purpose** - Adoption of Building Information Modelling (BIM) in Facilities Management (FM) provides an information platform to store and exchange asset data. Quantity Surveyors, with cost management expertise, are increasingly involved in FM roles in the operation phase. However, no study has been conducted on how BIM may assist Quantity Surveyors when contracted in FM roles. This study aims to identify the potential benefits and challenges of using BIM by Quantity Surveyors in FM roles.

**Design/methodology/approach** - Interviews were conducted with 8 professionals from an international built and natural asset design and management company and its facility management business partner in Australia.

**Findings** - Lack of complete and accurate data was the main issue faced by Quantity Surveyors in FM. The benefits of BIM in FM were digitizing and storing asset information and developing a cost database that would be useful for Quantity Surveyors whereas challenges included keeping model data up-to-date, cost, industry resistance to change and contractors’ lack of model use.

**Originality/value** - This study contributes to revealing the niche adoption of BIM by Quantity Surveyors in FM and identifying the issues faced by Quantity Surveyors in FM roles using BIM. It contributes to the knowledge of BIM adoption in post-construction. Findings will be useful to develop strategies for adopting BIM in FM and supporting Quantity Surveyors’ roles in FM.

**Keywords:** quantity surveyors; BIM, facilities management
Introduction

Facilities Management (FM) is defined by Standards Association of Australia (2004) as the “process of planning, managing, maintaining, rationalising and accounting for facilities and associated services, while simultaneously seeking to reduce the associated overall costs for a specified level of performance”. FM and asset management share similarities but have different priorities. FM focuses on occupants and end users’ workplace needs and demands while optimizing operational (OPEX) and capital expenditures (CAPEX) whereas asset management focuses on investor’s profits while minimizing assets capital expenditures (CAPEX) (Kavrakov, 2015). In this study, FM will be used to describe management of built assets and facilities in post-construction stage. The justification to any client for carrying out FM is where the optimum service is provided at minimum cost. The cost of maintaining a facility often exceeds the initial design and construction costs, with studies estimating that up to 85% of expenditure over the life of a building is associated with the operation of the facility, whilst the remaining 15% is associated with development costs (Edirisinghe et al. 2017). Typically, clients and stakeholders only focus on the initial outlay during construction as the high expenditure over a short duration has the potential to affect the development moving forward. However, with such significant investment during the operational phase, clients and owners should pay more attention to FM in this stage.

Quantity Surveyors are employed as a specialist contractor to assist in managing these costs. Traditionally, Quantity Surveyors provide cost management services throughout the design and construction phase, however, their diverse range of skills and competences have allowed them to add value to the operational phase, expanding their services and knowledge into FM. Whilst the involvement of Quantity Surveyors in FM is typically restricted to asset and maintenance management, their skills, competencies and construction knowledge have been recognised to assist FM in other areas such as whole life costing, space management, reviewing FM performance and benchmarks, management of tenders for refurbishment works, and setting budgets for cost control (Ashworth et al.
Therefore, the sound cost management skills held by Quantity Surveyors could assist the FM industry to provide the optimum service at minimum cost.

As a digital representation of a building (Becerik-Gerber et al. 2012; Stanley et al. 2014; Wang et al. 2013), Building Information Models (BIM) can play a significant role in reducing operating costs. Building Information Modeling (BIM) has benefited the construction industry ever since its inception over 25 years ago by providing opportunities for clients, builders, and designers to achieve higher quality facilities within shorter project durations and for lower costs (Pishdad-Bozorgi 2017). The parametric model contains individual objects and elements, inclusive of their properties and specifications, which are assembled to form a data embedded building.

Recently, Facilities Managers have started harnessing the opportunities associated with the use of BIM, leveraging it to ensure the seamless functionality of a facility and to reduce overall costs associated with its operation. According to Pishdad-Bozorgi (2017), the three most cited benefits relating to a BIM enabled FM system are, interoperability, visualisation and real-time data accessibility. The information and data related to a facility, including its construction, materials and maintenance schedules, can be stored, accessed and exchanged through BIM, thus acting as a reliable shared knowledge resource that can assist the decision-making process for facility managers throughout the lifecycle of a building (Stanley et al. 2014). The visualization and interoperability provided by BIM improves the efficiency and functionality within the FM profession, by enabling facility managers to appropriately plan maintenance activities and quickly locate building elements due for repair, thus reducing the time, money and resources typically used to locate plant and other assets (Pittard and Sell 2016).

Although the benefits of using BIM in FM has been studied in existing literature, the role played by Quantity Surveyors in the use of BIM throughout the operational phase remains unknown. Currently, Quantity Surveyors predominately utilise BIM during the design stage of a development,
harnessing BIM’s ability to automatically extract quantities, associated costs, and object data to assist with the formation of a cost plan (Wao and Flood 2016; Wong et al. 2015). However, as Quantity Surveyors begin to expand their services into FM, there is an urgent need to better understand the benefits and challenges that Quantity Surveyors would face when they provide BIM-based cost management advice in the operation phase for facilities management purposes. Further research is required to fill the gap of limited studies on the Quantity Surveyors’ use of BIM for FM.

This paper aims to explore the usage of BIM by Quantity Surveyors in FM. Objectives are to identify the benefits and challenges associated with using BIM in FM from the perspective of Quantity Surveyors; identify pertinent strategies for overcoming the challenges; and provide recommendations for using BIM as a tool to support Quantity Surveyors’ role in FM. The significance of this study lies on revealing how BIM supports Quantity Surveyors for their niche roles in FM. Findings of this study would be useful for Quantity Surveyors to further expand their services in FM, providing value-added cost management services for the operation and maintenance of assets. With the utilization of BIM, Quantity Surveyor can provide more accurate and efficient advice on FM. This study contributes to the limited research on BIM for cost management in the operation and maintenance of the built environment.

**Literature Review**

*Strengths and limitations of the Quantity Surveyors’ role in FM*

The involvement of Quantity Surveyors in the FM industry is relatively small. However, due to their strengths and adaptable skills in cost management, Quantity Surveyors have begun to expand into FM roles, applying their existing knowledge base to FM activities and processes. As seen in Table 1, opportunities where Quantity Surveyors can utilise their knowledge and competencies in FM roles include space planning, maintenance management, refurbishment works, insurance replacement
valuations, procurement of contractors, tender and contractual arrangements, budget and costs control, whole life costing, and benchmarking (Ashworth et al. 2013). These competencies are based on the 6 core and 12 optional competencies established by the Royal Institution of Chartered Surveyors (RICS) (2017) that are required of Quantity Surveyors to effectively manage costs during all stages of a development. As observed, many of these competencies and skills can be transferred into a broad range of FM services.

(Inert Table 1 here)

Of the aforementioned roles, Quantity Surveyors are predominantly recognised for their services in maintenance and asset management, and budgeting and cost controlling. The costs relating to maintenance are cited as being the second largest expense when operating a facility, after payment of staff (Ashworth et al. 2013). Therefore, managing maintenance expenditure is vital to ensuring successful economic operation of the facility. To assist in reducing costs and allocating available funds for maintenance, the Quantity Surveyor will create either an asset management plan or a maintenance management plan, defining financial limits, clear lines of action, and dates for asset replacement and response times (Ashworth et al. 2013). Budget and cost controlling involves Quantity Surveyors forecasting costs that will be incurred by the facility whilst in operation, and control of those costs to achieve budgeted targets. The budget can then be used as a monitoring tool in conjunction with a program of planned works, necessary for cash flow forecasts (Ashworth et al. 2013).

To effectively forecast maintenance costs and assist in defining financial expenditure on an asset over the life of the facility, the Quantity Surveyor requires access to a significant amount of asset data, such as maintenance manuals, asset registers (in cases where they are not developed by the Quantity Surveyor), condition registers, operating costs, warranties, and manufactures product information. However, it is noted by Ashworth et al. (2013) that Quantity Surveyors often face difficulty acquiring and getting access to these documents or other applicable information in order to
efficiently carry out their services. Acquiring data that is up-to-date is a significant challenge, limiting regular updates and adjustments to the budgets and maintenance costs. It is therefore imperative that Quantity Surveyors are promptly provided with all relevant data to improve the accuracy of their forecasts and budgets (Ashworth et al. 2013).

Quantity Surveyors in FM roles primarily face challenges associated with obtaining access to information (Ashworth et al. 2013). There is a need for an interoperable platform that enables the exchange of up-to-date information efficiently. Functionalities of BIM enable multiple disciplines that support FM services, including Quantity Surveyors, to have access to all asset information. However, the use of BIM for this purpose has not been thoroughly studied or researched from the Quantity Surveyors perspective, presenting a large gap in the literature.

**Current use of BIM by Quantity Surveyors**

From a cost management perspective, BIM has been deemed by numerous academics as a tool to assist in the creation of estimates, enabling Quantity Surveyors to accurately and automatically extract quantities, collaborate with other disciplines, and visualise the proposed development (Aibinu et al. 2014; Stanely et al. 2014; Wong et al. 2015; Ismail et al. 2016). The general consensus among the reviewed literature is that Quantity Surveyors benefit the most when using BIM during the tender design stage. The ability to extract quantities and their associated data has led to the production of successful projects by way of reducing cost and time overruns due to BIM’s efficient and effective operation. It also reduces the chance of manual quantification errors which can have significant implications on projects construction costs, especially if a Bill of Quantities (BoQ’s) is utilised as part of the contract (Wong et al. 2015). The top most cited benefits of BIM use by Quantity Surveyors as identified from studies undertaken by Aibinu et al. (2014) and Stanley et al. (2014) were increased productivity, visualization, collaboration, quality of information, and efficiency of take off’s. BIM’s interoperability assists with improving collaboration between teams, clients, and stakeholders, which
is a highly valued benefit to the Quantity Surveyor.

The study conducted by Aibinu et al. (2014) reported that Quantity Surveyors predominately use BIM for cost planning, preparing BoQ’s, and for bulk checking manually measured quantities. Less than 30% of participants reported using BIM for contract administration purposes, while no participants were reported to use BIM outside of the construction phase. The results from a study conducted by RICS in 2011 also verified that Quantity Surveyors primarily use BIM in the design and construction phase. However, contrary to Aibinu’s et al. (2014) study, RICS (2011) reported that a small number of Quantity Surveyors had utilised BIM for facilities or asset management. This study did not identify the benefits or challenges that Quantity Surveyors encounter when utilising BIM for FM services. However, as BIM has been cited to improve team communication and interoperability during the construction phase, though struggles with incorporating the correct data for extraction, it is imperative to understand if these characteristics are experienced when Quantity Surveyors utilise BIM for FM purposes. Therefore, further research must be undertaken to close this gap in the literature.

**Benefits of adopting BIM in FM**

Leveraging BIM for FM has lagged in comparison with the design and construction phases. However, BIM enabled FM has been recognised to assist in resolving common challenges faced by Facilities Managers over the life of the building (Pishdad-Bozorgi 2017). Facility Managers often encounter multiple problems on site, such as issues with locating assets for maintenance, and piecing together information from two-dimensional drawings, specifications, and operational and maintenance manuals. This often leads to significant losses in time and cost due to the requirement to collect and validate building data (Pittard and Sell 2016).

Bercerick-Gerber et al. (2012) identified application areas that have the potential to be improved through the utilisation of BIM. This includes locating building components, visualisation, facilitating real-time data access, creating digital assets, space management, control and monitoring
energy consumption, emergency management, and feasibility studies for non-capital construction. The reviewed literature considered the majority of these functions to be enhanced through the implementation of BIM. However, as shown in Table 2, it was agreed by all that visualisation and location of building components were the two most beneficial features of a BIM enabled FM system (Wang et al. 2013; Kassem et al. 2015; Pittard and Sell 2016; Pishdad- Bozorgi 2017; Edirisinghe et al. 2017).

The application of BIM in FM has also added value to the profession through improving the handover process from the construction phase to the operational phase (Kassem et al. 2015). Essential information to support the operation of a facility, such as product data sheets, operational and maintenance schedules, warranties, compliance data, and equipment lists, are typically handed over manually in paper format and are often inaccurate and incomplete. Consequently, the FM industry loses millions of dollars per year due to inefficient working processes in an attempt to incorporate the operational information into FM databases and programs (Kassem et al. 2015). “As-built” BIM models, which are models of the constructed building, contain the manufactures information and specifications within the buildings digital objects and elements, thus reducing the need to transfer information into a FM system. BIM therefore becomes a single point of reference (Edirisinghe et al. 2017). Moreover, the embedded information ensures that the facilities fabrics, assets and equipment are maintained in accordance with the corresponding specification and contract. The ability to extract this data has also enabled facilities managers to create equipment inventory lists and asset registers, which can facilitate the creation of a scheduled program for maintenance and management activities, thus improving maintenance expenditure (Pittard and Sell 2016).

(Insert Table 2 here)

**Challenges of adopting BIM in FM**

There are still many challenges and barriers to implementing BIM in FM. Even though as-built models
are being created and utilised in a handful of FM projects, updating the model with any changes to the physical facility is not being executed (Kassem et al. 2015; Becerik-Gerber et al. 2012). Consequently, this results in an inaccurate model of the facility, reversing the time and cost savings associated with the ability to locate building elements via the model. However, Becerik-Gerber (2012) argues that this may be a result of organisational issues where the roles and responsibilities of maintaining the model are not appropriately allocated during handover. To ensure that the model is able to continually provide useable and meaningful data to such an information reliant field, it is imperative that these roles are designated early on to prevent the model from becoming redundant overtime (Khelldani, as cited in Kassem et al. 2015).

Similarly, cultural behaviors also prove to be a barrier towards adopting BIM in FM (Kassem et al. 2015; Becerik-Gerber et al. 2012). Both the Construction and FM industries are unreceptive to new technologies, which unless clearly proven to benefit the day-to-day functions of personnel, will not be quickly adopted in practice. The combined lack of BIM skills by FM professionals and lack of awareness by clients inhibit the adoption of BIM in FM (Kassem et al. 2015).

Other challenges faced when adopting BIM in FM as outlined by literature include legal barriers to defining model ownership, necessary involvement of software developers, integration with other current FM technologies due to data libraries lack standardization, and insufficient collaboration between stakeholders and other disciplines (Kassem et al. 2015; Becerik-Gerber et al. 2012; Edirisinghe et al. 2017).

The identified benefits associated with BIM enabled FM are noted to improve both the operations of a facility and the functions, roles and responsibilities of the Facilities Managers. There is however little research conducted on how the improved functionality of the FM profession affects the traditional services provided by Quantity Surveyors in FM positions. Whilst it is noted that BIM has resulted in considerable cost savings to the operation of the facility, it should, therefore, be further
studied how the use of BIM in FM affects the Quantity Surveyors management of facilities expenditure.

Research Methodology

Data Collection

Quantity Surveyors using BIM for FM roles is an emerging area. The research aimed to identify the potential benefits and challenges associated with using BIM by Quantity Surveyors in FM roles and to explore potential strategies for the effective utilization of BIM by Quantity Surveyors in FM. Due to the exploratory nature of this research and limited empirical data on this topic, this study has conducted in-depth semi-structured interviews for qualitative data collection.

Interview questions (Appendix) were designed to explore benefits and challenges currently experienced by Quantity Surveyors using BIM for FM that may not be identified in the literature, and identify strategies for improving the utilization of BIM by Quantity Surveyors for their increasingly important involvement in FM roles.

Interviewees were selected from an international built and natural asset design and management company and its facility management business partner in Australia based on their BIM and/or FM knowledge. This included collecting data and opinions from Facilities Managers, Quantity Surveyors with experience in FM roles and/or have BIM experience, BIM technical managers, and digital strategists. Interviewees from the authors’ personal network in the chosen engineering consultant company and the related FM business partners were invited to participate via email.

Eight face-to-face or Skype interviews were conducted until data saturation. Eight interviews were considered to be sufficient because data were saturated and no new data was found starting from the seventh interview and was confirmed by the eighth interview. The interviews were comprised of open-ended questions to enable participants to discuss their experiences and elaborate on topics for in-
depth and detailed responses.

All interviews, excluding one, were audio recorded, in which one participant provided written responses in place of being interviewed. Recording of the interviews enabled analysis of the qualitative responses and facilitated the transcription of the interviews. Written transcripts were produced and sent to the participants for their review and verification that the information was correct.

Data Analysis

The qualitative data obtained via the conducted interviews has been analysed via open coding, where relevant words, sentences, and phrases from the transcribed interviews have been evaluated to identify underlying patterns and themes with reference to the literature. Similar coded patterns and themes that emerged from the interviews have been categorised. The coding has been done by the first author and verified by the second author of this paper for inter-rater agreement.

Results and Findings

Profile of Interviewees

A total of 12 industry professionals with varying roles within the construction and property industry were invited to participate in this research project. Of these 12 invitations, 10 individuals consented to participate, whilst only 8 completed their interviews. With reference to Table 3, nearly all interviewees are at a senior or director level within their organisation. A vast majority of them have had greater than 15 years of experience in asset or facility management, and quantity surveying practice. More importantly, 3 interviewees are BIM experts driving the adoption of BIM at strategic and technical levels. Their combined industry experience and professional expertise form a board knowledge base pertinent to BIM, facility management and quantity surveying profession. Thus, these interviewees are well-qualified to provide valid qualitative data relating to the research problem and topic.

(Insert Table 3 here)
Interviewees were asked about their current use of BIM and the project stages that they have utilised BIM on. Results for the current use of BIM are shown in Figure 1. As seen, half of the interviewees do not use BIM in their daily roles. This is because most interviewees are at senior/director level. Hands on BIM usage at technical level is likely not part of their daily routine. Despite this, the interviewees have advanced knowledge in FM operations and the effect of BIM on FM and quantity surveying operations at strategic level. Besides, this finding may also indicate BIM usage for FM purpose is still relatively limited and there is a shortfall of BIM use beyond the construction phase of a project. About 38% of the interviewees, who were Quantity Surveyors, reported utilising BIM for the purposes of visualisation, measurement, and bulk checking of traditionally measured quantities. These uses were recorded during the design stages of a project for cost planning purposes only. Only Interviewee E reported utilising BIM during all stages of a development. Throughout the design stage, Interviewee E reported using BIM for design, clash detection and quality assurance (QA) purposes, whilst during the construction stage of a project, the participant utilised BIM to sequence construction. During the operational phase, the participant utilised BIM to create a digital representation of the existing facilities and generated asset schedules from the information contained within the models.

(Insert Figure 1 here)

**Challenges faced by Quantity Surveyors in FM roles**

The Quantity Surveyor participants interviewed for this study identified that their roles in FM include conducting condition assessment on physical assets, developing estimates to establish original construction costs, adjusting the construction costs based on current asset conditions to attain backlog maintenance costs, life cycle costing and analysis to indicate the long-term maintenance requirements of the asset, and developing maintenance schedules.

When completing the aforementioned tasks, it was identified that the interviewees encountered a number of challenges, primarily centering around the lack of correct asset data. Obtaining asset data
from clients was noted to be a difficult process, however, the incompleteness and inaccuracy of the limited available data was recognised to have the largest impact on the accuracy of the services provided by Quantity Surveyors to the FM profession. Interviewee H expressed that:

In my experience, a key challenge is the accuracy and completeness of the data and the time it takes to correct and complete asset registers. This could include correcting room numbers, uses and names, and measuring room areas if the client doesn’t have this information completed. Another item is the asset replacement values (ARV’s) that are often prepared using insurance valuations or out of date information. These form the basis for so much of the work we do it would be worthwhile having them prepared in detail by a suitably experienced and qualified Quantity Surveyor (QS). We have seen some very inaccurate ARV’s and having this information right would help prepare a lot of the other components much more accurately. (Interviewee H)

Whilst interviewee H discussed potentially involving Quantity Surveyors to improve the quality of data by completing evaluations of ARV’s, interviewee A discussed how Quantity Surveyors are already employed by Facilities Managers to complete tasks, such as estimating the original costs of construction, to reinstate and replicate lost asset data:

All buildings have cost data associated with them which can identify the original construction cost in complete detail. This data is paramount to establishing maintenance costs for an asset and its building fabric. However, except for very recently constructed buildings, this data is almost always lost to the FM team, and so a QS is required to carry out an estimate of the original construction cost to obtain that data again… As a result, the same work has to be done twice, which I don’t think is good for anybody. The funds saved in the FM budget could be spent on assessments for more buildings. (Interviewee A)

The interviewed Quantity Surveyors continually stressed that lack of correct asset data
significantly hinders their role in FM. This issue was also identified by the interviewed Facilities Managers to be inherent within their industry that consequently has a flow on affect which results in Quantity Surveyors receiving incorrect data. This was made apparent with interviewee F stating “one of the issues that we have is keeping the data up to date” and interviewee C identifying “the challenge that typically exists is accuracy and currency of data regarding the asset”.

**Benefits of BIM adoption for Quantity Surveyors in FM roles**

**Digitising and storing asset information**

Digitising asset information was identified by the interviewees as the top benefit of BIM in FM. Embedding asset registers, operation and maintenance (O&M) manuals, and details about the buildings construction materials into a 3D model of the asset were repeatedly mentioned as features that would improve the everyday functions of a Facilities Manager and enhance the owners understanding of their asset. One interviewee mentioned:

> What I see BIM doing particularly is actually being able to integrate the asset register and bring that alive by linking it to the 3D representation of the asset. So it’s basically there to bring the as-built drawings and O&M manuals alive and turning them into something you can react with. (Interviewee C)

Respondents also spoke about the benefits of containing all asset information in one system, rather than over multiple systems and programs with interviewee B mentioning:

> Currently the way things work now, is an asset register (if they even have an asset register) someone has to sit there and pull out the items and put them in an excel spreadsheet or put them into a CMMS. If that was sitting in the model, you have the advantage of the asset register and also identifying where it is. (Interviewee B)
Developing a cost database

Developing a model inclusive of costs was frequently identified by the interviewees as a major benefit of BIM in FM that would improve the tasks required of FM consultants and employees. Participants who undertake predicative maintenance costing as part of their role discussed the benefits that an embedded cost database would have on their task, with one interviewee mentioning “if you need to replace carpet tiles, ceiling tiles etc then you’ve got those costs built in there” (interviewee C). Other interviewees mentioned how it could even aid their long-term maintenance plan with interviewee B mentioning:

You could embed in there the replacement costs of say a TMV and apply an escalation rate if it needs to be replaced every 10 years. We could effectively do a maintenance plan and can pull together a dollar value to forward project and be like so in year 10 these are all the items that need to be replaced, therefore, here’s how much money I need in 10 years’ time. So, it gives us a bit more of a planning tool. (Interviewee B)

From a Quantity Surveying perspective, Interviewee A discussed that incorporating the cost of construction into a model would result in obtaining access to complete asset data, consequently improving the accuracy of other services provided by Quantity Surveyors to the FM industry:

A BIM data set of completed buildings which retains not only the specific details of the building fabric, but also detailed records of its cost to construct would result in significant time savings as it will annul the need to carry out a redundant re-measure and estimate of the building, which is injurious to the project budget and wastes time and money for both clients and FM contractors. (Interviewee A)
Challenges of BIM adoption for Quantity Surveyors in FM roles

As shown in Table 4, the interviewees identified 9 challenges of adopting and utilising BIM in FM. These challenges include keeping data up-to-date; cost, industry resistance to change; contractors lack of model use; up-skilling of labour; lack of client awareness; lack of collaboration with other consultants; legal ownership issues; and model software only suits designers. Among them, the top 4 challenges identified by at least 5 interviewees (i.e. more than half of the interviewees) are selected for detailed discussion below.

(Insert Table 4 here)

Keeping model data up to date

Maintaining asset data and ensuring that the model is representative of the current asset condition was repeatedly mentioned by interviewees as a challenge for adopting BIM in FM and consequently was the most prevalent issue identified. Interviewees made similar comments regarding the difficulty of updating the model due to lack of skills and employees with BIM knowledge and experience. One interviewee mentioned that models provided from the design consultants contained existing issues that were not rectified prior to hand over, hindering the progression of the FM team and their desire to utilise the model. The relevancy of data contained within the model was also raised by an interviewee, stating that to update the model they would have to update information that wasn’t relevant to their tasks, making the process labour intensive for little benefit. Some of the comments from interviewees that demonstrate these issues include:

If you’ve not got reliable as-built models, then they won’t be representative of what’s on site and if you don’t keep them updated then they’ll very quickly go out of date. (Interviewee C)

So it’s great as a design tool but to me at this stage it’s handed over and then it’s forgotten
about because nobody is assigned with keeping that up to date. We don’t have the specialists to update the model. (Interviewee F)

We see examples of models being created and nothing happens with them and they get lost. So if there is work done on the asset, and no one is quite sure if the asset matches the model in reality, then obviously it would be hard to use then. (Interviewee D)

We struggle to keep 2D data up to date and in some cases, we don’t even have all the 2D data... We need to understand the 2D before we start moving to 3D. (Interviewee F)

**Cost**

The cost to develop and maintain a model was highlighted by interviewees as a significant barrier to implementing BIM in FM. In connection with keeping the data up to date, some interviewees spoke about not having employees skilled or trained to update the model. The cost of educating and training an employee to update the model was said to “…cost us more than it does to actually do the work itself” (Interviewee F), with interviewee C wondering “are they going to pay for up-skilling their people in these new technologies because unfortunately again the FM sector is probably a race to the bottom in terms of cost.” There was consensus amongst the interviewees that it would be difficult to get investment in BIM from clients due to the high cost and limited benefits experienced by Facilities Managers as mentioned by Interviewee F:

> There is no business case to say well if you adopt BIM this is how it’s going to save you money. At this stage BIM would only cost us a lot of money to incorporate… The cost to do that would get shot down straight away because there is no defined benefits to actually undertaking that type of exercise. (Interviewee F)

In addition to this, the cost to create models of existing buildings were also identified to be a constraint, with interviewee D noting that it would cost approximately 20% more than traditional
methods.

*Industry resistance to change*

The FM industry typically comprises of older members within the profession, and it was recognised by the interviewees that this has had a significant impact on the adoption of BIM in FM. Some interviewees spoke of the resistance they have encountered from senior colleagues who were opposed to adopting BIM with one interviewee stating “they’re less inclined to pick up technology because it’s a worry for them because they have to learn this new system.” (Interviewee E). This was also observed by Interviewee C stating that:

> Unfortunately, there is a sort of stigma around the FM sector in the fact that it’s an aging populous and tends to be more senior in their careers, therefore there is a greater resistance to change and adoption of new technologies. (Interviewee C)

Interviewee H also identified the difficulties associated with such a large industry which has limited the swift implementation of BIM, mentioning “so many different people have to get on board and learn it and use it. It will take time.” (Interviewee H)

*Contractors’ lack of model use*

The transition of BIM from a design tool to an FM tool was recognised by the interviewees to be prevented due to the lack of BIM use by the contractors. Interviewees highlighted that the FM team will often be provided a design model of the asset, rather than an As-Built model which will consequently be out of date from the beginning, not documenting the variation changes that occurred during construction. As identified by interviewee G, to adopt BIM in FM “it relies on the contractors and builders to actually provide you with an accurate set of data.” However, as identified by interviewee H, “the new challenge there is getting the construction team and everyone to have that technology and being able to update that model as well.” Obtaining accurate data from the contractors
is identified by the participants to be a difficult process due to the large number of participants in the construction industry:

The contractor will have their tier 2, tier 3 and tier 4 suppliers and what he’s got to do is try and get them all to adopt the BIM model and work in the BIM model to do their shop drawings, to do their connection drawings and then generate their as-built drawings and that’s the blocker in the market at the moment from what we’ve seen. (Interviewee C)

**Strategies to improve BIM usage of Quantity Surveyors in FM**

**Legislation and Government involvement**

Following the UK strategy of implementing legislation, a number of interviewees suggested that Australia should also legislate the use of BIM from the design stage through to asset operation. Interviewee D mentioned that “in the UK, the underlying legislation around BIM helps speed things up, because it creates a common standard” and by legislating the BIM process in Australia, a similar result may occur. Contrary to this, some interviewees stressed that government involvement and usage of BIM would be a better action than legislation in order to see industry progression. For example:

The people that will drive the change is government, semi-government and utility owners or holders of assets because they are the ones that have the invested interest to make it work. (Interviewee D)

I don’t think it needs to be legislated. My opinion would be that legislation can cause its own issues. If you put in place legislation for clients to adhere to, that could be quite rigid and quite restrictive for them… By government putting it into their projects, then the private sector will see that it is possible… So not legislation particularly, but definitely support from the
government and the bigger institutional players to get it rolling forward. (Interviewee H)

Training and employing BIM experts

The participants of this research study identified that adopting BIM in FM was a challenge due to insufficient BIM skills held by employees in FM positions. It was therefore suggested by numerous interviewees that clients need to invest in up-skilling their labour. Interviewee E suggested “Owners need to start employing BIM people… If they had a BIM person employed, they could guide those companies on what they need in order to get the right information and that would ease the transition for that facility owner.” (Interviewee E)

Making BIM a contractual document during construction and in Facilities Operations

Making BIM a contractual document during construction was suggested by some interviewees as a strategy to improve the hand over process and enable the FM team to be provided with an accurate 3D model of the facility in its As Built condition. Interviewee B identified that “currently, a lot of the time the BIM model isn’t even a contract document. So, I think it needs to evolve into a contract document to carry on”. Interviewee H also recognised that if it became contractual, the industry would advance towards BIM implementation quicker mentioning that “if it becomes a requirement for the clients and some builders start being able to do and meet those needs, the industry will have to adapt to be able to be competitive and keep winning those sorts of projects with those clients”

Implement design guidelines and involving Facilities Managers in the design

The facilities manager interviewees provided interesting suggestions to aid the adoption of BIM within their industry, expressing the need to involve Facilities Managers in the design stage of a development that is built and operated by one owner. Interviewee G mentioned “I think early involvement in the design of the building with someone who operationally knows how the building ticks… is going to be worthwhile.”
Developing design guidelines to provide to designers was suggested to involve Facilities Managers in the design stage and to produce a useable BIM model for operational purposes:

I think it needs to be tailored to the clients systems and we need to be telling others what we require in terms of the documentation… saying these are our standards, this is the information we capture against our asset, these are the assets we maintain and capture based on maintenance or financial or other reasons, and this is the way we need the information back. (Interviewee F)

Discussions

The collected data from this study has shown a strong correlation with the existing literature regarding the current issues experienced by Quantity Surveyors in FM roles and the peculiar challenges associated with BIM for their roles in FM. Potential benefits of using BIM by Quantity Surveyors for their FM roles have been undermined due to the overwhelming challenges associated with the current level of BIM adoption in Australia, which mainly limited to design and construction phases of assets and facilities. BIM opens new opportunities for Quantity Surveyors to make use of their professional expertise and competencies in cost management to provide services in FM; however, there are challenges arising from the whole BIM adoption process of different stakeholders to be tackled.

Lack of accurate data and limited availability of data were identified by both literature and the research findings as the most prevalent issues facing Quantity Surveyors in FM roles (Ashworth et al. 2013). The FM team did not have the data to provide to Quantity Surveyors because the FM team either not being provided with the data at project handover or the data has not been kept up to date by the FM team. This results in Quantity Surveyors struggling to provide accurate cost advice and requires Quantity Surveyors to perform tasks to assist the Facilities Manager to replicate lost data. This is injurious to all parties involved, as work has to be reproduced twice, resulting in unnecessary expenditure that could have been spent elsewhere. To make sure that BIM models contain useful
information for the operation and maintenance of the facility, data requirement of the FM team should be communicated early to the design/BIM consultant who is responsible for BIM model drafting. Quantity Surveyors with FM roles with good BIM skills would provide added-value if they can be engaged in the early stage of projects.

The benefits of adopting BIM in FM were highlighted by the existing literature, which included interoperability, space management, and monitoring energy consumption, with visualisation and locating building components cited as the most valuable features of BIM in FM (Bercerick-Gerber et al. 2012; Kassem et al. 2015; Wang et al. 2013; Pittard and Sell 2016; Pishdad-Bozorgi 2017; Endirishng et al. 2017). Regarding the benefits of using BIM for the FM roles by Quantity Surveyors, the interviewees highlighted two benefits specifically relevant to their cost management roles in FM, namely digitizing and storing asset information, and creating a cost database. Prior studies found that Facilities Managers regard access to digitally stored asset information as an advantageous feature of BIM (Bercerick-Gerber et al. 2012; Kassem et al. 2015). This was cited to be a result of the model’s graphical interface that enables uncomplicated interaction with the extensive amounts of data that the FM personnel require access to. With the capability to connect to other FM databases, it can act as a single point of reference for all project data, retrieving the necessary asset information to assist with operating a facility (Bercerick-Gerber et al. 2012). This interaction with asset information was confirmed by the interviewee responses.

This study have identified significantly more challenges than benefits for the adoption and implementation of BIM in FM. These challenges surround four main themes namely keeping model data up to date, cost, industry resistance, and the contractors lack of model use. These findings are consistent with the existing literature with both Bercerick-Gerber et al. (2012) and Kassem et al. (2015) citing updating models with asset changes, organization and cultural issues, insufficient collaboration with stakeholders from project inception, and shortage of BIM skills as major challenges and barriers
to implementing BIM in FM.

Keeping the model data up to date was considered the greatest challenge to adopting BIM. Both literature and study participants identified that this is underpinned by the lack of BIM skills held by FM personnel. Lack of BIM skills is a challenge, which as reported by Edirisinghe et al. (2017) requires extensive time to overcome learning curves experienced by untrained staff and involves significant investment by clients to fund training. The FM industry is focused on reducing costs and therefore encounters significant resistance from organizations when investing in and adopting new technologies.

Industry resistance and cultural issues have prolonged the uptake of BIM in FM for numerous years and were major issues identified by this study. This is supported by Bercerik-Gerber et al. (2012) who found that the FM industry had entrenched cultural issues and industry resistance to adopting new software tools due to lack of willingness to learn and investing in the new technology. Kassem et al. (2015) also cited that the industry has fears of the efficiency of interoperability between the different FM platforms and BIM, increasing their resistance to adopting the technology. However, more recent studies from Pittard and Sell (2016) and Pishdad-Bozorgi (2017) cite that interoperability is possible and user-friendly, therefore, should not limit adoption.

Interestingly, the lack of BIM use by contractors was not identified as a challenge by other studies reviewed as part of this research. This study identified the lack of contractors’ use a barrier for progressing the implementation of BIM for FM due to the absence of accurate As-Built models. The studies by Bercerik-Gerber et al. (2012) and Kassem et al. (2015) identified inaccurate As-Built models to be the fault of the design team as they currently have control over the creation of a model. It was therefore suggested by these studies that the FM industry should better collaborate with the design team. However, the findings of this study suggest that As-Built models should actually be the responsibility of the contractor due to their knowledge of the constructed asset. It is believed that this
would improve accuracy and result in the precise reflection of the constructed facility, preventing inaccurate data at project handover.

It is also important to note that there were discrepancies between the participant responses. It was found that Facilities Managers do not find many benefits in the adoption of BIM as it does not result in a cost saving to the operation of a facility. On the other hand, Quantity Surveyors believe that BIM could act as a single point of reference containing all facility information and data. This would resolve the most common issue faced by Quantity Surveyors in FM roles namely, lacking access to data. Consequently, this difference of opinion between the two groups would have a significant effect on the adoption of BIM in FM for use by Quantity Surveyors.

Due to the lack of benefits perceived by Facilities Managers, a model of the facility would not be utilised or maintained, resulting in the benefits for Quantity Surveyors being lost. Therefore, full adoption of BIM industry wide would be required for the benefits to be realised by Quantity Surveyors.

To prevent the aforementioned challenges from intensifying and to encourage Facilities Managers to adopt BIM in FM, it is recommended that specialist BIM technicians be employed within the FM team. By employing staff with the capabilities of manipulating and operating a model, asset information can be frequently updated to reflect the physical condition of the facility. It is also recommended that design guidelines be established by the FM team. Providing a guideline to the design team will ensure that a model is produced that can facilitate effective data retrieval and can assist with the operation of an asset. Design guidelines may also be better produced by a specialist BIM technician, further demonstrating their advantage in FM, as they will be able to understand what BIM is capable of achieving, whilst also understanding the requirements of the FM team. Thus, this will improve communication between the two teams. It is also recommended that BIM be made a contractual document during the construction phase of the project to enforce contractors to utilize BIM to complete an As-Built model and drawings. These strategies will therefore mitigate the challenges
associated with adopting BIM in FM so that the benefits for both Facilities Managers and Quantity Surveyors can be realised.

**Conclusions, Limitations and Future Research**

To conclude, this study The use of BIM in FM has the potential to alleviate the issues and challenges experienced by Quantity Surveyors in FM roles, primarily associated with improving access to accurate facility data. However, the use of BIM in FM is an emerging concept and its adoption in the FM industry is faced with numerous challenges. This study has investigated the potential benefits and challenges associated with using BIM by Quantity Surveyors in FM roles. The benefits of BIM in FM were found to be limited to two main features; digitizing and storing asset information and creating a cost database. These characteristics of BIM were considered to be beneficial functions that would facilitate access and interaction with asset data, acting as a single point of reference for all facility information. Due to both Quantity Surveyors and Facilities Managers utilizing large amounts of data in their FM roles, these attributes would positively contribute to improving their roles and functions.

However, the findings summarized in this paper identify significant barriers and challenges associated with adopting BIM in FM that need to be overcome before the benefits can be realised. These challenges include keeping the model up to date, costs, industry resistance and the contractor’s lack of model use. Notably, the skills of FM employees were found to underpin most of these challenges. The lack of BIM skills held by FM employees inhibit asset models from being updated regularly, and the cost and industry resistance to training and up-skilling employees further prevents the use of BIM in FM. It appears that implementing BIM in FM in its current state does not result in a cost benefit and therefore Facilities Managers are not encouraged to adopt BIM in the near future, thus preventing the issues experienced by Quantity Surveyors from being resolved.

This study has contributed to revealing the niche usage of BIM for FM by QS. It contributes to the knowledge on the under-researched area of BIM application in post-construction. It identified the
issues faced by Quantity Surveyors in FM roles and provided substantial insight into the challenges faced with adopting BIM in FM as an instrument to resolve the identified issues. It has also contributed to understanding the barriers of BIM implementation in the FM industry. The research has also highlighted the implications that these BIM challenges have on both the Quantity Surveying and FM profession and has recommended strategies for stimulating the FM industry to adopt BIM. These include employing specialist BIM technicians to assist with updating model data, establishing design guidelines to ensure models contain the required useable data, and making BIM a contractual document so Contractors can complete As-Built models to improve project handover data. Further research on the Contractors’ use of BIM during the construction stage is needed to identify and understand the challenges of developing As-Built models for handover to the FM team. There is also a need for increased case studies to demonstrate the strengths and weakness of adopting BIM in FM and to identify the success of implementing recommended strategies.

This study is limited by the number of participants and their profiles. Since the application of BIM for FM by QS is a relatively niche area in Australia, only eight interviewees from a global design, engineering and management consulting company and their FM business partners participated in this study. This study, however, demonstrates the latest application of BIM by QS for the role in FM. In the future, data should be collected from more QS consulting companies using BIM for FM, rather than from a singular company, to provide a more balanced view on the current QS practices using BIM for FM. This study is also limited by collecting data from South-East Queensland and Sydney in Australia only. Further research could be expanded to other States or Territories within Australia and other countries to provide a more comprehensive overview of how QS can use BIM for FM. A comparative study can be conducted with other countries which have similar levels of BIM adoption for facility operation and asset maintenance.

Appendix. Interview Questions
Questions for Facilities Managers

• As a Facilities Manager, what roles and operations do you perform?
• What technologies / computer application / systems do you use in your FM role?
  o What are the benefits and challenges to these systems?
• What issues do you currently face in your Facilities Management Role?
  o Do you think any of these issues may be reduced or improved through the use of BIM?
• Do you think any of your roles and operations would be improved by BIM?
• What challenges do you think you would face with implementing BIM into FM?
• For BIM to be successful in your workforce, what strategies and tools would need to be implemented?

Questions for Quantity Surveyors in FM roles

• As a Quantity Surveyor who contributes to Facilities Management, what roles and operations do you perform in FM?
• Do you think any of your FM roles, functions and operations would be improved by using BIM?
• What benefits and challenges do you see with implementing BIM in your role?
• For BIM to be successful in your workforce, what strategies and tools would need to be implemented?

Questions for BIM managers

• What project stages have you created and utilised BIM for? (e.g Concept design, Detailed design, Pre-tender, operational phase?)
• What size of projects do you typically use BIM for?
• What are the benefits of using BIM in your role?
• What are the challenges of using BIM in your role?
• Do you utilise BIM on its own or in conjunction with other programs?
• Do you believe there are any other areas or stages which BIM could be applied in, which are not being applied currently?

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