Challenges in the Implementation of BIM for FM - Case Manchester Town Hall Complex

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ABSTRACT

An often-introduced claim is that BIM can be a powerful tool for facility managers to improve buildings' performance and manage operations more efficiently throughout the life-cycle of buildings. Although this claim has been common since the early introduction of BIM, there is relatively little information about the real use on BIM in the operation and maintenance of buildings. Even most large public owners who have been early adopters of BIM, such as GSA, USACE or Senate Properties, have used BIM more in managing their construction projects than implemented it into their FM activities.

The benefits of BIM for design and construction are relatively well studied and documented, but there is little evidence of the benefits of BIM in the operational phase. In addition, the challenges involved in shifting from traditional FM processes to new BIM-based processes are not well-known. In this paper we document some of the issues involved in the adoption of BIM in FM and identify some of the enablers and barriers to BIM implementation in FM. The findings are based on a case study carried out during the final design and construction phase of Manchester Town Hall Complex, a major re-development project in the UK. Results confirm the lack of awareness the potential of BIM in the operation phase and need of clear guidelines for the implementation of BIM in FM defining required level of integration, standard BIM protocols and the key deliverables for FM purposes.

INTRODUCTION

The BIM (Building Information Modelling) adoption in the industry is currently accelerating rapidly, but the focus is still very strongly in the design and construction processes although BIM has been claimed to bring significant benefits in the FM (Facility Management): *"for facility managers BIM software can be a powerful tool to enhance a building's performance and manage operations more efficiently throughout a building's life"* (FacilitiesNet 2008). This claim has been commonly presented since the early introduction of BIM, but still most of the documented, quantifiable benefits of BIM are related to the design and production of buildings and there is relatively little hard evidence of BIM benefits in operation and maintenance activities (Becerik-Gerber et al. 2011). Even most large public owners who have been early adopters of BIM, such as GSA, USACE or Senate Properties, have used BIM more in managing their construction projects than implemented it into their FM activities.

However, the situation might be changing because one of the latest drivers for BIM, the UK Government's BIM requirements, include the delivery of electronic asset information (Cabinet Office 2011). This examples seems to have also global effects in the interest of BIM as a tool for efficient FM processes. The Manchester Town Hall Complex case study has been one of the research projects related to the detailed BIM requirements in the UK.

KNOWN OBSTACLES OF IMPLEMENTING BIM IN FM

Becerik-Gerber et al (2011) identified several challenges in implementing BIM in the operation and maintenance processes:

1) Technology and process related challenges:

- *Unclear roles and responsibilities for loading data into the model or databases and maintaining the model;*
- *Diversity in BIM and FM software tools, and interoperability issues;*
- *Lack of effective collaboration between project stakeholders for modelling and model utilization;*
- *Necessity yet difficulty in software vendor's involvement, including fragmentation among different vendors, competition, and lack of common interests*

2) Organizational challenges:

- *Cultural barriers toward adopting new technology;*
- *Organization wide resistance: need for investment in infrastructure, training, and new software tools;*
- *Undefined fee structures for additional scope;*
- *Lack of sufficient legal framework for integrating owners' view in design and construction;*
- *Lack of real-world cases and proof of positive return of investment.*

In addition, one of the main challenges in implementing BIM in the FM processes is the fundamental difference in project-based business and lifecycle management. Most organisations that own or operate buildings in long term have a significant existing portfolio, and some existing software platform to manage the FM information. New buildings are usually a very small portion of the portfolio, and this situation raises several questions related to the adoption of BIM: Should the existing buildings be modelled for the new system? What is the required level of information? How much would the modelling process cost? What are the measurable benefits? Is it possible to use a hybrid system managing existing and new buildings in different environment and using different data? What problems could this cause and how long is it feasible to maintain two different systems?

SOME EXISTING CASE STUDIES

One of the best publicly documented examples of successful implementation of BIM in FM is Sydney Opera House (CRC 2007). BIM did not come from the design and construction process, which regarding the age of the building it would of course have been impossible, but the building was modelled specifically for FM purposes. However, the project demonstrates excellently the possibilities of BIM in FM and basically similar data delivery could be implemented in real construction process, although it would require significant changes in the current work processes.

Some more recent examples of successful implementation of BIM for FM are presented in Teicholz's book BIM for Facility Managers (2013). Among those are Texas A&M Health Science Center and School of Cinematic Arts in the University of Southern California, which are among those few projects where the owner and project team have develop the design and construction processes considering the content and value of the FM information.

CASE MANCHESTER TOWN HALL COMPLEX

Research objectives and method. The research was done in the context of UK Government's BIM initiative. Further understanding of the key issues in the migration from traditional FM to BIM FM is crucial to the development of guidance. The case study was carried out to investigate the use of BIM FM in the Manchester City Council Town Hall Complex (THC) project in Manchester, UK. This research followed a previous investigation during the design and construction phase of the same project in 2011 (Codinhoto et al. 2011). The findings indicate that the FM team has developed relatively good understanding about BIM and capabilities that can be used to improve FM practice.

The research had 4 objectives: 1) Mapping Hard (e.g. building systems and fabric) and Soft (e.g. catering, cleaning, health & safety) FM services to better understand what FM entails and how it is organised; 2) To investigate the advantages and disadvantages that information models can bring to FM. Particular emphasis was placed on reactive maintenance services; 3) To assess BIM FM maturity levels to better understand and develop an application of the BIM maturity model for FM purposes; and 4) To identify enablers and barriers to BIM-based FM. Because of the limitations set for the conference papers only some of those will be presented here.

The research strategy was Case Study Research. The tools and methods used for data collection included a literature review on FM and ICT related topics, and interviews with project team members and FM team members. It also involved the use of the NBIMS Capability Maturity Matrix (NBIMS 2012) and archival analysis of documentation, and a workshop was carried out for data validation. The sources of evidence utilised were information extracted from the BIM with the addition of verbal explanations describing the integrated processes.

Mapping hard and soft FM services. From the literature review, several FM services were identified (Table 1). In general they are organised in key priority areas, each having its specific subdivision to facilitate the monitoring of performance indicators.

Mapping the as-is and to-be processes. From the interviews, it was understood that reactive maintenance currently represents 2/3 of the daily activities carried out by FM managers. Therefore it was the area mapped in this exercise. The remaining 1/3 of the time is used for carrying out Planned Preventive Maintenance (PPM). According to interviewees the amount of calls for reactive maintenance have a negative impact on the planned preventive maintenance. The FM team is working towards streamlining this process in order to have more time available for planned maintenance duties, so as to reach the current target of 90% completion rate of PPM tasks per month.

Table 1. Facilities management services

Facilities Management

Health & Safety	Fire & Safety	Security	Maintenance Systems	Stat. test & inspect.	Operational	IT
• Occupational safety and health, including compliance with local, state, and national laws and agencies, such as the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA), and EN 54 • Industrial hygiene, including indoor air quality • Display Screen Regulations • Safety Rules for Contractors • Permit to Work System • Risk Assessments • Control of Substances Hazardous to Health	• Fire protection and safety • Fire Risk Assessments • Fire Doors • Fire stopping • Wet risers • Fire extinguishers • Sprinkler systems • Fire alarm systems • Smoke/heat detectors	• Security • Access control • Security guarding • Intruder alert • CCTV	• Heating, ventilating, air conditioning and refrigeration • preventive and predictive maintenance • Corrective maintenance/ Reactive repairs • Building automation systems • Building fabric and decorative • Grounds maintenance and horticulture • Computerized maintenance management system	• Lifting equipment • Work equipment • Legionella • Pressure systems • Asbestos • Man-safe systems (window cleaning, roof access, etc.) • Electrical portable appliances and fixed wiring • Lightning conductors • Emergency lighting • Fire protection systems • Compliance audits	• Help desk • Asset management • Disabled Access • Cleaning • Waste management • Environmental Issues • Reception • Meeting room management • Mail Room • Photocopying • Vending • Office space planning, layout, and furniture placement • Car Parking • Specifying, tendering and contracts' negotiation • Pest control • Daily inspection of escape routes and fire exits	• Hardware Maintenance • Software maintenance • System management • Upgrading • License control

Based on the collected information the research team made two process maps, "as-is" (current state) of the reactive maintenance system in which BIM is not considered and "to-be" (future state) in which BIM is embedded in the process routine. Finally, a comparative analysis between these two scenarios was carried out.

The diagram in Figure 1 depicts how the process of reactive maintenance is currently conducted within the MCC. It also shows the stakeholders involved as well as the software systems and sources of information used by FM managers to manage this process. In this process, there are 7 main actors involved in the process of reactive maintenance.

As shown in the process map, there are three separate software solutions used in the reactive maintenance process. Because of the lack of interoperability the information of service orders raised in the Helpdesk System has to be manually entered in order to get a protocol number that is then entered into the next system to generate the invoice. Taking into consideration that for each job there is a need for logging the problem, indicating progress and closing the job, in the current system each job thus has nine points for information entering within three different systems.

Another relevant aspect to be highlighted in the current state is the way that the FM team assess the information necessary to carry out the reactive maintenance process. Currently, the assessment is done by consulting blueprints and archived hard copies of documents, such as statutory requirements, product manuals and facility design information. These documents are stored within the facility and due to intense use over the years the documentation is partially out-dated and worn-out.

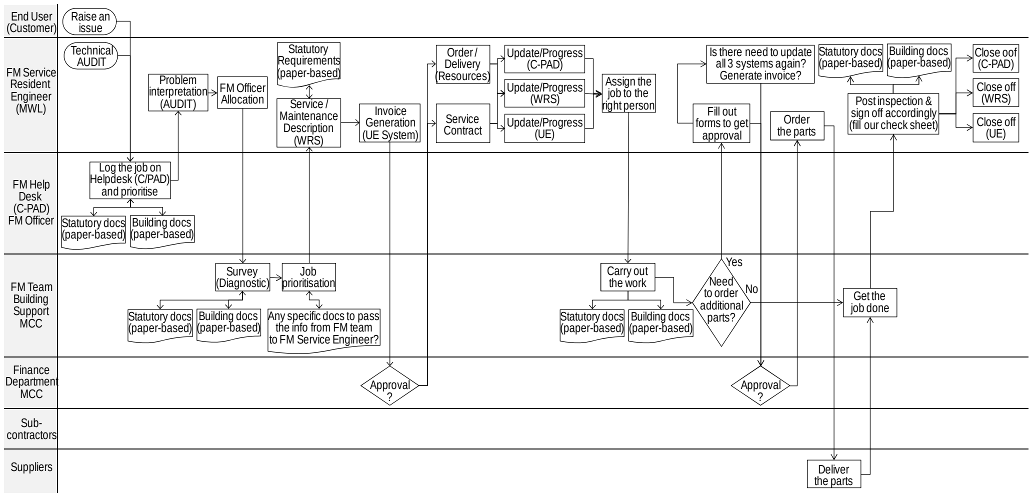

Figure 1. Current state map of the reactive maintenance process within MCC

The diagram in Figure 2 shows how the process of reactive maintenance within the MCC has been streamlined in the ongoing implementation. Similarly to the current state map, the FM Service Resident Engineer (SRE) is the leader of the process in the future state too. The responsibilities of the actors have not changed, but differently from the current state, there will be four interoperable software solutions for supporting the reactive maintenance process and instead of manual paper-based archive the assessment information will be available in the databases.

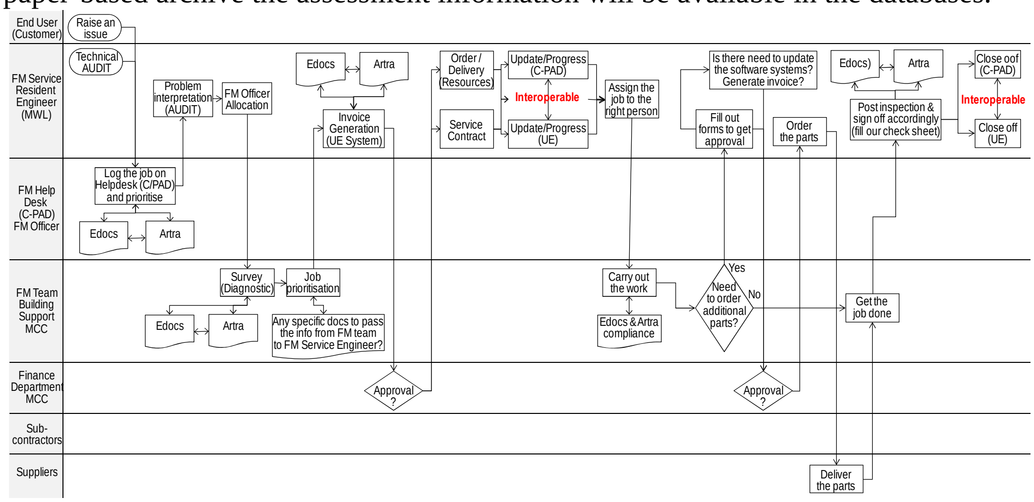

Figure 2. Future state map of the reactive maintenance process within MCC

Comparative analysis – current state vs. future state. Reactive maintenance involves not only the work done by trades on fixing the problems reported by end users but also gaining information about the problems. This task is carried out by the FM managers through surveys on site and research into building documents prior to trades getting on site. This is the most time consuming part of the process because of the fragmented information stored in archived documents e.g. drawings, equipment specifications, O&M manuals, warranties, etc. Thus, a major advantage of BIM is related to data/information structuring and access. According to the FM SRE, one of the issues faced in old buildings such as the Town Hall is that it has been patched up over the years leading to out-dated and inconsistencies in documents. There is no central source of information in which the FM manager could explore in detail the characteristics and configuration of the area or service to be repaired. In some instances, there is no documentation other than employee's knowledge.

It is envisaged that the use of BIM will facilitate the search for information. The preliminary tests in THC indicate a significant reduction in time spent searching for relevant and accurate information of the building and its components, when it is digitally linked and stored. Thus the FM managers would be able to perform a better and faster diagnosis of the reported problem.

Another advantage of using BIM would be to ensure that the work is carried out in the correct area. THC is a considerably large building that contains a number of relatively similar or identical rooms. This building characteristic, associated with a compact FM team and a non-sophisticated IT system, imposes difficulties for keeping track of the rooms that have already been subject to maintenance works or soft services, and the use of BIM could improve and speed up the control process.

Identified future actions. The interviews indicated that the FM team was aware that the use of BIM will require the definition of a number of operational processes. For instance, model updates will have to be performed systematically to maintain the accuracy of the information. Interviewees were also aware that even a simple process such as model updating will require the definition of protocols for data structuring, roles and responsibilities. These issues must be resolved prior to BIM FM becoming fully operational within the THC. More importantly the FM team knows that the decision for using BIM must be one that is linked to solving a practical problem to avoid the creation of complex and costly processes that are less efficient than simple ones. As stated by the FM manager: "…maybe it will cost me more to process the changing of a bulb in the system than the actual cost of the bulb and changing it".

An additional issue observed in the current state map is the occurrence of repetitive operations. These repetitions are perceived to occur due to the lack of interoperability amongst software systems used by the Council and its service providers. The awareness regarding this issue led the FM team and the service provider to look for a joint solution that is to be implemented before the end of 2013.

A further improvement that is expected from BIM FM is the systematic generation of information, such as KPIs. To achieve this improvement the FM team will have to define the criteria for measuring process improvements as well as financial savings. For instance, actions could be taken by knowing what problems related to reactive maintenance happen most often. Also, managers could interrogate the system to check the number of purchases of a certain component (e.g. pumps or bulbs) during the year in order to decide whether this component should be bought through bulk buy or in small batches. To date, these KPIs are not clear or known. However, the FM team has started investigations through the realisation of internal case studies. It is fundamental that managers understand where process inefficiencies occur so as to be able to measure value-for-money related to BIM implementation. The exercise of analysing the existing information will provide clarity on where to go and should indicate where the opportunities for improvements are in the future.

In this respect, an important shift was perceived during the research. Rather than investing time defining the information required for operationalizing BIM FM, the FM managers have changed their focus to the examination of the existing information within the organisation in order to identify the current problems through cost saving analysis. The FM department is working at the moment on the development of business cases with the aim of justifying the use of BIM. It is expected that this exercise will increase the level of awareness of the FM team with regards to the potential value that BIM can bring to the FM processes and also to identify the areas in which more information should be gathered. Also, it is assumed that the identification of potential improvements will facilitate the deployment of BIM since it can serve as a starting point for the implementation.

DISCUSSION AND CONCLUSIONS

The literature review and case study indicated clearly that one of the main challenges faced by facilities managers is the lack of up-to-date information, integration and transparency across the many functions of FM. Integration and interoperability seem to be the way forward for the sector and BIM has been considered as a facilitator of this process. Although there are some FM software capable to use BIM, the fragmentation and lack of interoperability of the existing FM systems is a major obstacle. However, our research supports the findings documented also in previous studies; the main challenges in adopting BIM in FM activities are not related to technology but current work processes and organisational structures.

The demonstration of maturity levels through the use of NBIMS maturity matrix models helped to understand how different practices (design, construction and FM) are approaching BIM and what their main interest and competences are. It also supported making explicit the set of alternative services that can be supported by BIM, therefore facilitating communication between clients, designers and contractors. However, it is important to highlight that the use of BIM maturity matrices for FM requires adaptation to be more related to the FM practice and its intricacies. The barriers associated to the change in technology can be overcome with training, but the implementation of BIM requires first that organisations become aware of their own inefficiencies, so the adoption of BIM is purposeful; an organisation that does not know its problems, cannot improve them.

As a public project, from where it started the THC team achieved a relatively high level of maturity. In relation to FM, the results were above expectations and considerably higher than the average performance of the sector. However, several issues still remain to be solved. For instance, there is a need to better define the BIM capabilities for FM. In this respect, an initiative has been taken and the examples of capabilities to be implemented in the future include links to several functions; fire strategy and evacuation plan, security strategy, thermal modelling building changes, digital signage, energy management system, staff induction tool, customer communication tool, marketing tool, operational zones, cleaning, events, and ability to run logistical tests (e.g. flow and movement). Also, the approach adopted at the THC was a bottom-up one. This means that the required interdepartmental integration that could bring gains to the primary business of the organisation is yet to be achieved. It also means that the initiative for the adoption of BIM is required from the senior management in a top down approach.

A lesson learnt from this research is that the expected utilisation of BIM from design and construction in FM activities is not a straightforward exercise. In general the BIM used for design and construction practice does not contain all, or even a significant part of, the necessary information for FM (soft and hard) practice nor were its assemblies created in a way that would benefit FM. For that, a champion that is capable of managing BIM and also an FM expert is necessary.

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