DIFFERENT PERSPECTIVES ON FACILITIES MANAGEMENT TO INCORPORATE IN BIM

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ABSTRACT

Purpose: This paper will review the value of Building Information Modelling (BIM) and demonstrate how the early integration of Facilities Management (FM) within BIM can enhance building performance from the perspectives of the building delivery team, facilities management team and building occupants.

Background: It is proposed that involvement of the facility management team at an early design stage can contribute towards enhancing building performance, but this requires a multiple perspective of FM to be adopted. BIM has the potential to be used for managing facilities as it provides extensive information about all physical assets in the building.

Approach: Pilot data has been acquired from a newly built and operated university building in the United Kingdom using interviews to capture information from these different perspectives.

Results: The differences in perspectives are presented based on the responses collected from the interviews. Three parameters are used to compare and analyse them highlighting how these differences are difficult to accommodate in building design

Practical implications: The paper proposes a structure for BIM to accommodate the different perspectives on FM from the building design stage. This leads to the necessity of involving the facility management team during the design and construction process.

Research limitations: The proposed structure is based on the responses from the interviews, and may apply to other educational buildings, but may not be generalised to all buildings.

Originality/value: This paper provides an initial platform towards better understanding of the contribution of facilities management in the design process to improve building performance with the use of BIM.

Keywords

Building information modelling (BIM), Building performance, Facility management (FM), Soft systems.

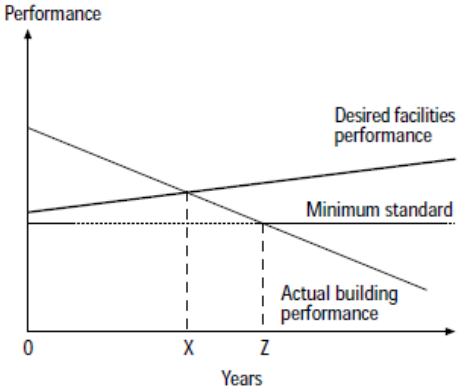
1 INTRODUCTION

Buildings are the containers of many social activities where this imposes the need for an efficient building design that can operate effectively, support these activities and can be maintained for a longer period. Studies of building performance have shown that buildings do not perform as intended and are a barrier to productivity (Cooper, 2001). Building performance is a complex concept that has been difficult to measure and to incorporate into building design. The advantage of being able to make buildings to be a productive workspace for their occupants is essential both financially and organisationally. Facilities management (FM) supports maintaining the building performance by managing operations by integrating people, place, process and technology to ensure functionality of the built environment (IFMA, 2013). Nevertheless, the challenge of integrating sophisticated multidisciplinary systems within the building to perform as intended once the building starts operating has increased the difficulty of evaluating building performance (Mahadev, 2010). The advent of BIM provides the opportunity to predict building performance. BIM collects extensive data and performs calculations in real time to feedback information to the building designers. This paper reports on part of a wider study that is researching this use of BIM in the design process to deliver building performance during design and the role of FM to deliver performance. The adoption of multiple perspectives represents one of the bases of soft systems where different perspectives are essential in solving real life issues (Mehregan *et al*., 2012). In addition, soft systems enable effective collaboration among stakeholders negotiating different actions that can be taken to improve situations. This paper considers the way that different perspectives on facilities held by the building delivery team, facility management team and building occupants affect building performance. It uses semi-structured interviews to capture these perspectives in the context of a newly completed building. Differences in perspectives are analysed to propose an information framework to incorporate these different perspectives on facilities into BIM model.

2 STATE OF THE ART

There is a growing interest in the area of building performance as buildings do not perform as intended. Ensuring the intended performance and operation of buildings will extend the service-life of buildings (Dino and Stouffs, 2014). One of the major causes of inefficient building operation is inaccurate evaluation of building performance at the design stage (O'Donnell *et al*., 2013). This is because building performance can be interpreted in many different ways such as evaluating it against the identified requirements for the building or how the building is being perceived by users, and thus it is an interdisciplinary concept (Alexander, 2011).

Figure 1: Relationship between facility management and building performance (Douglas, 1996)



Inevitably, the performance of any building declines over time (see figure 1) and this is due to many factors including these associated with climate change, technical issues or user misuse (Douglas, 1996). On the other hand, the degree of this decline is claimed to be dependent on how well the facilities support the building (see figure 1) in order to maintain the performance over a longer period of time (Douglas, 1996; Barret and Baldry, 2003). According to British Institute of Facilities Management (2014), facilities management is defined as integrating processes within an organisation in order to maintain the agreed services that support and improve the effectiveness of the primary activities for that organisation. In this context, FM includes hard facilities (e.g. building fabrics, MEP systems) and soft facilities (e.g. catering, security, cleaning) in the building.

Facilities management (FM) is also incorporated in the performance of some building aspects such as energy usage by engaging with up-to-date models for energy management, calculation of building's life costs and sustainability certification (Junghans, 2013). Some systems such as computerised maintenance management system (CMMS) have been developed to support facilities and their maintenance performance (Lai and Yik, 2012), but it is yet to be identified what information is to be acquired and to what extent it can be integrated to enhance the facilities' performance. The value of facilities in a building should be considered in the context of its use and as a service provider to extend the life of the building (Alexander, 2011). This supports the need for the building to be considered from a user perspective so as to be efficient for use, and from a facility manager's perspective to be easily maintained. Nevertheless, bridging this multiple perspective gap between FM and building performance needs a tool to manage the complex information and provide this knowledge so that it can be utilised in an effective way. BIM (Building Information Modelling) provides a full design model by integrating all systems (structural, architectural, MEP and HVAC) within one whole model (Porwal and Hewage, 2012) supporting an inter-disciplinary simulation and analysis in a single model (Azhar *et al*., 2011).

According to British Institute of Facilities Management (2012), BIM currently does not represent a solution or a tool for FM, but it is a process that allows facility managers to inform the designers about the information they need at an early design stage. British Institute of Facilities Management (2012) claims that showing a 3D visualisation of the plant room to building maintenance people using BIM could offer the opportunity for better training and avoid maintenance access problems. One way that BIM is being used for facilities management is the creation of Construction Operation Building Information Exchange (CoBie) structured information which provides spreadsheets of data containing list of equipment, product data sheets, preventive maintenance, etc. (East, 2013). However, the representation of these sheets do not adequately represent the performance of a building from a facilities managers' perspective as they do not reflect the problematical nature of building operation and maintenance (Mayouf and Boyd, 2013).

These current approaches to the development of BIM for facilities management do not acknowledge the differences in viewpoints that occur between different stakeholders in buildings. In fact, BIM effectively only provides a single perspective of information which is contributed by the building delivery team. This has a negative impact on FM operations (British Institute of Facilities Management, 2012) both because it does not accommodate what is necessary for managing building operations and because it does not recognise the different concerns of building users. An effective evaluation of building performance requires multiple perspectives in terms of project stakeholders (designers, facility managers and occupants) to be considered. A multiple perspective would acknowledge the problematic nature of FM in buildings and how it impacts building performance from the perspectives of designers, facility

managers and occupants. BIM would enable the involvement of the facility management team, incorporating their requirements and occupants' needs which would enhance the delivery of building performance.

3 APPROACH

The wider research uses a soft systems approach as a process of inquiry into a problematic situation which acknowledges cultural differences and systemic complexity (Mehregan *et al*., 2012). As part of this work, case study research was conducted on a newly operating (September 2013) university building in the United Kingdom. Interviews were undertaken with members of the building delivery team, the facility management team and building occupants on their perception of building performance.

There were four interviewees from the building delivery team, including the university's estates department (project director, BIM coordinator and BREEAM assessor) and building designer (BIM manager). The selection of these individuals sought to explore any contradictory understanding of building performance even though they belong to the same team. There were two interviewees from the facility management team; a senior facility manager and building services supervisor. This enabled a view of both soft and hard services and the way they should be delivered to satisfy building occupants' needs. There were three interviews with university staff who were chosen to represent the building occupants and had continual daily use of the building. These three groups allow multiple perspectives of facilities on building performance to be explored.

The data was collected individually using semi-structured interviews, as this allows the exploration of more detailed insights about different perspectives on building performance. The use of the interviews in the context of a case study would allow a live reflection on the building itself from a performance perspective and unlike surveys (for example, post-occupancy evaluation), interviews would allow the discussion of different meanings of the idea of performance. The interview questions aimed to investigate the different perspectives with respect to the concept of building performance, role of facilities in the building and how BIM can support achieving the desired building performance. These factors were selected to allow an understanding of: the different perspectives on the performance concept, how facilities management can deliver building performance and how design technology (BIM) can assist in this task. A brief introduction to BIM was provided for the facility management team and building occupants, so as to enable discussion about the sort of information that it would be useful for BIM to include.

4 RESULTS

Respectively, the results present the responses from the building delivery team, facility management team and building occupants. The results represent the responses from interviews are presented for each perspective under three parameters which are: concept of building performance, facilities management role for building performance and BIM value to support building facilities. These three parameters provide a more holistic approach towards understanding the problematical nature of FM, its effect on building performance and BIM value to support it.

4.1 Building delivery team

Table 1: Building delivery team perspective

Role / **Criteria**	**Concept of building performance**	**Facilities management role for building performance**	**BIM value to support building facilities**
Project Director	It is about maintaining all levels of understanding of control and maintenance of the building's energy and operation on the long term.	Impacts building life cycle.	Energy assessing and maintenance information.
BIM Coordinator	The performance of the building is to do with energy efficiency and maintenance.	Flexibility and adaptability for the building.	Space and maintenance information.
BREEAM Assessor	It is based on energy efficiency and how the building can function adequately to meet the needs of the users.	Delivering sustainability.	Facilities information.
Architect (BIM Manager)	It is about maintaining the balance between aesthetics, robustness, durability, thermal comfort, levels of natural and artificial light, energy usage, flexibility to suit changing uses, acoustic performance, capital budget, on-going maintenance costs, clarity of building diagram and organisation of spaces to avoid clutter of imposed signage, integration of services with structure and building fabric and accessibility of building and its uses to all.	Occupants' satisfaction and maximize building assets for the most efficient usage.	Allows optimisation of layouts when modelling required access for plant maintenance or replacement which in return allows maintenance to be planned without unnecessary disruption to the users.

4.2 Facility management team

Table 2: Facility management team perspective and their standing point with BIM involvement in the process

Role / **Criteria**	**Concept of building performance**	**Facilities management role for building performance**	**BIM value to support building facilities**
Facility Manager	The building needs to function in a way that keeps the occupants comfortable and it also depends on from what perspective you look at it.	The middle connection between occupants and building design team.	Ease of information retrieval especially for operation and maintenance manuals. It would help if BIM can find the specification of a particular item. Benchmarking the flexibility to accommodate changes.
Building Services Supervisor	Everything in the building should be in working order and what the customer needs is there for them.	Maintain the building performance for a long period and they represent the undercover power of the building.	It would show the facilities which can or cannot be removed from a space. Engaging BMS (building management system) with BIM.

4.3 Building occupants

Table 3: Building occupants perspective and their expectations of BIM involvement in the process

Position / **Criteria**	**Concept of building performance**	**Facilities management role for building performance**	**BIM value to support building facilities**
Senior Lecturer	The way that the building performs as a result of the planning process by the various ranges of disciplines which in total should allow me to do my work.	It should contribute towards the health and safety for the occupants. It occupies a major role in the working environment.	Occupants should be informed about the how the building is functioning. Occupants can contribute towards some of the health and safety issues associated with the design of the building. Space settings should be informed to the occupants.
Senior Lecturer	It has to support my needs as an occupant to do the job assigned to me.	Facilities should be where you actually need them. Should not have any adverse effect on occupants' health and safety. Occupants should be informed about who to tell about any issues arising.	Should allow occupants to know which facilities are movable and which ones are fixed. Check the facilities locations and whether they conflict with the access pathways within the building. Noise level of facilities within open spaces.
Deputy Head of a School	It depends on what the building is going to be for; there are several parameters to measure like feeling, heat comfort, and connectivity between spaces among the building.	Functionality and the quality of its work. Should be interactive with the users of the building. People should have an easy access to feedback about facilities.	Some noise levels from heating and cooling systems. Occupants to be informed about certain aspects within the building. Facility management should interact with users in a way that allow them to report useful information back to the designer.

5 PRACTICAL IMPLICATIONS

The data from the interviews presented in the previous section provides an insight into the problematic nature of the delivery of building performance. Three issues will be discussed. First, the singular nature of the concept will be challenged and the need for multiple perspectives illustrated. Second, the role of facilities management in delivering building performance in building operation will be outlined. Finally, the requirements for BIM to help this provision will be presented.

5.1. Concept of building performance

The interview evidence demonstrates that the three groups see building performance in different ways. Indeed even within the building delivery team the concept was not understood in the same way, although all saw managing energy as part of building performance. These different understandings related to their disciplinary backgrounds. The BIM manager (project's architect) provided the more holistic definition also relating to aesthetics and organisation of space. The facility management team saw building performance as the ease of maintaining facilities within the building and the functionality of building facilities to serve the occupants' needs. The occupants on the other hand claimed that good building performance should allow them to do their daily job comfortably. Each of these groups sees building performance differently depending on their needs. The success of a building is multi-dimensional but it is critical that it works for the occupants who must be productive in their practice. The facilities management team did understand this but could not explain this in detail or show its application in practice. The different perspectives for building performance demonstrate the necessity for a more holistic approach for building design and operation that accommodates these differences.

5.2. Facilities management role for building performance

The facility management team have a different perspective on building performance but can only influence this as part of building operations. They focus on maintenance and management issues of the building thus necessitating easy monitoring of facilities to report problems and manage the facilities to maintain long-term operation of the building. They did understand the need to maintain the facilities for occupants' satisfaction but are only able to engage with this in a reactive way when occupants report issues or make complaints. Most importantly, the facility manager pointed out the difficulty of retrieving facilities information especially for maintenance; currently this is only available in operation and maintenance manuals. The facility management team are aware that the layout of the mechanical, electrical and plumbing systems in the building has a direct impact on their ability to maintain efficiency but have little control over this. The layout of public and private spaces and the relation of the services to these also influence other factors like noise levels and usability again these are dealt with only when problems arise. The ability of the facilities management team to deliver building performance is very limited both for the maintenance of facilities and the accommodation of occupants needs. Such issues show the need for multiple perspectives in the consideration of facilities in the building at the design stage. It is claimed by Jensen *et al*. (2012) that incorporating different stakeholders perspectives into FM would have a major impact on the value of FM. This implies the necessity of involving the facility management team at an early design stage by giving them the means to work through their tasks.

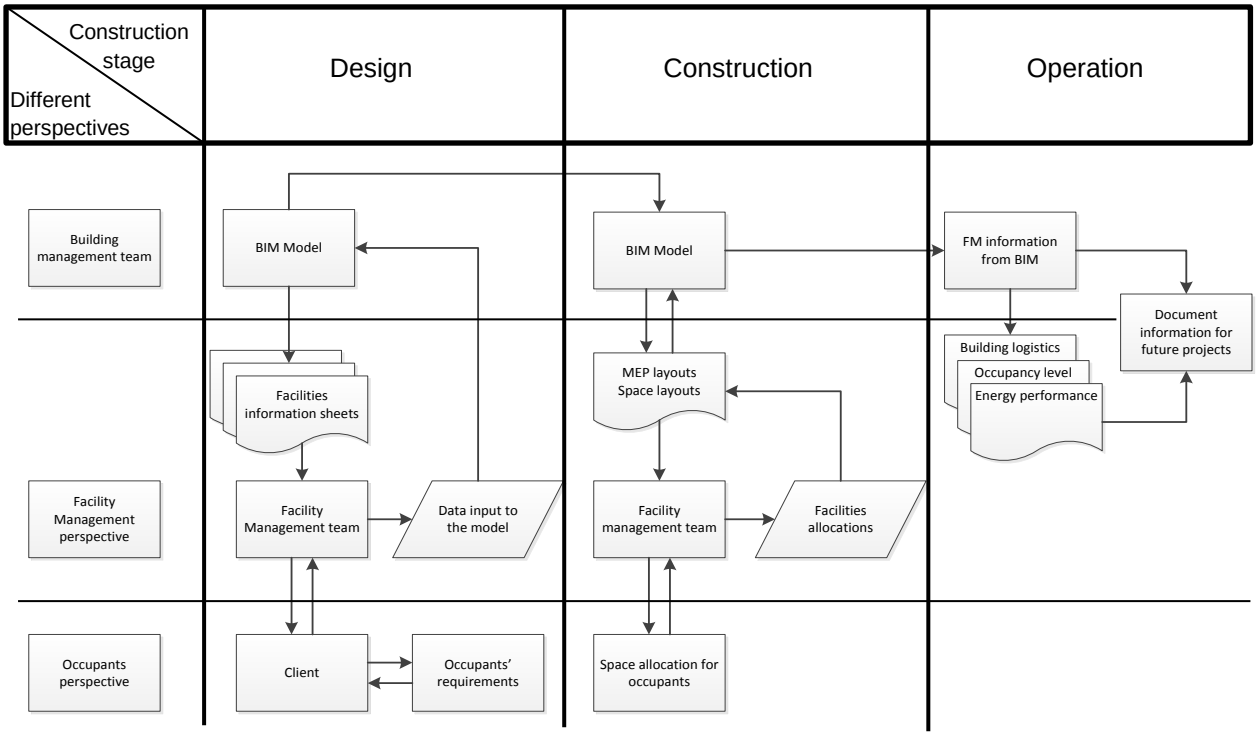
5.3. BIM value to support building facilities

As discussed in the previous sections, building performance is seen differently and the facilities team is not able to proactively deliver building performance. This paper argues that BIM has the potential accommodate different perspectives and to engage all parties more effectively in the design process to deliver building performance. In particular, for the facilities management team, BIM can bring greater and more effective information for operations and maintenance through this being included in the model. The model would allow them to check the equipment specification and benchmark the flexibility to accommodate changes. Although, not identified strongly by the facilities management team, they were aware that they would require more involvement early in the design stage in order to provide better building performance. In these

respects, BIM should represent a useful collaborative platform where fragmented bits of information can all be taken in consideration to achieve overall better building performance.

Nevertheless, as claimed by Wiesner *et al* (2011), data models currently lack sufficiently structured information for use by facility management team and so this remains as an obstacle for BIM to be useful for FM. Rasys *et al*., (2013) also point out that current existing information integration uses a mediator engine to represent heterogeneous data sources as if it were a single data sheet. This illustrates that although BIM could support the integration of the three perspectives, information is not currently available which serves the needs of each perspective. Figure 2 proposes how different perspectives on building performance can be incorporated into BIM.

Figure 2: Proposed framework for FM information incorporation among all stakeholders



This illustrates how at the design stage, documents with respect to facilities information (e.g. their location, function, heating or cooling) can be shared with the facility management team to help them to understand FM and occupants' needs. This would raise the designer's awareness of maintenance factors for the facilities, the effect on occupants' of possible breakdowns of some facilities (e.g. HVAC) and reduce costs as changes can be applied at this stage before commencing to the construction phase.

During the construction phase, the facility management team can integrate the finalized Mechanical, Electrical and Plumbing (MEP) layouts into the building's building operation management system which can also measure performance of the building. Additionally, the space layouts could also be provided to the facility manager through the BIM model as they are more aware of the possible noise levels, maximum capacity for occupants and accessibility for users within the building and can therefore assist the delivery of better building performance.

6 CONCLUSION

This research aimed to investigate the value of facilities in improving building performance and how BIM can facilitate the delivery of different perspectives with respect to facilities in the building. Literature showed that the value of facilities plays a major role through the life cycle of the building. BIM provides information integration and supports coordination among those involved in building delivery by integrating interdisciplinary systems in a single model. Interviews showed multiple perspectives of building performance, which contribute to buildings not performing as intended. The facility management team are limited in their ability to support building performance and need to be involved during design. BIM provides the opportunity for this to happen. The practical implications of this research will be to incorporate the information needs of facility managers in the BIM model in a way that connects the building delivery team and client (including occupants). The proposed inclusion of FM information would raise the awareness for BIM coordinators of the sort of information that should be collected through building delivery. It is believed that with BIM capabilities, the gap of building performance can be facilitated through a more holistic multiple perspective approach to have a more effective integration of building facilities.

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