BIM FOR FACILITIES INFORMATION MANAGEMENT

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ABSTRACT

Successful adoption of Building Information Management (BIM) during design and construction phases is recurrent, and the benefits achieved through such adaptation had been encouraged to extend BIM in to other phases of construction including facilities management. However, a limited application of BIM in construction facilities management is noted. This paper reveals the potential use of BIM in FM phase, by giving more priority on 'value of information'.

The paper is based on a detailed literature review. The first section reveals the application of BIM in AEC/FM environments and second section discusses the industry standards and guidelines behind BIM in FM. The findings of the literature review explain that the key technological features attached to BIM drive for its wide application, however most of these features are tailored to design and construction tasks rather helping in FM tasks. A non-realisation of value of information is identified as a key issue for limited adoption of BIM in FIM. Therefore, the paper recommends to identify the value of BIM in its complete sense (information, technology and pocess) to understand the FM information requirement and technical developments that is necessary for specific FM needs.

Keywords: *Building Information Modelling (BIM); BIM Standards; Facilities Management (FM); Information Value.*

1. INTRODUCTION

Construction industry has stepped forward into digital construction through Building Information Modelling (BIM). BIM is a digitised approach supporting through life application of building information with an information exchange and interoperability capacity (Eastman, 2011). A frequent adoption of BIM during design and construction phases is identified (Eadie *et al*., 2013), and if this extends towards the facilities management (in-use) phase, significant benefits can be further expected. Information rich BIM models are capable of overcoming the issues of handover process (Kassem, Kelly, Dawood, Serginson and Lockley, 2015). Although the application of BIM is dominant in early stages of a building, owners and facilities manager have good potentials in achieving benefits of through life BIM adoption (Eadie *et al*., 2013; Howard and Björk, 2008). However, it is important to note that all the potential benefits are based on the information it carries and information passed through to the facilities managers and owners may depend on the clear specification of employer information requirement (EIR) at the early stages.

Having identified the lack of motivation in facilities management sector in adopting BIM for FM tasks, this paper reveals the key reasons for such slow pace adoption. The first section of the paper discusses the key features of BIM and it's through life applications in construction context. When considering the through-life application of BIM in construction, an extra effort needs to be made in early stages of a facility to identify the EIR, although very little payback/incentives were given for such efforts. Therefore, this paper further investigates the available approaches for identifying the EIR at the early stage of project initiation. The standards and guidelines which support the decision on specifying information requirements and their limitations are also discussed where appropriate. Finally, paper argues that there is a clear gap in current knowledge on realising value of BIM beyond a mere digital model.

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2. BUILDING INFORMATION MODELLING IN AEC/ FM ENVIRONMENTS

Building information modelling was initiated in Architecture, Engineering and Construction (AEC) sectors of construction industry because of its visualisation ability (Volk, Stengel and Schultmann, 2014). This was further extended to FM industry. Visualisation has made a major impact on adopting BIM in AEC/FM environments. A shift from 2D platform to a BIM environment is a significant value addition in current design and construction environments. Moving forward, this is also recognised as a significant feature to be considered in facilities management functions. Visualisation through 3D modelling has been popular in daily operations and management as well as to understand root causes for the problems in FM (Patacas, *et al.*, 2015). One such example is scenario planning for refurbishment projects with least disturbance to existing structure (Kassem *et al.*, 2015), and locating building components (Korpela *et al.*, 2015). Scenario planning is one of the commonly achieved benefits by adopting BIM in FM.

Collaboration is another key feature in BIM. It solves many issues encountered due to the fragmented nature of the construction industry (Eadie *et al.*, 2013). In other words, BIM brings all stakeholders together into a single platform taking them out from the silo environments. This feature has the highest positive financial contribution to BIM projects during design and construction stages (Eadie *et al.*, 2013). Yet, there is hardly any evidence on considering collaboration in FM tasks. Cost modelling is another such use of BIM which is benefited at the early stages of a construction projects (Eadie *et al.*, 2015) yet no straightforward application beyond the construction phase.

Clash detection is a similar impressive feature, which facilitates the review of different drawings (architectural, mechanical, structural etc.) together to detect any physical clashes. This feature is a value addition of BIM and it is well recognised for the savings made by detecting potential variations/rework before starting the actual construction work (Eadie *et al.*, 2013). However, there is no considerable contribution to the FM tasks with this feature other than the potential small scale refurbishments which could take place during in-use phase.

Straight forward benefits of BIM for FM has been identified as significant time savings at the transfer of as-built information to the CAFM systems, and efficient handover process (Korpela *et al.*, 2015). Delivering handover information through digital format minimises the unnecessary time and rework in data transferring at the facilities management stage (Akcamete *et al.*, 2010). Although digital information is not a unique feature of BIM, it is considered as a value addition which comes along with it. This digitised aspect also add value in design and construction stage with altering design drawings over and over again with little effort. Another important feature is the intelligence. BIM model identify the space and objects for what they are rather symbolising (Ding *et al.*, 2014). Application of this feature could be seen in different occasions throughout the life cycle.

FM is trying hard to make some use out of the given BIM features. Figure 1 considers BIM features with FM expectations.

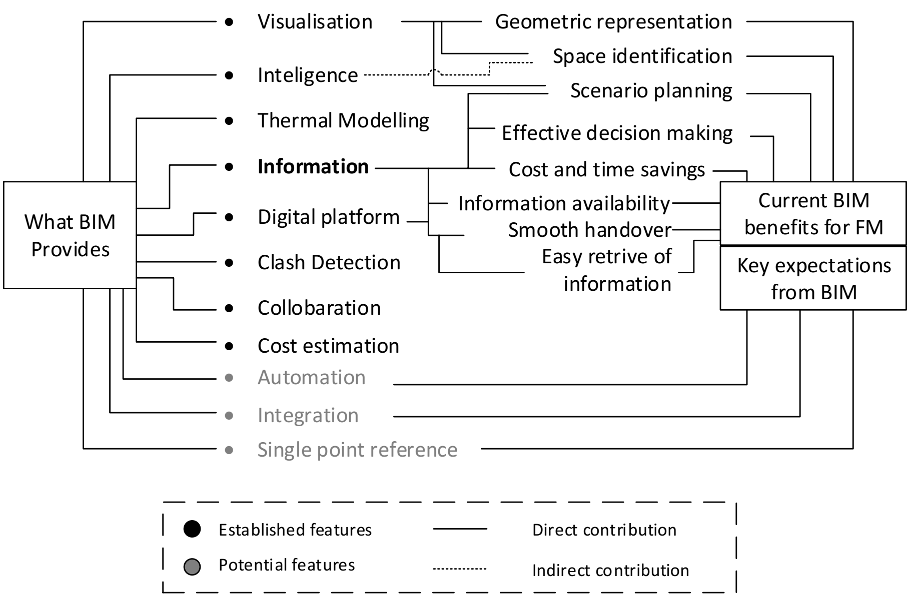

Figure 1: Mapping BIM Features with FM Expectations

For instance, visualisation through 3D modelling is a key feature in BIM, and it is utilised in FM for scenario modelling, presentation and management purposes. Therefore, visualisation is a feature which promotes the investment in BIM in FM. Another well recognised feature is clash detection. It has proven to be beneficial in design and construction stages more often. However, this is not an attractive proposition to promote BIM in FM. Likewise many established features are dedicated to improve the efficiency and effectiveness in design and construction stages rather in FM. On the other hand, most of the FM related BIM features are merely seen on papers to exaggerate the potential contribution of BIM for FM.

It is information which makes all above features possible (Antón and Díaz, 2014; Arayici, Onyenobi and Egbu, 2012), and it is the key value addition to FM through BIM. Therefore, it is essential that necessary information are included in the BIM model without information overloading (Parsanezhad and Dimyadi, 2014). Referring to the above features, it is clear that most of the exciting features are mainly for design and construction purposes and not many have an impressive contribution for facilities management. However, beyond the unique features, information carried through BIM has a greater potentials in FM (Eadie *et al.*, 2013). Therefore, it is critical to understand the facilities management information requirements to make the best use of BIM. A lack of experience and knowledge related to information requirements is a key reason for the limited adoption of BIM in FM (Giel and Issa, 2016). Therefore, the successful adoption of BIM in FM will depend on the understanding of value of information for facilities management and integrating these information in to BIM models. Identifying value of information is knowing what you need (Zhao *et al.*, 2008) indeed it is a filtering mechanism to separate what we need from what we want. The next section considers the standards and guidelines which supports identifying facilities management information requirements.

3. FACILITIES MANAGEMENT RELATED BIM STANDARDS AND GUIDELINES

Facilities Management (FM) is the integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities (European Standard EN 15221.1, 2007). The FM process focuses on managing the complexities of a built facility to smooth functioning of its physical structure and support services to enhance the core business performance (Kincaid, 1994). Towards achieving such targets, the information flows during FM stage is significant.

FM deals with enormous amount of asset information; including acquiring, updating and analysing of them (Wang *et al.*, 2013). BIM as a platform evolving from the early stages of a building is a perfect solution for FM data management. BIM allows to communicate FM needs at early stages of projects (British Institute of Facilities Management, 2012). The positive contributions of BIM for facilities information management (FIM) is identified as a significant value addition to FM (Gu and London, 2010). Eadie *et al.* (2013) explain facilities managers and clients benefit the most out of BIM implementation. Klein *et al.* (2012) argue that a considerable effort should be given to define client’s FM needs at the project briefing stage. However, majority of BIM enabled projects are reluctant to handover the complete 3D model and Construction Operations Building Information Exchange (COBie) datasets at the commissioning stage of such built assets, which prevents BIM adoption in FM (Eadie *et al.*, 2013).

Standards and guidelines are the most common way to understand the information needs at the early stages of a building. Having identified the potentials of BIM and its long-term benefits, the number of standards developed under this theme is rising fast. Table 1 summarises the standards and guidelines related to construction information management through BIM. The summery of the available standards reveals that major concerns related to BIM implementation is addressed. However, they do not provide a complete solution in specific to FM information requirements (Patacas *et al.*, 2015).

Table 1: FM Information Related BIM Standards

Standard/ Guideline	Relevant facts for information management
BS 8587:2012 Guide to Facility Information Management (British Standards Institute, 2012)	• Information management strategy, policy and procedure • FM handbook containing legal, commercial, financial, technical and managerial information about the facility • Recommends COBie • Asset registry

Standard/ Guideline	Relevant facts for information management
ISO/WD 19650 - 1 (PAS 1192 - 2) Organisation of information on construction works - Information management using building information modelling - Part 1: Concepts and principles	• Relevant standards for BIM and information management • Relationship between documents used for information management • Information delivery cycle and responsible parties for each stage • Content areas of EIR • Information classification – Uniclass • Information Exchange - COBie
ISO 19650 - 2 (PAS 1192 - 3) Organisation of information on construction works - Information management using building information modelling - Part 2: Delivery phase of assets	• Relevant asset information standards • Information management plan • Asset information process • Content of the Asset Information Model (AIM) • Link between AIM and enterprise system • Need of a data manager to enhance accuracy of data
BS 1192 - 4:2014 Collaborative production of information Part 4: Fulfilling employers information exchange requirements using COBie - Code of practice	• Assist information demand side • The role of employer, design/contractor lead and subcontractors/manufactures in information exchange • Purposes of required facility information
CIC BIM Protocol Standard Protocol for use in projects using Building Information Models (Construction Industry Council, 2013)	• Need of an information manager • A form to be attached with the contract documents explaining BIM model needs specifically with data drops at different project stages, types of software and version to be used
Uniclass 2015 A universal classification system for the construction industry	• A classification system for building elements and products
ISO 16739:2013 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries (British Standards Institute, 2013)	• A standard format for data exchange • Provide categories and coding system for building elements and assets
BS 8536-1:2015 Briefing for design and construction. Code of practice for facilities management (Buildings infrastructure)	• Early involvement of the FM for information requirement identification • Transfer of information from Project Information Model to Asset Information Model • Specified after care period to extend the service of the project team after the handover of the facility
Digital Plan of Work	• Web-based free tool to guide the information responsibilities and delivery at each stage of the construction project • Defines information requirements

4. VALUE OF INFORMATION

Understanding value of information forms the foundation to recognise value of BIM. The term 'value' is multifaceted, providing different meanings to different stakeholders. Therefore, what is communicated by term value could make a significant difference in the choice of adopting BIM. At a glance, it is the 'cost' over 'benefits', which represents the ultimate worth of the considered matter (Neal and Strauss, 2008). Literature suggest several mechanisms to determine the value of information. From a case study analysis, Gavirneni *et al.* (1999) developed an equation to measure the value in supply chain information flow. The equation is integrated with the monetary, performance and lead time improvements made through availability of information. Similarly, by elaborating factors considered as benefits in value equation, Neal and Strauss (2008) introduced a measurement tool to capture the brand value. Both methods have been considered as successful attempts due to the structured nature of the manufacturing industry/products. There are key facts which can be taken forward to determine the value of information in facilities management yet not solely applicable due to heterogeneous characteristics in construction projects.

When being specific on information, allocation of a monetary value to a piece of information is not always practical (Gallagher, 1974).The method which is popular in manufacturing industry compares two situations of performing a task with and without completed information (Gavirneni *et al*., 1999). However, value is something more "adjectival rather substantive", therefore, it should be considered along with object and interest (Perry, 1914). Moreover, Gallagher (1974) suggested three possible ways to measure the value of information. Among those three methods, measuring the value after the information is being used and the consequences of the action are known as the best method to determine the value of information. Having considered such characteristics of value of information, this paper adopts "practical consequences result by construction information towards achieving the FM functions" as the value of information. Thus, the value-in-use is considered as its concerns fit with the characteristics of FM information, which assists to understand the uses of information within FM. Repo (1986) explained value-in-use as the benefits of information to its users which includes both subjective and objective in nature.

5. DISCUSSION AND CONCLUSIONS

Building Information Modelling (BIM) in construction considers use, reuse and exchange the relevant information throughout the building life cycle (Korpela *et al.*, 2015) while ensuring the efficiencies in terms of time, cost, and quality. To promote this good practice, responsible authorities around the world either recommend or have made it mandatory to use BIM in current construction projects (Kassem *et al.*, 2015). This influence is a clear reason to why it has slowed down the adoption of BIM in FM as it is a regulations pushed strategy practiced in related to BIM in FM rather a market pull strategy. The forecasted theoretical benefits of adoption of BIM in FM and popularity of BIM in design and construction phases have overrun the practical concerns of FM with regards to BIM. As a result, most of the information passed through BIM models during handover are useful for architects and contractors rather to facilities managers and owners (Clayton *et al.*, 1999; East, Nisbet and Liebich, 2013). As this make no good to facilities management, use of BIM model limits to fulfilling mandatory requirement of having a BIM model and no contribution to the efficiency in performing FM tasks. Therefore, there is a critical need to reflect on the facilities management needs in BIM concept in order to take BIM beyond construction.

Also, BIM process requires considerable effort in identifying and defining EIR in order to have a whole life application. In contrary, BIM does not provide an attractive payback for facilities management compared to the effort it demands in considered time frame. In a nutshell, current potentials of BIM does not bring a significant contribution compared to the current CAFM systems, hence facilities managers and owners are not much motivated to adopt BIM beyond construction (Korpela *et al.*, 2015). Particularly, FM related technical features such as automation and integration with rest of the CAFM systems are key expectations of FM. However, with the current trends in technological developments, this could be expected to be solved in near future.

The most common known reasons for backwardness in FM to adopt BIM is lack of tangible benefits, standard specifications, BIM skills, knowledge and resistance to change (Kassem *et al.*, 2015). Although there are number of standards and guidelines covering almost every area of BIM in FM to help adopting BIM, their usability depend on certain assumptions. For instance, PAS 1192 series gives a detail guidance on the process of defining information requirements to acquire asset information for FM. However, this is under the assumption that facilities manager is involved at the briefing stage of the project and/or client is well-informed about his requirements. Yet, both these assumptions are not frequent in current FM practices.

In conclusion, it can be noted that BIM is continuously moving forward from design construction phases to facilities management phase. However, such adaptation appears to be driven by the regulations and mandatory requirements rather than on a realisation of potential value that can be obtained by the client. On the other hand, the broader concept of BIM offers benefits in facilities management phase. Especially in wider sense with big data, internet and virtual reality. The narrow focus towards BIM as a technology (3D model) and/or an information management platform has limited its application. Therefore, there is a gap in identifying the value of BIM as a complete package. Secondly, construction industry has a low record in moving forward with technology and improving efficiency. Introducing concepts and standards works for an ideal market would not fit for an industry which is not motivated through innovation and competitive market trends. Therefore, when considering the value, it is necessary to accept the backwardness in the industry with moving forward with high-tech solutions for the mere reason that *it is the trend*. The value is the trigger point to BIM for FM since the gap is not in what BIM is but how it is being packaged. Having understood the importance of value of information for facilities management is an achievement in itself, with or without BIM, under given circumstances as it is increasing the need to understand the value of information to make decision in an information driven world. As BIM provides through life economic benefits to project stakeholders, there should be a mechanism to promote BIM within FM information management. The paper recommends 'value of information' as a core mechanism that needs to be considered throughout the lifecycle of the project.

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