TOWARDS FACILITIES INFORMATION MANAGEMENT THROUGH BIM

ABSTRACT

Information plays a significant role in managing built environment facilities. These information are generated at different lifecycle stages, by different parties, which also provide different values to a variety of stakeholders. The acquisition of appropriate information efficiently and effectively is two of highly important considerations in facilities management because of the nature of information flows, number of information providers and users. Building Information Modelling (BIM) is one of the popular mechanisms, which has adopted in construction sector to manage its information. This preliminary paper investigates how construction information is valued in facilities management. This is an initial step of understanding the possibilities and hindrance of using BIM as an effective vehicle to manage information during the facilities management stage.

To achieve this aim, data were collected through literature review and 13 semi-structured interviews among construction professionals. Data were analysed thematically. The literature reveals BIM is an efficient mechanism to manage construction information. However, there is a difficulty of transferring appropriate information from construction stage to facility management. The study further identified the types of construction information that are highly usable for completing FM tasks, their uses and value attached to them.

Keywords: *Building Information Modelling; Construction Information; Facilities Management; Information Flows; Information Value*

1. INTRODUCTION

The success of facilities management highly depends upon the correct practices of information management (NBS, May 2015). The data flows (in – out) during the lifecycle of a facility is frequent and are significant to manage the overall facility. On the other hand, the UK construction industry is highly depend on sub-contracting (HM Government, 2013) and the information related to the built asset is provided by several parties. Hence, BIM is identified as an effective solution to minimise such deficiencies as it provides robust platform for collaboration. Although BIM is meant to provide benefits throughout the building life cycle, current literature has been unbalanced in focusing on the application of BIM in post-construction stages (Codinhoto et al., 2013). Also from the practitioners' perspective, the primary attention of project owners / stakeholders are more towards the built facility (end product) rather its operational and maintenance considerations (Becerik-Gerber et al., 2012).

Therefore BIM enabled Facilities Management (FM) is been promoted within construction industry in the recent past. However, the pre-identified benefits of BIM is merely based on the information it holds. Therefore, this study attempts to investigate how construction information is valued in facilities management in deciding which information to be passed down through BIM.

2. BUILDING INFORMATION MODELLING (BIM)

BIM is identified as "a novel approach to design, construction, and facilities management, in which a digital representation of the building process is used to facilitate the exchange and interoperability of information in digital format" (Eastman, 2011). It is a process rather than a tool (British Institute of Facilities Management, 2012). At construction stage, it appears as an AEC (Architectural, Engineering and Construction) digital modelling process (McGraw-Hill, 2009). Looking beyond construction, BIM is considered as a technology based process used to enhance the performance of a built asset through each phase of its life cycle (Love et al., 2013). Being nourished by different views, this paper considers BIM as the process of data acquiring, storing, integrating and management through the building life cycle with graphical modelling. It provides number of advantages to project stakeholders through apposite coordination, waste reduction, informed decision making and also contributing correct information at the correct time (Love et al., 2013). However, the overall benefits of BIM is not completely realised and construction project stakeholders are facing difficulties to make the decision on adopting BIM in their project execution plan (Barlish and Sullivan, 2012). On the other hand, BIM is a complication as it continues expanding from a software to an asset management information system (Love et al., 2013).

Moreover, BIM should not only be seen as a mere technology used at the design and construction stage but also its impact on the future of the organisation as an information tool for operation and maintenance of the built asset. To be an effective tool at the facilities management (FM) stage of a building, BIM should contain FM information (NBS, 2014).

FM is dealing with enormous amount of building information; acquiring, updating and analysing (Wang et al., 2013). BIM as a platform coming from the early stages of a building is a perfect solution for FM data management. BIM allows to communicate FM needs in early stages (British Institute of Facilities Management, 2012). The positive contribution of adopting BIM in facilities information management is identified as a significant value addition associates with BIM (Gu and London, 2010). Eadie et al. (2013) highlight that facilities managers and client benefit the most out of BIM implementation. From clients perspective, a considerable effort should be given to define client's FM needs at the early construction stages (Becerik-Gerber et al., 2012). Above that, most of the projects do not hand over the 3D model and Construction Operations Building Information Exchange (COBie) dataset at the commissioning and this prevents grasping of BIM advantages in FM (Eadie et al., 2013).

COBie and IFC (Industry Foundation Classes) are currently available standard formats for data exchange with BIM. In terms of facilities management, COBie is a neutral spreadsheet format which allows data exchange in a structured manner for commissioning, operation and maintenance of an asset (British Standards Institute, 2012). IFC is another common language for information sharing (Abanda et al., 2015), which provides a standard form of data sharing between construction, operations and maintenance stages of a built asset (International Standard Organisation, 2013). IFC itself does not give a detail explanation to decide what information is required by any specific task under the given scope (East et al., 2013). On the other hand, information overloading and poor understanding on information needs of FM, and level of details of those information drive towards the low implementation of BIM within FM (Parsanezhad and Dimyadi, 2014). This indicates the niche for robust mechanism to acquire necessary information for facilities management. Correct identification of the value that attached to facilities information is a key mechanism to filter necessary information (Zhao et al., 2008).

3. FACILITIES INFORMATION MANAGEMENT

Facilities Management (FM) is the centre point of responsibility which ensures services of an organisation perform up to the agreed standards to support the core business performance to achieve business objectives (British Institute of Facilities Management, 2015). To be successful, a business should understand the impact of rising cost on building occupancy, services and workplace management over the business life cycle (Codinhoto and Kiviniemi, 2014). FM is dealing with large amount of building information including acquiring, updating and analysing (Wang et al., 2013). On the other hand. facilities managers' spend lot of time in searching the required information (Jylhä and Suvanto, 2015). Therefore, acquiring and storing required information related to the building is the initial success factor for a well-planned facility management (Akcamete et al., 2011).

In order to be successful in continuously growing, complex built environment, FM requires to manage the information produced by different stakeholders throughout building life cycle (Pittet et al., 2014). This task has become much complex and challenging due to increasing volume, continuous changes take place in information and variety of parties interested or using the same information (Zhao et al., 2008). As a solution, Wang et al. (2013) suggest the early engagement of FM in construction process will help to overcome such challenges. Yet, the early engagement of FM is rarely practiced and depends upon the type of procurement arrangement. BIM as a platform coming from the early stages of a building is therefore a practical solution for FM data management.

However, this fascinating solution brought in through BIM for FM is highly depend on how building owner explains his information requirements (Giel and Issa, 2016). Therefore, the question of what information to be transferred through BIM still remains unanswered. Due to the complexity and difficulties in transferring information from construction stage to facilities management it is necessary to use a means of measurement to filter the necessary information from the least important information. Identifying the economic value of information which is based on cost over benefit equation is the most common method of capturing value of information (Neal and Strauss, 2008). On the other hand value-in-use is another mechanism to capture value of information in user perspective (Repo, 1986). Certain characteristics in the construction industry such as contractual liability to fulfil client requirements and the responsibility on client to prepare the Employer Information Requirement (EIR) document impose on the value-in-use. Therefore, value-in-use is the most appropriate measurement for construction information. Value is something more "adjectival rather substantive" hence, it should be found with along the considered object and interest (Perry, 1914). Also the value of information differs based on the kind of information and context of use (Repo, 1986). Accordingly, value is considered as usefulness of information (Norton, 2010).

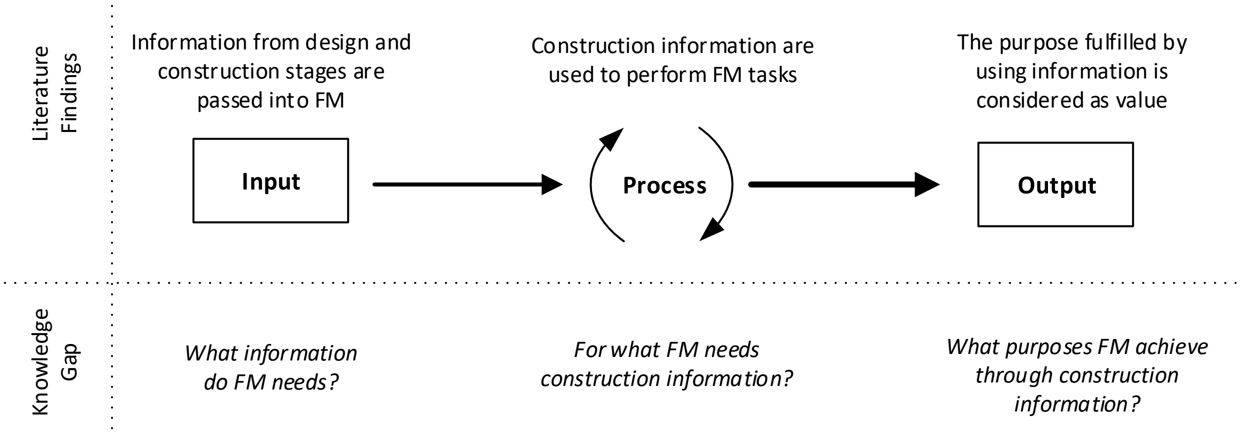

Figure 1: Information Value Process

Having studied the existing knowledge on facilities management information requirements and value-in-use, information value process is developed summarising the essence of literature (Figure 1).Accordingly, it is evident that information is an input for FM from the design and construction stages. These construction information are then used to perform different tasks during facilities management (process). Finally, information users at the FM stage perceive a sense of value by processing information during their job tasks. This conceptual model developed based on literature is needed to be taken forward to explore its applicability in facilities management context and to study further to bridge the knowledge gap by finding answers to the above questions (Figure 1).

4. METHODOLOGY

This paper aims to investigate how construction information is valued during facility management. Literature review was undertaken to identify the application of BIM in facilities management. Having identified the magnitude of information flows from construction stage to FM stage, 13 interviews were undertaken among the construction industry professionals (5 facility managers, 2 estate managers, 2 contractors, an architect, surveyor, BIM manager and a CAFM service provider) to understand the information requirements. It was evident that information requirements are made based on the usability and value of information. The study further noted that the term 'value' is multifaceted and the information value depends upon for what and by whom it's being used. Data was analysed through coding.

5. DATA COLLECTION AND ANALYSIS

The interview transcripts were analysed through coding process adopted from grounded theory research methodology. The first step of analysis engaged with Open Coding where the researcher looked for the themes generated from the data with an open mind. All possible themes were captured and categories were made grouping the similar themes together. These categories were coded by giving a name which represents the similarity in the themes (Figure 2). In Axial Coding, the properties and dimensions of categories were defined and relationship among categories were realised by going through the data once more. Memos were written during the analysis. Figure 2 is an extract from the first two steps of the analysis explaining the development of "Types of information" category.

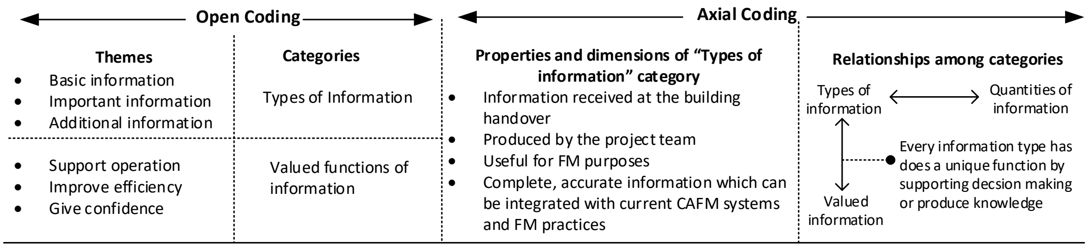

Figure 2: Extract from Data Analysis - Open and Axial Coding

Three kinds of information were highlighted by the respondents when referring to the construction information. A category named "types of information" was developed grouping these 3 types of information. Going through the interview transcript and memos highlighted the common and extreme characteristics such "*the lead contractor is liable to provide necessary documents in softcopies at the handover*" as stated by a facilities manager was used to determine the properties and dimensions of the category. For example, this quotation emphasise a dimension of the "types of information" category through the code "*at the handover*" by limiting the amount of factors falls under the category. Another example for a characteristic of the category was derived from a surveyor's statement *"not all information is accurate most of the time"* which made the point that information should be accurate to perceive its value. Once the categories were structured, key relationships were noted such as each type of information has a predictable quantity and a function. Then at the selective coding, "information" was selected as the core category and the relationship of this to other categories was formed to explain the developed concept.

6. RESULT AND DISCUSSION

Based on the research aim, "construction information" was selected as the core category. The other categories related to construction information builds the properties and dimensions of the concept. Base on the literature, the term value refers to the ultimate output of the information (Norton, 2010). Accordingly, the role of construction information is developed in three sectors (Figure 3).

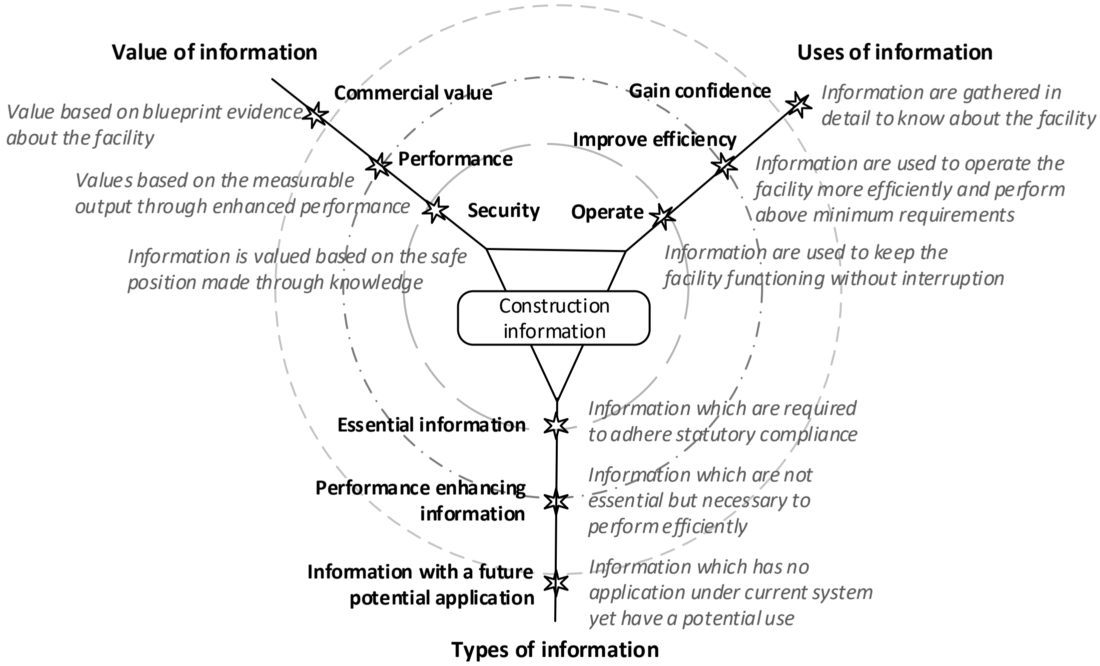

Figure 3: Role of construction information in FM

The construction information was detailed in three aspects. They are; types of information, the uses of these information and their values. The category "types of information" consists with three sub categories namely; essential, performance enhancement and potential application. The "essential" category identifies the information which are highly necessary to run the facility. For example as-built drawings, safety manuals and operation manuals. These information are collected to adhere to the statutory compliances. Second category under types of information coded as "performance enhancement" is the group of information which are not essential to have with to operate the facility but having this additional information will help to provide an efficient service. The third category is "future potential". This includes the "*nice to know*" information as explained by an information provider and also by the BIM manager. This does not have any practical application under current system but may have a potential contribution in the future with the system and technology changes. For example; this category answers the question, if any change of use occurs in the existing facility which information may be required?

The uses of construction information is also identified as key aspect. Here, the applications of construction information to facilities management tasks were identified and noted under 'uses of information' category. Facilities managers prefer to have as-built information about the facility as it helps the operation of the building. This is the most basic but most important use of information. The expectation of gathering information at this stage was to understand the features and characteristics of the facility in order to operate the building with minimum disruption. It guides the user on how to operate the facility including the equipment handling, maintenance requirements and possible precautions to be taken for any failure. Information are also used to make the FM functions efficient and effective. Having more detailed information tend to avoid time spend on physical inspection to collect necessary details about the built asset. Therefore, information are used to improve the efficiency of the FM performance. Then, information are gathered to retain knowledge and gain confidence by knowing more about the facility. This is very subjective therefore, no practical application is visible. In other words, more additional information are gathered about the facility although they have no practical application but merely to satisfy a psychological condition of information users.

Once the types and uses of information are formed, value of construction information was considered with related to facilities management. The term "value" refers to the final output of having construction information at the operation and maintenance stage of a building. Accordingly, information is valued in three different perspectives. The most valued output of information is secure environment it builds through knowledge. When the people are informed about the procedures, risks and characteristics of the built environment they tend to be familiar with work place and the work they do. Next, information is valued for the measurable output it brings through performance enhancement. The visible contribution of information such as time savings, support on decision making and risks avoided falls under this value group. Finally, information gains a commercial value when it is in a formal structure. This refers to benefits which could be gained at the reselling point or working on receiving accreditation for best practices. At such instances information acts as a visible proof giving evidence to the services provided by the FM team.

The proposed construction information framework will be assisting laying the input, process and out of construction information in FM. The three outlooks of the construction information also show a relationship between each category. The scattered lined on the framework explain the inter-relationships between three categories. Accordingly, it revealed that the majority of the construction information are the least valued at the facilities management (the largest circle). Therefore, this indicates that economical point of construction information for facilities management should be considered when choosing the information to be stored on BIM platform for long term purposes rather being guided by information management software capabilities.

7. CONCLUSION

It is evident that information carry a value with or without BIM. With the capabilities of BIM, this traditional situation of gaining advantages through information has become business as usual. BIM practitioners hold evidence for the value addition gained through BIM. If the same amount of information is handed over through BIM, building operators are capable of overcoming the basic problems faced in traditional method. It will bring in many opportunities by having digitized information. It will enable the long term use of information, inter-operability within CAFM systems and make it easy to update and manage information. However, value of information through BIM exceeds more as it is capable of handling more information and brings value through graphical demonstrations. Also, with the future expectations of linking BIM with internet enhances its capabilities. This takes the value of information to the next level as this one way information feeding loop will become a cycle going beyond feeding information to BIM but also generating information through BIM.

Having identified this fact, it is necessary to choose the right information to be taken forward with BIM through the building life cycle. Facilities managers play a vital role at this point by contributing to the decision on selecting information which has a value addition beyond design and construction. Having knowledge on the role of construction information is therefore the base for the success of BIM in FM. Not only to the information users but, the model introduced through this paper is also beneficial for the information suppliers such as contractor, architects, etc. to understand the user perspective of the information they generate. This will promote to produce information with a lifelong application by informing both supply and demand sides. However, as a preliminary output of an ongoing research, detail development of the model is yet to be made.

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