# ABILITY OF BIM TO SATISFY CAFM INFORMATION REQUIREMENTS

Mehala Gnanarednam* and Himal Suranga Jayasena
Department of Building Economics, University of Moratuwa, Sri Lanka

***ABSTRACT***

*Facilities Management (FM) and Building Information Modelling (BIM) are contemporary day concepts that have modernised the way built environment behave. In modern day, FM concepts are moving towards to sustainable FM (SFM). Incidentally, Facilities Managers (FMs) become responsible for assuring the sustainability of facilities of the business. Modern day buildings are increasingly sophisticated and the need for information to operate and maintain them in sustainable manner is vital. Currently FMs rely on the information of the facility retrieved from conventional Computer Aided FM (CAFM). However, FM professionals face challenges from existing information inefficiencies resulting in unnecessary costs, productivity, efficiency and effectiveness losses where these leads to failure of SFM. Considering its favourable features, BIM had been identified as promising solution to effectively reach SFM goals. BIM conceptually has been developed to overcome the inefficiencies in conventional building information systems and recording methods. Combined data would enable the art of making any building more intelligent and sustainable. Significant efforts were found which had focused on getting the benefit of BIM for FM. However, there was no certain answer to "how far could BIM satisfy the information needs of CAFM?'' This paper proposes a methodology to theoretically answer this question, which had been proposed for the next step of the study being conducted in Sri Lanka.*

***Keywords:*** *Building Information Modelling (BIM); Computer Aided Facilities Management (CAFM); Facilities Managers (FMs); Sustainable Facilities Management (SFM).*

## 1. INTRODUCTION

Facilities Management (FM) and Building Information Modelling (BIM) are contemporary day concepts that have modernised the way built environment behave. These two concepts are vital in the rapid changing world to track the facilities effectively. Managing the non-core activities are mandatory in order to function efficiently and effectively in Facilities Managers' (FMs') day to day operations who relies on the accurate information of the facility retrieved from Computer Aided FM (CAFM). CAFM still largely based upon the conventional methods such as tabulated data and 2D (two dimensional) drawings. Consequently adopting a three dimensional capabilities with the object oriented database offered by BIM to the CAFM is vital for FM to manage information at their fingertips. Therefore, a research was initiated to study how well BIM can satisfy CAFM's building information needs. This paper is based on the literature synthesis presenting preliminary findings of this ongoing research, while also identifying specific challenges faced by researchers living in a less developed industry.

## 2. FACILITIES MANAGEMENT

Sustainability of the built environment depends on involvement of the operation and delivery of services within occupied environments. FM is becoming an increasingly important role in the built environment. FM covers a wide range of disciplines in built environment. FM is the integration of people, place and processes within an organisation to maintain and develop the non-core services which support and improve the effectiveness of its core business activities (British Institute of Facilities Management [BIFM], 2013). The effective management of the facilities services required a

* Corresponding Author: e-mail - mehala@bimlab.net

multi-disciplinary person who is called Facilities Managers (FMs). FMs have extensive responsibilities for providing, maintaining, and developing myriad services. FMs could be identified as hybrid management discipline that combine people, property and process management expertise to provide vital services to support of the organization (Shiem and Then, 1999).

## *2.1. FUNCTIONS OF FACILITIES MANAGERS*

The FMs functions are mostly concern in four core areas (Barrett and Baldry, 2003) as shown in Figure 1.

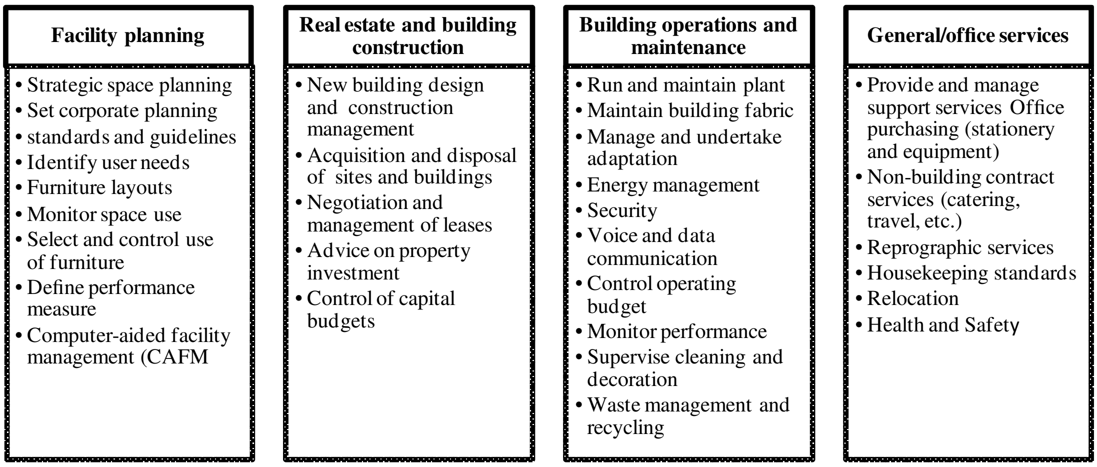


Figure 1: FMs' Functions (Source: Barrett and Baldry, 2003)

## *2.2. THE CORE COMPETENCIES OF FACILITIES MANAGERS*

According to IFMA (2013), communication, emergency preparedness and business continuity, environmental stewardship and sustainability, finance and business, human factors, leadership and strategy, operations and maintenance (O&M), project management, quality management, real estate and property management and technology are the core competencies of FMs. By looking at these competencies and functions, it is clear that FM is an umbrella term which covers a wide range of properties and user related functions in a built environment (Kamaruzzaman and Zawawi, 2010).

## *2.3. CURRENT PRACTICES AND STATUS OF FM*

As building become more complex and high tech, user expectations rise and the pressure on FMs to perform increases (Alexander, 2000). The FM industry encompasses an array of complex tasks and soft services all of which have a very high dependency on the prompt availability of relevant information. Currently FMs are continually faced with the challenge of improving and standardizing the quality of the information they have at their disposal, both to meet day to day operational needs as well as to provide upper management reliable data for organizational management and planning (Sabol, 2008). The above challenges have become severe due to current practices of FMs. To perform these functions within the organisation FMs use the CAFM as their management tool. The input data for CAFM is acquired from diverse professionals in built environment right after completion of construction. It leads tediousness, lack of accuracy and blunders.

Whole Life Cycle (WLC) information is essential to support the O&M and asset management by the owner or FMs (East, 2012). Smith (2010) stated that problems related to O&M of buildings currently FMs are dealing with are: facilities are costly to operate, use a lot of energy and water, produce a lot of waste during the building process, and FM cannot control costs very well, timely information is rare, too many change orders, inaccurate drawings, high cost, increasing poor quality, buildings often end up in litigation and duplicates in data collection. All these problems are directly related to lack of or poor quality of information. As Christopher and Hodges (2005) stated that the above problems raise the need for Sustainable Facilities Management (SFM). SFM defined as,

> The process of integrating the people, place and business of an organization that optimises economic, environmental, and social benefits of sustainability (IFMA, 2012).

## 3. COMPUTER-AIDED FACILITY MANAGEMENT (CAFM)

CAFM is the support of FM by Information Technology (IT). CAFM includes the creation and utilization of IT based systems in the built environment (James and Watson, 2011).

According to CAFM Explorer (2013), CAFM modules are mainly grouped as following software,

- Computerised Maintenance Management System (CMMS) software that is used for Planned Preventive Maintenance, Reactive Maintenance and Asset Management.
- Resource booking software used for room booking, catering, equipment, and visitor management.
- Health and Safety software used for recording accidents or incidents, permit management, security and risk assessments.
- Supporting software used for stock, purchase ordering, digital dashboard and invoicing.
- Integrated Workplace Management System (IWMS) software used for space planning and management.
- Real Estate (RE) and Capital Planning software.

Integrated CAFM with CMMS software, Resource Booking Software, Health and Safety Software, Real Estate and Capital Planning software, Supporting Software and IWMS increase productivity and efficiency in FM (Alexander, 2000). CAFM evolves significantly to address all the operational challenges in FM industry (BIMhub, 2013). Janssen (2010) defined CAFM as,

> The use of information technology to effectively manage physical facilities in various ways.

According to Judicial Council of California (2001), CAFM performs the following functional supports,

- Project management
- Portfolio management
- Facility management or Maintenance management, and
- Real property management

and according to BIMhub (2013), CAFM contain following features,

- Centralised data
- Ability to report data
- Ease of data auditing
- Take better informed decisions
- Better management of O&M
- Efficient identification and allocation of tasks for the FM staff
- Regulatory compliance, and
- Improved sustainability

### *3.1. DEFICIENCIES OF CAFM INFORMATION TO CATER FM REQUIREMENTS*

Today FMs often spend unnecessary amount of time looking for information in order to fix a facilities O&M problems. The FMs need to ensure that a balance is maintained between the capital and running costs of the information system and the value of the information generated (Alexander, 2000). Furthermore Alexander (2000) argued that the information in a built environment should enable better informed decision making at strategic, tactical and operational level.

It is suggested that a useful way of focusing information systems and the IT that serves FMs is to orientate them towards the best decision making processes. For this objective to be achieved, the information system should be sensitive to the FMs' responsibilities as well as to all organisational elements which have an indirect or direct impact upon the performance of the FM function. FMs should develop information systems and IT solutions which appreciate the differing types of decisionmaking processes and their associated information requirements (Barrett and Baldry, 2003). Transitions from design to construction and to operation result in loss of data added cost to reconstitute the data and overall reduction in data integrity (Autodesk Inc., 2008). This information could be hard to get and hard to use or is not corresponding to the real life situation (Gokstorp, 2012)

Alexander (2000) accentuated that present CAFM does not consider the strategic requirement of the facilities nevertheless its concern are only for O&M. This results in failure of using CAFM by top management for the purpose of decisions making capabilities. Moreover according to Ahmed, et al. (2012) CAFM has the lack of monitoring performance of the building. Information is not free and it is costly to collect, verify and maintain. Further, it has to be defined the stakeholders, requirements and priorities determine criteria, health or life safety requirements, regulatory requirements and business justification (Schley, 2012). The limited graphic capabilities of data centric applications of CAFM have focused mainly on space management rather than other functions (BIMhub, 2013). The challenge for FMs is to overcome these obstacles by utilizing the resources available; and convincing leadership, efficiencies and cost savings can be achieved with investments in technology, such as a well-planned CAFM system. It will be best initiate by integration of CAFM with BIM.

## 4. BIM

National Institute of Building Sciences (2007, p. 21) defines BIM as

> BIM is a digital representation of physical and functional characteristics of a facility.

It is also called as the "Electronic Owner's Manual" (Chobot, 2012) for simple comprehension. Figure 2 shows that types of data in the BIM. These data helps to FMs to perform their work. It is incorporated huge amounts of service, maintenance and cost information. The model includes all information about objects within the building such as Mechanical Electrical and Plumbing (MEP) system and importantly the relationship between them in a single repository (Sabol, 2008). BIM data are extracted in a COBie format, which is a standard that used to handover the BIM Design to FM.

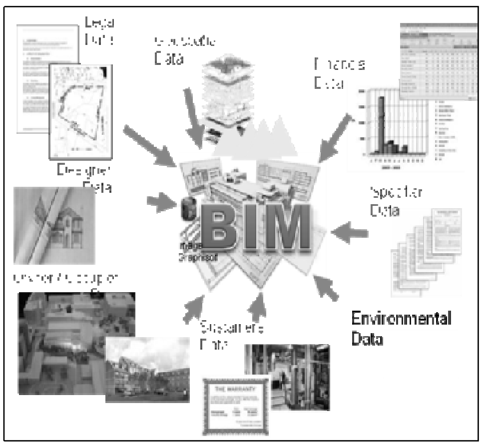


Figure 2: BIM Data (Source: Schley, 2013)

### *4.1. CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE (COBIE)*

Construction Operations Building information exchange (COBie) is a vehicle for sharing predominantly non graphic data about a facility. The primary motivation for the use of COBie is to ensure that the Client as owner or FMs receives the information about the facility in as complete and as useful form as possible (East, 2012). The primary COBie addresses the handover of information between the construction team and the owner. It deals with O&M, as well as more general FM information (Earley, 2012). COBie is an information exchange specification for the life cycle capture and delivery of information needed by FMs (East, 2012). This information is provided cumulatively during the design, construction, commissioning and handover phases (East, 2012). It combines data from designers, as they define the design and then by contractors as the building is constructed. It categorises and structures the information in a practical and easy to implement manner. Furthermore East (2012) found COBie can be viewed in design, construction and maintenance software as well as in simple spread sheets. COBie comprises sheets that document the facility, the levels or sectors, spaces and zones that make up the function of the facility. These are then filled with the actual manageable systems and assets and details of their product types.

Table 1 explains the required data in the each and every phase of COBie deliverables. There are eight phases and end of each phase, information must be transferred to owner or FMs

Table 1: COBie Data (Source: Whole Building Design Guide, 2009)

| COBie Phase | Required COBie Information |
|---|---|
| **Architectural programming phase** | 1. Contact worksheet<br>2. Facility worksheet<br>3. Floor worksheet<br>4. Space worksheet<br>5. Zone worksheet<br>5.1 Circulation zone<br>5.2 Lighting zone<br>5.3 Fire alarm zone<br>5.4 Historical preservation zone<br>5.5 Occupancy zone<br>5.6 Ventilation zone |
| **Architectural design phase** | 1. Type worksheet<br>2. Component worksheet<br>2.1 Component records for interior doors and windows<br>2.2 Manufacturer information in component worksheet<br>3. Attribute worksheet.<br>4. Coordinate worksheet |
| **Coordinated design phase** | 1. Type worksheet<br>2. Component worksheet<br>3. Manufacturer information in component worksheet<br>4. System worksheet<br>4.1 Fire protection zones<br>4.2 Intrusion detection zones<br>4.3 HVAC service zones<br>4.4 Plumbing service zones<br>4.5 Electrical service zones<br>5. Coordinate worksheet<br>6. Connection worksheet |

| COBie Phase | Required COBie Information |
|---|---|
| **Construction documents phase** | 1. Spatial assets<br>1.1 Gross area<br>1.2 Net area<br>1.3 Floor covering type<br>1.4 Wall covering type<br>1.5 Ceiling type<br>2. Manufacturer information in component worksheet<br>3. Fixed assets<br>4. Document worksheet<br>5. Attribute worksheet |
| **Construction mobilization phase** | Document Worksheet |
| **Construction 60% complete phase** | 1. Subcontractor contact information<br>2. Manufacturer contact information<br>3. Room tag<br>4. Manufacturer information in type worksheet<br>5. Installed material, products, and equipment<br>6. Government furnished products<br>7. Bar codes.<br>8. Approved submittals<br>9. Submittals remaining to be approved<br>10. Attribute worksheet |
| **Beneficial occupancy phase** | 1. Spatial assets<br>1.1 Gross area<br>1.2 Net area<br>1.3 Floor covering type<br>1.4 Wall covering type<br>1.5 Ceiling type<br>2. Equipment assets.<br>3. Parts and warranty contacts<br>4. Warranty information<br>5. Replacement parts<br>5.1 Detailed parts set<br>5.2 Replacement parts diagrams<br>6. Operating plans.<br>6.1 Operator prestart<br>6.2 Start up, shutdown, and post-shutdown procedures<br>6.3 Normal operations. Provide narrative description of normal operating procedures<br>6.4 Operator service requirements<br>6.5 Operating instructions<br>7. Building services descriptions<br>8. Preventive maintenance<br>9. Emergency operations<br>9.1 Troubleshooting instructions<br>10. Safety instructions<br>11. Final approved submittals and documents<br>12. Coordinates.<br>13. Products and equipment attributes |
| **Fiscal completion** | Updated previous phase information, as needed |

Objective of the COBie is to improve the life cycle building information interoperability using commercially available releases of BIM. But all the details are described above are in a form of spreadsheet. There will also be a need to have a more robust system for processing the information as understanding and needs grow (Department of Business Innovation and Skills, 2011). BIM data delivered to owners in a form of COBie. Sophisticated system should be available to receive, share, store and process COBie data. Doing this without proper systems will be a difficult task for FMs in incorporating them to their day to day work. There is a need for user interface to the data to facilitate to FMs. This could be done by CAFM. Since this is an unknown fact, the next section explores the capability of CAFM to do so.

### *4.2. CAFM INTEGRATION WITH BIM*

CAFM systems can be easily integrated with BIM for information transfer from the Architectural Engineering Construction industry to the FM (ACE/FM) industry (BIMhub, 2013). Integration of CAFM into BIM includes not just design and construction phase information as well as complex work order management systems and tenuous maintenance schedules, which encompasses the impact of facilities management on the entire business (BIMhub, 2013). The Figure 3 illustrates the group of integrated CAFM which are IWMS, CMMS and RE and Capital Planning software. This is called as BIM integrated CAFM (BIMCAFM).

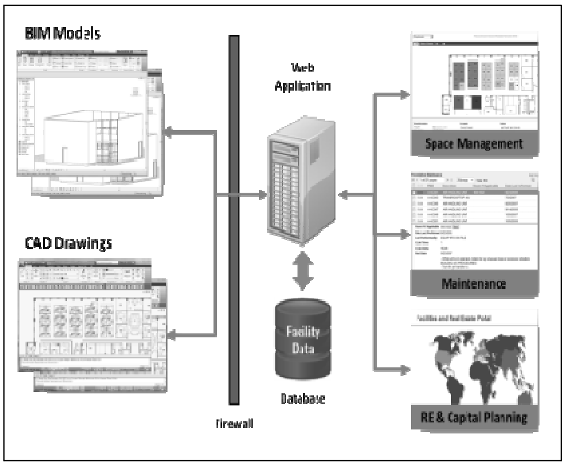


Figure 3: BIM & CAFM Integration
(Source: Smith, 2010)

Therefore the BIMCAFM mitigate the previously mentioned problems in present CAFM.

- Can be used as a strategic decision making tools because it has all the data ragarding sustainability (Schley, 2013).
- Complex data can now be stored, retrieved, combined, and analysed in BIMCAFM.
- It can be explore where the exactly problem occures regarding asset location of the place can be knows by BIM.

### *4.3. BENEFITS OF BIM INTEGRATED CAFM (BIMCAFM)*

BIM is a way to create better designed better managed and longer lasting sustainable facilities (BIFM, 2012). When BIM is integrated with CAFM it creates a favourable environment to carry out FMs function in an effective manner.

Specific benefits of BIM to FM include,

- Fostering faster and more effective FM by providing information that is easily shared and reused by the variety of contractor and staff employed in the organization.
- Ability to control WLC and environmental data leads to predictable building
- Enhanced information for emergency preparedness
- Increased building performance and quality

- Improved collaboration using Integrated Project Delivery (IPD)
- Improvement of building analysis, energy efficiency and sustainability
- Improved commissioning and handover of facility information
- Better management and operation of facilities (Eastman *et al.,* 2011)

Therefore if the FMs Paying attention to building systems, maintainability, operating costs, energy management, staffing and organizing, turnover procedures and training, as built drawings, warranties, and sample books during construction; it will help ensuring that the organisation will assume an operable building at turnover and that initial operating problems will be minimised. This can be achieved by the BIMCAFM (Cotts *et al.,* 2010). Using BIMCAFM enables FMs to meet with the growing need for better information flow and standardization of operational data. Earlier, the CAFM system was used to collect data mainly from the design team. Now, with the BIMCAFM more detailed information is reported to FMs, so that the FMs can use this information to maintain the building as well as to communicate with senior management and building owners. The Figure 4 illustrates the applications of BIM integrated CAFM in occupancy stage.

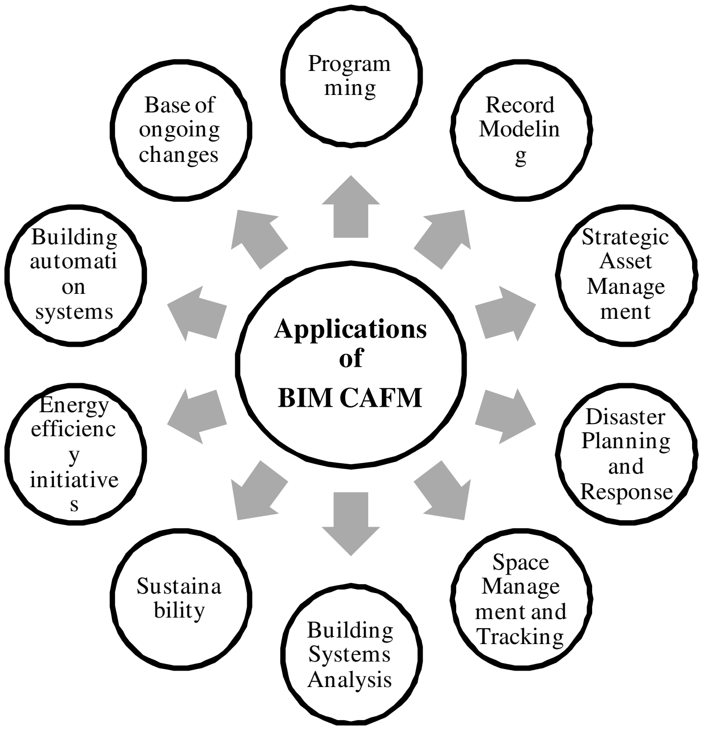


Figure 4: Applications of BIM Integrated CAFM (Source: Autodesk, 2013)

## 4.4. CHALLENGES IN BIM INTEGRATION WITH CAFM

The following challenges will be occurred when BIM integration with CAFM,

1. Challenges with collaboration and teaming with FM department
2. Legal changes to documentation ownership and production
3. Changes in practice and use of information
4. Implementation issues
5. User interference
6. Interoperability problem
7. Software hardware and liveware requirement
8. Implementation strategy
9. Technological problems
10. Poor cloud computing facilities

## 5. CAFM AND BIM IN SRI LANKAN CONTEXT

This research has been initiated in Sri Lanka. FM is in infancy stage in Sri Lanka. During an interview conducted on 21 January 2013, leading Facilities Manager stated that CAFM is not used in Sri Lanka, and neither does BIM (Jayasena and Weddikkara, 2012). Therefore the primary challenge for this research is that observational data will not be available for the study. This is however, not a limitation since the research does not focus on CAFM in Sri Lanka. Absence of both technologies in practice makes it difficult to collect necessary technical and human resources conduct an experimental study. Thus, the researchers will have to rely on published data. However, it was found that necessary data is not readily available in published media. The researchers will generate necessary data for the research by analysing various publications available.

## 6. CONCLUSIONS

The review of current knowledge shows promising integration of BIM with CAFM. COBie was found to be the primary focus in present day endeavours for this purpose. While COBie is thought to be a well-developed data exchange from BIM to FMs, it is not certain if all information demanded by CAFM is delivered by it. There were other implementations in projects using IFC (Industry Foundation Class: open BIM model) as data exchange showing significant degree of success. Thus, it could be hypothesise that BIM will satisfy the information needs of CAFM to a significant extent. However, research is required to verify this with certainty so as to how far it will satisfy the needs. Identification of this will help future advancement of BIM to become more FM friendly and CAFM application developers to consider BIM integration without reluctance.

However, the environment in which the research is being conducted is in its infant stage in terms of CAFM and BIM. This poses significant challenges in terms of applicable methodology for the study. The researchers will use various publications to generate required data. This method relies on the assumption that technology implementation documents such as white papers and user manuals represent what information is necessary for and available in each application. The conclusions made from this data will therefore be "how far BIM can theoretically satisfy the information needs of CAFM". Ultimately, the integration of BIM supported by these findings can move the FMs practices towards SFM for everlasting sustainable facility operations.

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