International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

A STUDY ON DISTRIBUTION CLOUD AND BIM SOFTWARE IN CONSTRUCTION INDUSTRY

Naveen P S[1], Dr.A.G. Mohandas Gandhi[2], S. Janani[3]

[1]ME Construction Engineering & management, Department of Civil Engineering, RVS Technical Campus, Coimbatore -641402, India
[2]Head of Department I/C, Department of Civil Engineering, RVS Technical Campus, Coimbatore -641402, India
[3]Assistant Professor, Department of Civil Engineering, RVS Technical Campus, Coimbatore -641402, India

---

Abstract - *The design, Engineering & Construction (AEC) sector may be a extremely fragmented, knowledge intensive, project primarily based business, involving variety of terribly completely different professions and organizations. comes applied at intervals this sector involve collaboration between varied folks, employing a kind of completely different systems. This, in conjunction with the industry's robust knowledge sharing and process necessities, implies that the management of building knowledge is advanced and difficult. This paper presents an answer to knowledge sharing necessities of the AEC sector by utilizing Cloud Computing and BIM computer code. My resolution presents 2 key contributions, 1st a governance model for building knowledge, supported intensive analysis and business consultation. Second, a model implementation of this governance model, utilizing the extraterrestrial object Cloud involuntary Cloud Computing engine supported the Master/Worker paradigm. I actually have integrated my model with the 3D modelling computer code Google Sketchup. The approach and model conferred has relevance in an exceedingly variety of alternative eScience connected applications involving multi-disciplinary, cooperative operating victimisation Cloud Computing infrastructure.*

In general, Facility Management is that the integration of processes inside a company to take care of and develop the services that supports and improve the effectiveness of its activities. The effective facility management is all regarding maintaining correct knowledge. The approach of operating to gather the flow of information for a cooperative surroundings aid by the discharge of ISO 19650,the International customary for Building info Modelling (BIM),which has served to mark a turning purpose for the utilization of BIM in construction and facility management. The most aim of this project is to seek out out the applying of Building info Modelling in facility management. So as to seek out the applications, the literatures area unit used to spot the applying areas, values, and challenges of Building info Modelling in facility management. therefore the findings incontestable that Building info Modelling price in facility management assist in info relinquishing improves accuracy in facility management knowledge, improves accessibility of facility management knowledge, reducing operating hours, improved potency.

1. INTRODUCTION

The building lifecycle moves through various phases for achieving the better outcomes. In the life-cycle, the operational phase becomes the main contributor to the cost estimates. The building lifecycle cost is increasing day by day than the initial investments costs. The economy need to manage both the new and existing facilities in an efficient ways. The use of BIM technology in the operational phase of a building's lifecycle is just beginning to take hold as building owners look for new ways to improve the effectiveness of their facility operations. The emergence of BIM in construction, improves the efficiency of FM functions. The FM is the total management that integrates all services to support the core business of an organisation.

The Architecture, Engineering & Construction (AEC) sector is a highly fragmented, data intensive, project-based industry depending on a large number of very different professions and firms, with strong data sharing and processing requirements across the lifecycle of its products (primarily buildings). The process of designing, re-purposing, constructing and operating a building involves not only the traditional disciplines (Architecture, Structure, Mechanyuical & Electrical) but also many new professions in areas such as energy, environment and waste. All of these professions have large data sharing requirements.

2. REPORTED ISSUES AND OTHER POSSIBLE BENEFITS

The interviewees also indicated some aspects that can be considered as drawing and BIM related. The main issue mentioned was the lack of as-built drawings due to insufficient updated drawings.

2.1 INSUFFICIENT UPDATED DRAWINGS

One of the facility managers mentioned that : Every facility managers thinks that it is a dream to have updated drawings .However, many of the interviewees mentioned that the drawing material they had was outdated and did not represent how it looked on site. The main reasons why the drawings were not kept up to date was prioritizing of other tasks, lack of routines for drawing updating and for delivery from projects, as well as insufficient resources regarding time and money.

2.2 POSSIBLE RESISTANCE

During the interviews mistrust and resistance towards BIM could benoticed, mainly among the older interviewees, were sentences such as fortunately, I will be retired when (BIM) is implemented in the company, and it (BIM) sounds great, but were quite frequent during the interviews.

2.3 LIMITED NEED OF INFORMATION AT NEW BUILDING

One of the interviewees that were responsible for a two year old building had access to 3D drawings of this building, but stated that at the moment there waslimited need for drawings and information on that building. The reason for thiswas that often just minor adjustments occur whilst the same tenants operate in the building. This was shown by the same facility manager who said- we have not needed to do changes of that magnitude that we needed to hand over such (3D model)material.

2.4 INFORMATION EXCHANGE AND TRANSFER: INTEROPERABILITY AND DECISION MAKING

BIM can be considered as a product, a process and a FM life-cycle management tool. Therefore, it is important for organizations to look at what they want out from BIM, and how. For an organization that implements FM functions and wants to use BIM in FM practices, it needs to consider several aspects connected to pro-cesses and usage of BIM prior to implementation. The findings of this review are directed towards identifying the basic minimum requirements to facilitate BIM for FM.

The data integration and information exchange for FM is mostly based onthe integration of different IT tools. CAFM systems commonly use and integrate various building information. However, the re-usability of data in CAFM systems and the fragmented nature of construction industry make the information transfer challenging. To overcome this problem, such systems which can integrate 3D BIM models and FM information in a database are being developed as acknowledge-based BIM system that enables better decisionmaking. Since existing CAFM systems have inadequate capabilities and functions for collecting the building information pushed from various stakeholders and different phases of the project life-cycle, BIM based applications are being developed to simultaneously collect the data from different stakeholders and transfer this information to the facility manager in a cloud environment to enable the mobility of facility man-ager during the FM activities. For such FM functions, BIM can act as a virtual database application. However, BIM is not enough by itself to collect and transfer the facility data Simultaneously. To overcome this BIM systems need to integrate and communicate with technologies such as radio frequency identification (RFID). RFID provides wireless sensor technology to track and monitor the assets and building environment. The integration of RFID systems with BIM applications through database servers and cloud services provides access to the run-time dataof the assets in a facility via either desktop or mobile devices. A construction project involves different applications for various tasks such as architectural modelling, engineering analysis, and construction management. Despite technological advancements, the existing BIM systems or other IT based software applications are mostly implemented in isolation. There is also a lack of interloper-ability between systems. Therefore, sharing the data in such a heterogeneous environment becomes complicated. In addition, it is still not clear which facility data should be transferred by whom, when the related data should be transferred, and how. To overcome this problem in terms of technology and strategy, several studies have been reported in the literature. A common interoperable computational environment such as extensible markup language (XML) has been proposed to facilitate the exchange, transfer, archival and re-usability of facility data through different database and software systems, and web-based environments However, XML may not be adequate for the all practices of construction industry which rely on several processes, people and products. The development of industry foundationclasses (IFC) began in 1990s and it is still ongoing. IFC provides a framework for the digital representation of building design, engineering, construction, and operation data to facilitate information exchange between differ-ent BIM software. However, the information that is transferred with IFC contains lots of other information which are not needed for FM activities. Therefore, it should be filtered and modified for FM purposes. In response to this need to filter the information, the COBie (construction buildings information exchange Specification was developed to provide a structure for the lifecycle capture and delivery of facility information needed for FM purposes.

COBie is a simplified non-geometric subset of IFC and can be created in IFC format or Excel. COBie data includes rooms (spaces) and zones of the facility, equipment and its location, submittals, instructions, tests, certificates, maintenance, safety and emergency plans, start-up and shut-down procedure and re-source data for the related activities. Although there is an agreement about the requirement of COBie for structuring the facility data, COBie does not pro-vide details on what information is to be provided, when, and by whom, and it has been found to be complex and unclear to use. At the same time, FMie (facility management information exchange) specifications are being developed by building SMART to link and exchange facility information more efficiently with the latest version of IFC.

Traditionally, the focus has been on the data that is created or updated during de-sign and construction phases, but for effective FM practices, as-built data is need-ed. An accurate as-built model of the existing facility meets the owner's requirements and provides the best value [31]. The technology to produce as- built data (e.g. 3D laser scanning)

needs to be integrated with other FM technologies and transferred through BIM process. Most existing technologies are not able to satisfy the integration and interoperability requirements between different systems.

2.5 EARLY INTEGRATION TO FACILITIES DESIGN

Successful implementation of FM functions depends on the identification of major requirements, functions and communications of the development at the earliest possible time. Facilities design comprises the details of structural, architectural and MEP disciplines which elicit graphical and non-graphical

Related facility. Considering the principle —begin with the final process in mind‖; and FM needs and integration of owner/end-user and facility manager at the early design could potentially be worthwhile for the FM activities.

Another common subject mentioned in literature is the early integration of FM process to facilities design. Early engagement of FM could potentially reduce the needs for major repairs and alterations that will otherwise occur at the operational phase. Facility managers have to identify the components' location and get access to the relevant documents and maintenance information. However, due to difficulty of altering the main structure and core service areas in the operational phase, it is hard to implement design process by considering operational conditions; and also most of the time designers do not care much about the factors in building maintenance. Facility managers should also provide past maintenance information of facilities for the designteam as a feedback. Since facility managers have a daily contact with users and obtain in-depth knowledge about the special needs for the facility, a knowledge transfer framework should be developed based on a combination of knowledge push from building operation, knowledge pull from building design; and assumptions and specific facility requirements that are used as the input of design process. BIM can be used as a potential tool. Implementation of BIM throughout design and construction stages, with the owners' and facility managers' data requirements in mind could pro- vide an opportunity for facility managers. However, one of the biggest challenges for BIM enabled FM practices is to define these data requirements, and to identify by whom and when the data should be provided through the project lifecycle. Although the data requirements are defined in the early phases, it is hard to follow theserequirements due to dynamic and fragmented nature of a construction project. In addition to data requirements, interoperability and automated electronic data delivery are important for leveraging BIM in FM. Recent studies have attempted to clarify the information requirements and information transfer frame-works for facilities and asset management. However, the companies should configure and adopt their existing management strategies with respect to these frameworks for the individual projects. Recent developments such as COBie and FMie facilitate and provide solutions to transfer up-to-date facility information from different phases of the project lifecycle. Apart from them, CAD technologies, building automation systems (BAS) and CAFM tools are other potential systems to collect and transfer the required FM information between maintenance and operation, and design phases.

2.6 TRANSCATION BENEFITS

In the case that a building with BIM is being sold, more information will be available with less effort. Were at the BIM building all documentation should be able to extract digitally and most of it will also be able to collect from one file. Whilst at today's non-BIM buildings, the documentation of a building is often in several binders at the office or in a storage room in the building. Whether the increased information leads to a higher transaction price depends on the buyer, the complexity of the building and the information given. But the main benefit with BIM for transaction will, according to the interviewee, most likely reduce the time spent to produce sales material and find proper information to answer uncertainties.

2.7 5 SUSTAINABILITY BENEFITS

The benefits from the view of sustainability is that you will be able to easiertrack where different materials are within a building, so if a certain material turns out to be hazardous it will be quick and easy to see where it is placed in the building and remove it. However, the main benefit, from the sustainable point of view, will most likely be if BIM leads to higher quality buildings, because there are tight connections between the quality and the environmental footprint of buildings.

3. RESULTS AND DISCUSSION

3.1 GENERAL

The study focused on improving the effectiveness and usability of BIM technology in Facilities Management. This chapter will state the conclusions drawn from the project and recommendations the study has for future BIM Facilities Management work. This will include the improvements for the handover process for better resource attainment for facility management and the investigation on practicesto improve facility management for building operations.

3.2 IMPROVED HANDOVER PROCESS

Through the study for this project, I learned that the facilities management, which would find the BIM software most beneficial, is not involved early in the construction process. This leads to a retroactive approach for the facilities management. Any information that is needed for the assets must be located through the many files of warranties and asset–specific information. Without early engagement from the FM team, the models

become more difficult to use and less practical as the required information has not been connected to the assets in the models. The new handover process guidelines, for the project can be seen in the following sections below and are the recommendations for improving the handover process and BIM usage in facilities management.

3.3 CONTRACT WITH TEMPLATE

The study reviewed the workflow used for inputting information and concluded that a systematic approach would be most appropriate to improve the handover process. The current workflow does not require the facility management team to work early on in the design or construction process. Having the FM team included early in the process would allow the team to Create or customize model templates for the project. This process would give the data integration team an opportunity to focus on creating or editing the parameters desired in the model for the facilities management use. The model template or template file would be contractually used throughout the design and construction phase to collect the data during installation of assets versus retroactively. Doing this would in effect lead to a BIM model that is not only accurate but is also rich in valuable and up-to-date information. This template- based system should heretically work for decreasing the amount of time that is used in ensuring that desired parameters are in the models by populating modelsearly on with information attached to the objects.

3.4 IMPROVED FACILITY MANAGEMENT OPOERATONS

The current software programs used for facility management and BIM may require an extensive training program. For this reason, many FM users do not become familiar with the software or technology that is presented throughout the differentBIM platforms. Even when information can become very impactful and powerful, the complexity of programs like Autodesk Revit can discourage FM employees from accessing information in the BIM models. Another important aspect to consider when investigating FM software and processes is the cost of the platform. When investigating a possible integration option for the use in facility management operations, the team conducted pros and con analysis on various items, including factors such as practically, cost and benefits.

3.5 POTETIAL BENEFITS OF BIM FOR FACILITY MANAGEMENT

It will most likely take several years from the completion of a newly produced, BIM based, building before the facility managers are able to realize most of their potential benefits. The reason for this is that few changes occurs during the first couple of years and that most of the drawings and knowledge that BIM has the ability to substitute will still exist. However, after a while should the potential benefits become able to realize, and the key aspects with BIM will then be the collected and Structure documentation. That eases information gathering as well as communication with consultants, entrepreneurs, and customers.

Several other benefits for facility management might even be realized without BIM, but the approach towards BIM offers a possibility to highlight issues within the organization and set out guidelines, allowing these issues to be fixed simpler withBIM than it should have been done without it. The benefits that are not directly for the facility management, such as higher project engagement and earlier simulations, mightlead to projects with higher quality, and the increased quality might, in the end, turn out as the main benefit for facility management with BIM.

3.6 IMPLEMENTING BIM IN FACILITY MANAGEMENT ORGANISATION

The main benefit that most researchers mention is the increased level of communication and collaboration during the projects, but the focus of facility management is to get a model that aids their daily work. However, the way to reach a good facility management model should be quite similar to the way of getting good projects, what should be needed is a focus on the final deliveries throughout the wholeprocess development.

In order to get good BIM projects is standard processes and agreed protocols a key. Additional, is proper education important, so the involved persons can handle their responsibilities. Another aspect is that the level of detail within a BIM project is almost endless which makes a set level of ambition important to control so everyone has the proper detail and design costs are kept on a reasonable level.

During the setting of processes and protocols there are several issues that need to be kept in mind. The first is to decide who is the owner of the model and is responsible for changes during and after the project, this is extra important though efficient BIM is dependent on simultaneous design on drawings that are still work in progress.

7. CONCLUSIONS

BIM practices for planning; design and construction phases have been discussed and researched in the literature. Understanding the existing status of BIM for FM with the challenges and value-adding potential is fundamental at the earlystage of a project. In this paper, the challenges and important aspects of BIM for FM are analyzed through a literature review. The findings from the review provide evidence that there is an

agreement about the value and potential of BIM in FM. This research shows that the value of BIM in FM practices are mainly for:

Automated data process and information transfer from the early stages of the projectto the operation and maintenance phases,

Increasing the efficiency of work orders and decision making process by access toreal-time as well as previously stored graphical and non-graphical data.

However, there are several challenges that are hindering the effective use of BIM inFM. These include:

- The interoperability between BIM and different FM (CAFM, BAS, etc.) technologies
- The lack of clear requirements for the implementation of BIM in FM through early stages of the project
- Despite the documentation, challenges exist in identifying clear roles, responsibilities and collaboration requirements of project team to provide and exchange the necessary information due to the traditional implementation practices and the adoption process
- Integration of as-built information with BIM and FM technologies
- Complexity and limitations of information exchange frameworks such asCOBie that need to be clearer and more usable.

Among the other issues, due to the evolving nature of the BIM for FM field, and the different structures in the existing FM technologies, organizations should not fit their FM processes to suit a particular technology for decision making which would otherwise result in a continuous effort of adaptation. Instead, they should define the dynamics of their FM strategies and adapt the related specifications of BIM aspects, which suit their individual organizational and operational strategies.

The CloudBIM project was a feasibility study that aimed to explore the feasibility and potential for utilizing Cloud capability to address data storage and processing needs of stakeholders in the AEC sector. In the course of this project we have explored some of the technical and non-technical issues related to the outsourcing of BIM data into a Cloud Computing environment. Various other approaches currently exist to support collaborative working in the construction sector – most of these, however, are focused on the use of a centralised server that enable upload/download of BIM data – such as BIM server and ProjectWise from Bentley Systems. We believe such an approach limits the kinds of interactions that can be supported within the AEC sector and more effective approach would involve integration of data storage and processing capability across different industry partners involved a particular project.

We have found through a process of consultation that, unsurprising, the majority of the barriers to the adoption of Cloud-based BIM have been related to ensuring that the design of a system is in compliance with complex industry requirements.

To this end a governance model and a prototype have been constructed and we have evaluated these in three ways. Firstly, the governance model has been validated using further industry review. Secondly, the governance model and the technical implementation has been evaluated by the utilising a number of use cases supplied by our construction project management industry partner. Finally, a technical performance analysis has been carried out of using the operations in our query language and CloudBIM's fault tolerance capability.

The results that we have so far are promising: The industry has reacted positively to the idea of the governance model and the functionality that it provides. The trials from the case study have shown the governance model is able to correctly model the scenarios presented to it. where the CloudBIM system was able to successfully track a complex structure of versioning of the architects model.

The results of the performance analysis are also promising. In conducting this experiment we firstly timed several key operations - the dynamic addition of new workers to the system and the time to recover from worker failure. Secondly, we also measured the governance overhead - that is the extra time taken for upload/download of files to the CloudBIM system compared to standard file uploads to the same machine and the upload/download speeds when transferring BIM data to the CloudBIM system.

In summary, both sets of results are promising and show that the CloudBIM System is able to:

●Recover from single worker failure.

●It is able to add multiple new workers in under 4 seconds.

●When transferring BIM data it can achieve an download speed of approximately 10MByte/s and an upload speed of 7.5MByte/s.

●The overhead of using the governance model to manage access to the BIM data is less than two seconds per query.

One of the interesting lessons learnt in this project, has been examining a number of other disciplines that are attempting to solve the problem of out-sourcing their data storage. It was interesting to find that many of these disciplines are facing different, but related problems and it is surprising that in many cases there were experiences from one discipline that can be carried over into another.

However, it has also become apparent that because the majority of buildings are unique, meaning each must be treated as a prototype, and that the lifetime of BIM data is far longer than the lifetime of many data-sets (the lifetime of the building), the problems faced in this industry are unique and challenging. Our future objective is to make CloudBIM more scalable and use it in a realistic end user system. This will involve integration of various backend systems that host BIM data using the Worker model used in CometCloud. These systems can range in complexity from a structured data base to a file system. Our current work is focused on developing suitable plugins to enable such integration to be supported.

8. REFERENCES

1. Autodesk (2011). BIM and facilities management, from: http://www.autodesk.com/bim.
2. Wikipedia. (2013, November 10). Building information modeling. RetrievedNovember10,2013,fromWikipedia: http://en.wikipedia.org/wiki/Building_information_modeling.
3. Autodesk (2011). Autodesk Revit Architecture, from: http://www.autodesk.com/revit-architecture.
4. Open BIM Network (2012), Open BIM Focus, COBie, October, London.
5. Dr Mohamad Kassem ―BIM in facilities management applications: a case study of a large university complex‖. ARTICLE in BUILT ENVIRONMENT PROJECT AND ASSET MANAGEMENT · MAY 2015
6. American Institute of Architects. (2008). AIA Document E202-2008: Building Information Modelling Protocol Exhibit.
7. NBS, "NBS National BIM Report 2013," ed, 2013.
8. Thomas H Beach-cloud computing foir the architecture engineering & construction sector: requirements, prototypes& experience, Beach et al journal of cloud computing(2013)