How Building Information Modeling (BIM) Helps in Facility Management

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ABSTRACT : *Building Information Modeling(BIM) one of important future technologies. This technology depends on information from software used in buildings and construction. The dimensions of BIM are constantly evolving with the development of software used in this field. The focus of this paper is on dimensions that related with facilities management. Applications of building information modeling in facilities management includes Energy Management, Emergency and safety management, Space management, information sharing and other applications.*
Keywords: Building Information Modeling, Facilities Management

1. Introduction

The Building Information Modeling usually makes use of specialized project management software to govern the use of information technology especially in building and construction [1]. BIM methodology can be applied to existing facilities through the initial thorough examination of existing documentation. The state of the current structures such as buildings is also examined and planning initiated. Residual performances are mapped out so that there is a basis from which the evaluation can be initiated and interventions can be made. The interventions would result in realignment of the building to the current rules.

The use of BIM 6-D has become a pre-requisite for many contractors that are trying to increase the level of promptness that is achieved in making decisions during the life cycle of a project [2]. The orientation of BIM 6-D is targeted towards improving the facilities linked to facilities management whose overlapping is also linked to the life-cycle performance of a building.
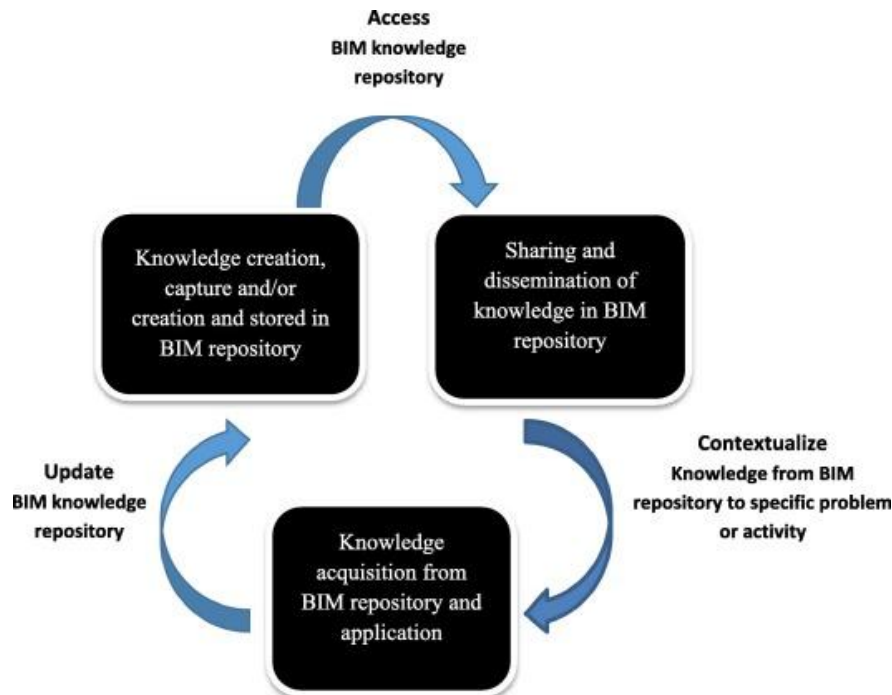
Fig 1: Knowledge management of building information

2. Knowledge Management of Building Information Benefits

BIM results in the provision of virtual knowledge and availability in the form of a library. The availability of a repository for the building information can be maximized from the initial design stages. The knowledge repository creates a situation whereby the information can be exchanged in a seamless manner through the collaboration of the various available professionals working on the project [3]. The knowledge management leads to a guarantee that the building performance is mandated in a manner that increases its functionality and sustainability. The design reviews and seamless flow of details about the various parts of the building model results in high levels of flexibility and durability of structures that are put up. The knowledge management feature also assists in the avoidance of collision because of the analysis and feedback given by the different parties that are involved. Therefore, the mandate and performance of one party is not compromised by another since they have a non-limited opportunity to air their concerns and views on the parameters of the building that would affect their functions as experts in their respective professionals [4]. The professional interactions between the different professionals also ensure that there are no losses on the intended building performance.

The knowledge management would also result in the best available customization of the clients' designs for facilities. The discussion between the different stakeholders such as engineers, clients, and architects would involve the discussion of the materials to be used and costs for the construction project. The professionals would propose the use of different types of fabrics based on the costs and quality that the client would be comfortable with and prefer. The discussion would lead to the proposal of customization of some of the designs and therefore generate the design that would best satisfy the client and meet their needs [5].

3. Applications of Building Information Modeling

3.1. Assessment of Construction Risks and Aversion

The 3D, 4D and 5D Building information modeling repositories also contribute to timely costs assessments and improvement on the quality of designs to be used. Therefore, any implications on the quality of structures or items to be used would be improved early on before being purchased. Such a move would result in the cutting back of costs and utilization of the best available materials. The professionals concentrating on the design

process could make the required changes and submit them for implementation within set timelines provided that the assessments and need for correction are expressed early [6].

3.2. Management of Space

Building information modeling is critical in ensuring that there is streamlining of forecasting and move processes so that the existing space is well analyzed and therefore managed. The BIM also allows the owners of the asset to visualize the type of business operations that should be allowed to operate based on the visualization from the existing models. Any modifications that would be required to suit a particular space could also be made to ensure the comfort and safety of the clients and vendors of the business to whom the space would be leased.
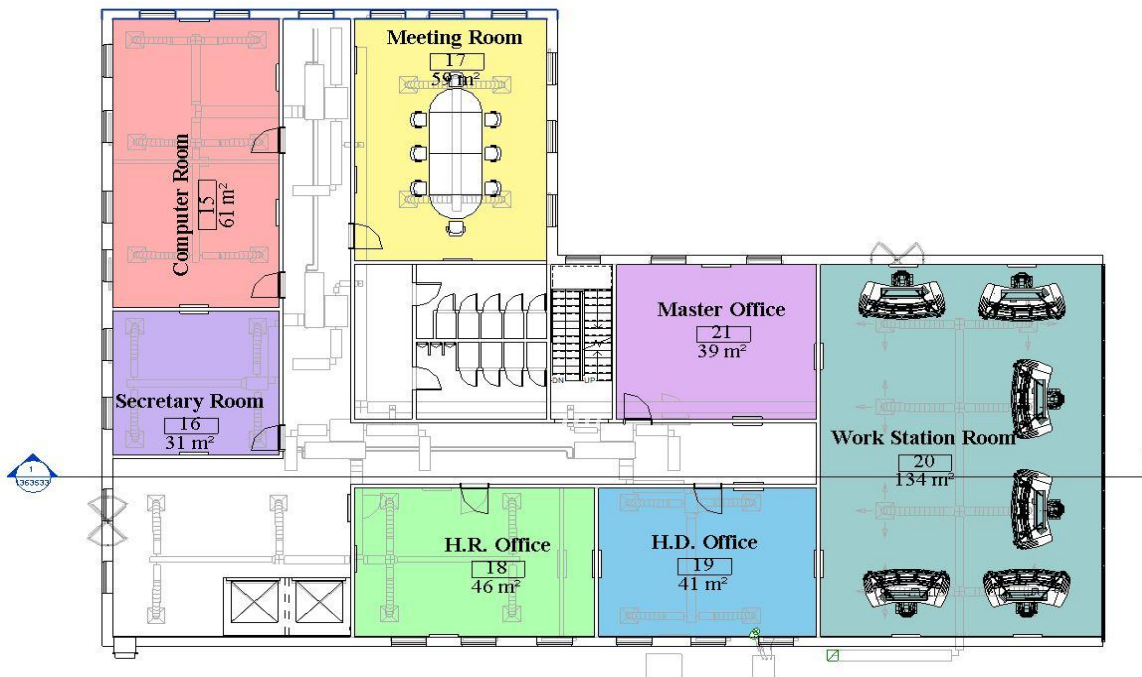

Fig 2: Space management using Revit software

3.3. Feasibility and planning for renovation

BIM offers grounds through which feasibility studies and planning can be conducted and the existing database on a building van be utilized in reference for making estimates of costs for the work that is being planned for ahead. This parameter is based on the contractual relationship between the contractors and clients [7]. The clients might attain a better project outcome if they engage the contractors on the attainment of selection of their project from an analysis of potential existing projects.

3.4. Maintainability studies

Maintainability refers to the specific approach through which the various parties that hold different expertise collaborate to ensure successful completion of the project at hand. The use of BIM models throughout the life cycle of the project, contribute to the minimization of costs. There is also minimization of the possibility of preventive maintenance costs and practices, increase of access, and sustainability of materials used in the project [8].

3.5. Analysis and use of energy

The operations that are utilized in building operations contribute to 40% global energy consumption and carbon greenhouse emissions of 30%. BIM allows for minimization in the amount of energy used and in the procuring process of investments that are sustained. The BIM system allows the project managers to conduct a thorough

assessment of the project and determine the areas where improvements can be made to increase efficiency. Clients are also interested in working with contractors that have a record and interest in working in projects that have high energy efficiency. The managers use the BIM to integrate processes that evaluate the energy use and performance throughout the building asset and life cycle of the project.

The utilization of facilities management features has the potential of reducing the efforts that would be used in maintenance during the operation facilities. Operational facilities maintenance is usually expensive and contributes to the consumption of limited resources for contractors and owners [9].
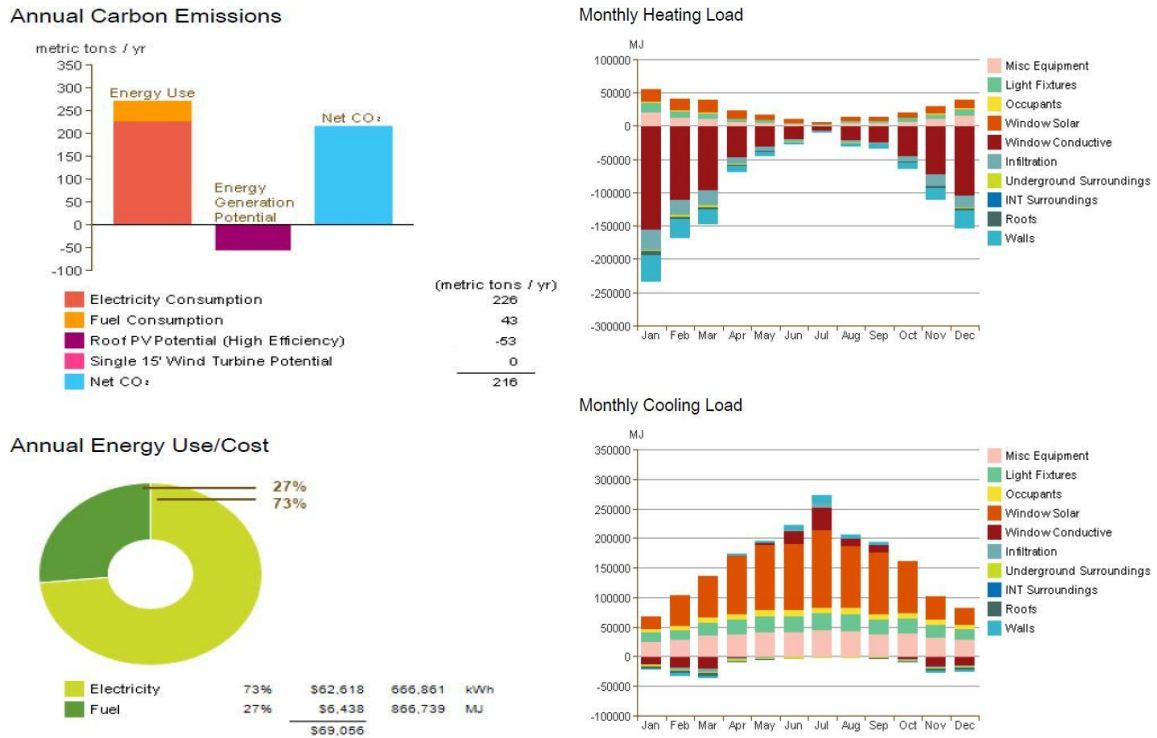

Fig 3: Energy analysis of a building by using Revit Software

3.6. Emergency and safety management

Building Information Modeling (BIM) allows access of the data to persons that possess certain log in credentials. Therefore, there is protection of sensitive data so that it is only accessed authorized persons who would not use it in a malicious manner. However, the persons in charge of the project should ensure that the access and log in details are only given to trustworthy persons involved in the project. They should also institute protective systems that would ease the tracking of data access to increase accountability and responsibility [10]. The information on structures and facilities is sensitive and can easily be misused by persons that have ill intensions such as terrorists. The BIM system allows the organization of information into packets. Various types of information could be accessible to professionals with various levels of access authorizations. Therefore, sensitive information such as all evacuation and entry points cannot be misused.

BIM models have been critical in the construction industry because of contributing to a positive transformation in the conception, design, construction, and management of projects. Most experts in the construction industry currently use BIM in the design and preplanning stages rather than in the management of operations and facilities. Therefore, high levels of effectiveness are achieved in ensuring that possible negative eventualities in the building industry are avoided. In most life cycles for projects, the operations and facilities management period consumes about 60% of the total planned and estimated cost. The inadequate inter-operability between different systems by different experts in a project lifecycle can amount to costs of about $ 15 billion [11].

(6D) and (7D) of Building Information Modeling (BIM) are beneficial for use because of their advantages over other applications that have been used by engineers and architects in the field. The 2D CAD has been favored in the past, but it use is limited to using entities that are graphical. Such a property is limited when compared to the intelligent contextual semantic parameter provided by BIM models. The models generate data that is both geometric and non-geometric which makes use of the building parameters and considerations that require spatial relationships, quantities, cost estimates, elements, maintenance, building elements, inventories for materials, and project schedules. Therefore, the activities and life cycle of the project can be viewed from a diverse perspective when the BIM is utilized in comparison to other existing tools.

3.7. Information sharing

The construction industry is highly fragmented and can benefit from collaboration between the different professionals whose expertise is required in ensuring success in the completion of buildings. There is a need for a shared platform through which the professionals can generate and challenge ideas regarding the needs of modern clients for facilities and their management [12]. Luxury specialized and high tech facilities are in high demand and landlords and managers that possess buildings with attractive facilities attract and retain clients at great prices. Multiple talents are required in the designing of functional buildings and facilities [13]. Building information modeling creates a tool through which the various professionals whose expertise is needed can collaborate and communicate from the initiation to the end stage of the building process.

Traditionally, contractors have used their own data and tools in modeling the project that they are working on. The independence of the various experts is bound to generate incompatibility in the work processes that are generated. The information sharing ensures that there are no miscommunications and redundancies. Therefore, the cost of any resources that would be used on the back and forth or need for revisions on current work is eliminated [14]. All the planned systems can be integrated so that the best visualization and optimized can be adopted by all the professionals and stakeholders working and hold interest on the project respectively. The holistic view and approach and building offer a platform through which the quality of work and costs are highly optimized [15].The centralized platform also creates a shared tool that all the professionals can make reference to in future rather and it can be updated depending on the real time changes made on the facilities.

3.8. Interoperability

Building Information Modeling represents the functional and physical parameters of a facility. The shared knowledge between the various functions ensures that there is collaboration for the different from the design phase and there are high levels of convenience created [16]. The full implementation and utilization of (6D) and (7D) of Building Information Modeling (BIM) is expected to encounter some challenges before its full adoption and success. There should be a prediction of the possible challenges so that they are dealt with before hand. The interoperability ensures that there is coordination and discussion so that the functions and facilities that are used inside a building are aligned to its outside operations [17]. The interoperability ensures that the building performance is mandated in a manner that increases its functionality and suitability.

3.9. Schedule and cost optimization

In traditional building systems, a clash in the utilized systems is usually detected late which contributes to wastage of irrecoverable resources such as time and money. However, Building Information modeling presents an opportunity through which any form of wastages can be detected at the design stage and corrected to ensure the avoidance of resources being over-used. There is also a smooth flow in operations because of the clarity offered in the stages to be followed throughout the construction process by the involved experts.

3.10.   Construction process
Building Information Modeling is highly effective in the design process because it acts the basis for other activities in the project. Once all the professionals involved in the project execution are on board with the design process, they are expected to give their input and physical effort in ensuring that the construction process runs smoothly. The construction process is critical because it is where the designs that are on paper are actualized into reality [18] [19]. The designs and set of available resources are actualized into a physical product which has to function as expected by the clients for it to meet its purpose. The resources that are utilized in the project cost money, and the laborers and other professionals that contribute to the actualization of the project also have to be

paid. Therefore, the generated product is expected to be fully functional for the project to be considered as being effective.

For the materials, equipment, and personnel to be considered as having been invested in a worthwhile project, the construction process should be highly effective. The productivity stage can be improved through ensuring that the delivery systems are flexible and reliable so that their performance is also optimal. The building information modeling application would support the operation of a system that supports high levels of effectiveness. The timeliness, equipment used, and availing of the required materials would contribute to a smooth flow of operations. Proper procurement and scheduling would contribute to the improvement of the timelines within which the required timelines are availed to the workers at the site.
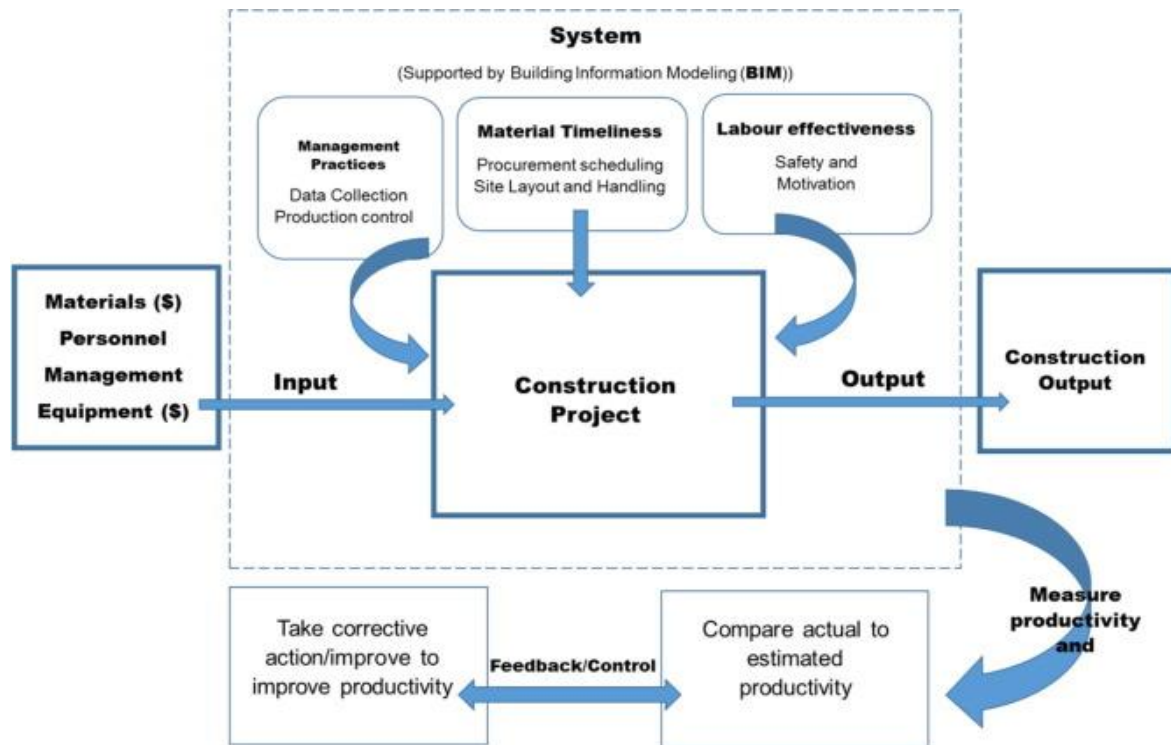

Fig 4: Framework for improvement of construction process using building information modeling

The full implementation of the BIM in projects might be challenging at first, but the attainable benefits offer high levels of efficiency which should be pursued by the involved professionals in the field at a maximal rate. The existing gaps in the facilities management sector should be understood and explored by all the industry players. The possibilities that would be attained through the use of Building Information Modeling (BIM) would be attractive and therefore push the involved players to allow full exploration and utilization of the efficient tool [20]. The use of BIM models is highly favored because of its integration of parameters that involve design, operational and construction components. Therefore, during the initial process, the professionals at the end stage can already be contacted and they would give their input on the best strategies and tools that they feel would increase effectiveness. The integration of diverse experts on a particular project has a synergetic effect and promotes creativity and efficiency. A BIM model would generate information related to weight, height, geographical information system (GIS), weight, and length. The figure below (figure 5) shows the extent to which BIM would contribute to efficiency for various parameters required in facilities management.
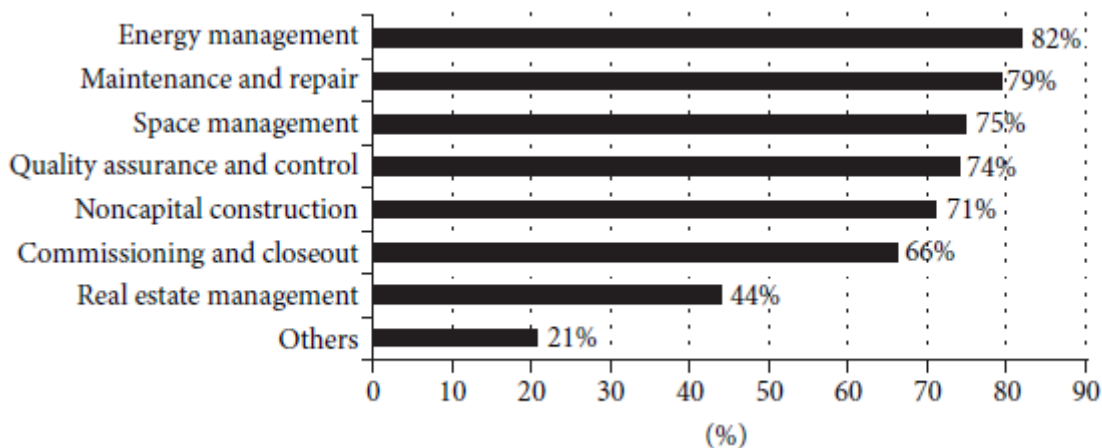
Fig 5: Parameters that are positively impacted by BIM

4. Conclusion

The Building Information Modeling usually makes use of the design stage in a great way because there is discussion of the involved parameters by the involved professionals. The building information is usually shared and the professionals are given a chance to give their input and feedback on the design, fabric, timelines, costs, and other issues that they feel would affect the success of the project. Building information modeling contributes to the brainstorming and presentation of ideas on how designs and other elements of a construction process can be improved in a timely manner. The involved professionals can discuss the availed designs for parameters such as effectiveness of functionality, materials, costs, and customizations. Such discussions would involve all the stakeholders such as client, engineers, architects, and project managers. The inclusion of the client would keep them interested and motivated to give functional ideas and cooperate in areas such as attaining authorizations for necessary processes and availing funding [21].

The management of the project should ensure that there is provision of the required level of remuneration so that the staff members stay motivated. Production should be properly controlled, and the managers should ensure that data collection and handling is well done. The productivity of the construction process should be monitored and evaluated in a consistent manner. The productivity of a project would be considered as highly effective if it met or has surpassed the targets that were stated at the initial stages of the project. If there is a serious delay in the timelines that had been set earlier, an assessment should be made to determine the problem areas.

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