Comparative Study of Bim Method with Conventional Method for Building Construction

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ABSTRACT

Building Information Modeling (BIM) is becoming a comprehensive collaborative process in the construction industry. Despite its short history, BIM has had an increasing growth during the last decade. This is happening mainly due to its capabilities on construction projects. BIM can create a common language between all parties and system divisions in a project and make them an integrated team. The approach of BIM strongly matches with integrated project delivery systems. The role of BIM as a coordinator of project system is quite similar to the duties of a project manager. BIM integrates different disciplines by effective communication, analyzes the project systems for constructability, estimates the cost and time of projects at any time using quantity takeoffs, draws a big picture of projects using visualization and builds collaborative teams. All these are what a project manager does in a different scale during a project life cycle.

This paper aims to show the correspondence of BIM and project managers' roles on construction projects. It emphasizes the importance of having proper BIM knowledge and experience for project managers to succeed. This paper also discusses the requirements of BIM knowledge and experience enrichment of project managers.

Keywords-- Building Information Modelling, Project Management, Construction

I. INTRODUCTION

1-1. History

Building Information Modeling (BIM) can be defined as a reliable, digital, three dimensional, virtual representation of the project to be built for use in design decision-making, construction scheduling and planning, cost estimates and maintenance of construction projects (Words & Images, 2009). The BIM Handbook (2008) defined BIM as a computer-aided modeling technology for the purpose of managing the information of a construction project focusing on production, communication and analysis of building information models. The National Building Information Model Standard Project Committee defined the BIM as following: “A BIM is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward.”

The concept of BIM theoretically emerged and was developed at Georgia Institute of Technology in the late 1970s and grew rapidly after that. The growth happened because of the increasing attention paid to construction teams and firms that found merits in using BIM in order to integrate the process of the construction projects and managing them. The term Building Information Modeling was first used in 2002 to describe virtual design, construction and facilities management (Harris, 2010).

Graphisoft in 1986 introduced its new software as a solution for virtual building. This software, Archicad, was really a drastic improvement in CAD programs of that time since Archicad allowed the creation of three dimensional (3D) models of projects (Dey, 2010). The terms Building Information Modeling and Building Information Model and the acronym of BIM were widespread when Autodesk released the “Building Information Modeling” (Autodesk, 2003).
1-2. Construction Project Management

Construction projects constitute the main part of all disciplines projects due to their amount, variety and cost. The U.S. Census Bureau News (2013) estimated that the construction industry would spend more than $874 billion in 2013. These projects range from small residential or retail projects to mega multifunction projects. Needless to say, with any scale of a construction project, there is a necessity for managing it. The management of construction projects requires knowledge of modern management as well as an understanding of all construction processes. Along with the change in technology, organizational arrangement or procedures and new features and methods, the management of construction projects differs (Hendrickson, 2000). Construction project management is a series of activities for determining how, when and by whom the work, including all life cycle activities, will be performed.

Similar to the Project Management Body of Knowledge (PMBOK) definitions, the construction project manager handles project management planning, cost management, time management, quality management, contract administration, safety management and risk management. The project manager is also in charge of communication between all stakeholders on the project including owner, designers, engineers, professional crew and administrative staffs. Generally, construction project management shares the common and overall characteristics of general projects, therefore, the rules and methods required for general project management can be applied to this type of projects.

II. BUILDING INFORMATION MODELING ASPECTS

Technical Aspects of BIM

BIM has some specific features that can effectively be used in project management. These features, which are increasingly developed, can be summarized as follows (Lahdou & Zetterman, 2011):

1. Clash Detection

One of the common problems of different disciplines’ plans for a construction project is the geometrical design inconsistencies. This issue happens when there is an overlap between the plans of different disciplines. Using BIM, it would be possible to bring the plans together and detect the clashes. Modifying the aesthetic problems is another possibility of this visual checking.

2. Constructability

Using BIM, it would be possible for teammates in a project to review and handle constructability issues and (if needed) promote issues into RFI’s. In addition, visual information can be provided from a vantage point to show the problems. This visual information accompanying markup allows further investigation for finding solutions and, thus, mitigates the risks.

3. Analysis

Helping the project managers, designers and engineers in doing more analyses and enabling better decision making is another aspect of BIM. By linking the building information models to appropriate tools, it would be possible to analyze the energy consumption of a construction project and then find better solutions such as changing materials and orientation, mass and space, etc. Moreover, light, mechanical and acoustics analyses are also available to be performed by BIM.

4. Time & Cost Estimation (4D & 5D)

Time and cost estimation are other features of BIM which enable project managers to visualize the construction project at any point in time and have a clear understanding of project phases. Time and cost estimation, which are generally called 4D and 5D, can be properly utilized in the first stages of a project and facilitate the decision making process with minimum cost and time needed. Furthermore, BIM has the capability to simulate the various alternatives for a construction project and hence helps project managers and executives to reliably predict the consequences of their decisions.

5. Integration

The project team can deal and interact with a unified model when a composite model is built from an amalgam of various disciplines’ models. Having this capability, and through the different phases of a construction project, BIM can coordinate the design, analysis, and construction activities on a project and, therefore, results in integrity of projects.

6. Quantity Take-off

Quantity takeoffs in a BIM model can be very helpful for the project teams and managers to analyze their decision and have a clear and reliable insight to various alternatives in the design phase or even throughout the project lifecycle. Since there is a possibility of integration between the BIM model and a database.

III. ROLE OF BIM IN PROJECT MANAGEMENT

3-1. BIM vs. PMBOK Knowledge Areas

Capabilities of BIM on construction projects correspond to the PMBOK knowledge areas, since the nature and role of each item are alike. Therefore, BIM can be considered as an effective and powerful tool in project management in the construction industry.

Integration management is the first area of PMBOK, which has the same function as the BIM. BIM integrates the documents, plans and efforts of all parties involved on a project. BIM is also an object-based environment that can categorize different elements of a building and break it down into different groups, like what occurs in project scope management. Another characteristic of BIM is its capability in managing time and cost or what is allegedly called 4D and 5D. This is similar to project cost and time management areas in PMBOK standard. Although the constructability does not illustrate all risks associated with a construction project, it is a powerful tool in building a project and mitigates the construction risks. Clash detection in BIM acts as a quality process which visually recognizes, modifies and analyzes the soft and hard clashes. Collaboration and team building in BIM is what human resource
management considers as a project management area. Communication is a main feature of BIM which facilitate the professional relationship between all parties including project managers, designers and engineers on a construction project by creating effective and direct communication channels. Finally, procurement management would be possible by quantity takeoffs which are produced by BIM. In addition, changes in any item can be easily reflected in cost and time and work needed for its procurement. In spite of the extensive framework of project management, BIM can be presented as a main and effective concept corresponding to project management knowledge areas. Figure 2 shows model of P3OK knowledge areas considering BIM on construction projects.

3-2. BIM Benefits and Advantages

Different sources of construction project management identify key advantages of using BIM as follows (Qian, 2012):

- “Enhanced project collaboration and control among stakeholders
- Improved productivity (less re-work, conflicts and changes)
- Better project quality and performance
- Faster project delivery
- Reduced wastages
- Reduced construction costs
- New revenue and business opportunities”

BIM Tools available for construction practice

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Manufacturer</th>
<th>Primary Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cad-pipe HVAC HVAC</td>
<td>AEC Design Group</td>
<td>3D HVAC Modeling</td>
</tr>
<tr>
<td>Revit Architecture</td>
<td>Autodesk</td>
<td>3D Architectural Modeling and parametric design.</td>
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<tr>
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<td>Revit Structure</td>
<td>Autodesk</td>
<td>3D Structural Modeling and parametric design.</td>
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<td>Revit MEP</td>
<td>Autodesk</td>
<td>3D Detailed MEP Modeling</td>
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V. PROBLEM STATEMENT

A G+4 proposed building of 24 flats and of 4 shops is taken for case study location is in Ravet, PUNE under PCMC for plot size 6800 sq. feet

- Case study of a G+4 proposed building of 24 flats and of 4 shops in Ravet, PUNE
- Design Team: Apex consultant
- Owner and Developer: Shivaji Patil
- Architect: Ravi Varma
- Structural Engineer: Navneet Patil and Prashant Patil
- Builder: Praj Infra Solutions pvt.ltd.
- Area: 6800 sq.feet
- Cost of land: 1.98 Cr.
- Cost of construction: 2.5 Cr.
- Area of 1 BHK: 464 square feet
- Area of 2 BHK: 800 square feet
- Total No. of flats: 24
- No. of skilled labours required: 25
- No. of site engineer required: 1
- No. of structural engineer required: 1
- No. of architect required: 1
- Location: Ravet, PCMC
- Set back distance: 14”
- Side distance-9”
- TDR: 20%
VI. RESULT AND DISCUSSION

This work studies effectiveness of building information modeling for effective project planning, management.

- A 6D model of G+4 building is prepared as per methodology of BIM as mentioned which includes 3D models, scheduling, quantity, and costing.
- For present case study it was observed that total 39 days can be saved in total for tasks like scheduling, planning, monitoring, cost analysis which will lead to saving in costs and 25-30% reduced due to coordination and reduction in man power. However, the cost of material will remain the same.

VII. CONCLUSION AND RECOMMENDATIONS

This work studies effectiveness of building information modeling for effective project planning, management.

REFERENCES


