

BIM Implementation Strategy- A proposal for KMRL

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Abstract –

The implementation of Building Information Modelling (BIM) is a widely adopted pattern of revolution in the construction sector and the results gained through BIM adoption in multidisciplinary projects are well pronounced. Even though BIM is a widely accepted technique, its adoption in Kerala, especially for Kerala government projects is rare.

Kochi Metro Rail Limited (KMRL) is one of the rapid transit systems serving the city of Kochi in Kerala and now its 2nd phase has obtained approval. Taking advantage of its current status, this research aims to develop an effective implementation strategy for BIM adoption in the 2nd phase of the Kochi Metro Rail project. This research also focuses to develop the key contents of the BIM Execution Plan (BEP) - which sets the standard for BIM execution by defining how, when and by whom the BIM processes should be carried out. The surveys conducted with KMRL project team members and BIM professionals for the smooth adaptation of BIM and framing BEP contents based on survey results are included in this study.

Keywords –

BIM implementation strategy, Kochi Metro Rail project, BEP contents.

1 Introduction

Building Information Modelling (BIM) is a process which enables the development, use, and transfer of a digital information model of a building project to improve its design, construction, and operations. BIM also contribute to construction documentation with its potential for sharing and managing information with project participants. The advantages of BIM usage are more utilised in multidisciplinary projects as its sharing requirements of information are high.

Even though large multidisciplinary infrastructure projects are taking place in Kerala, the adoption of BIM in Kerala government projects is very less. This means the complexities which are offered to be overcome with BIM usage still exist as a future achievement in such projects. A revolutionary strategy is still required for the actualisation of BIM in Kerala government projects.

Kochi Metro Rail project is one of the large infrastructure projects in Kerala and now it has obtained its approval for 2nd phase with 11.2 km Pink Line and 11

stations. From this perspective, there exists an opportunity for proposing a BIM culture in this new venture. Given this situation, this research aims for developing an effective implementation strategy for BIM in the Kochi Metro Rail project. At the same time, it is also important to understand the significance of the challenges behind its effective implementation. This paper also works on overcoming these challenges.

2 Related Research Studies

For the purpose of identification of implications behind BIM adoption, several case studies and journals that are associated with BIM and its implementation strategies have been referred to. From those references, it was evident that the process of implementing BIM requires significant adjustment to the current practice followed in the organization [3]. All members of the team must understand the project goals and the eventual end-uses of the BIM model in order to set it up properly to allow the end uses [5]. Also, BIM-enabled practice requires construction professionals to interact frequently through a common information-sharing platform [3]. The weakening of this collaboration in BIM-based working could lead to design clashes, omissions, and errors [3].

When it comes to BIM standards, a BIM Execution Plan (BEP) is one of the powerful tools in providing a standardized workflow and general guidance for strategic BIM implementation in a holistic approach for a particular project or a group of projects [1]. Developing a strategic framework for BEP is thus important for the successful implementation of BIM in any construction project [1] [5] [6]. About BEP or any standards, one of the common misconceptions is that all projects are the same, and the same methods can be used for all of them, but every project is unique. i.e., construction projects involve people with varying degrees of knowledge and expertise, and project managers with different levels of sophistication; some projects are predictable, others are complex and risky, and so on [4]. This implies one standard doesn't fit all. Also, the involvement of all parties such as design, construction and Operation & Management (O&M) teams is necessary for the preparation of BEP [5]. When it comes to BEP contents, its elements include- Project goals- Roles and Responsibilities- BIM process design- Collaboration Procedures- Model structure- Model Quality Control and

Project Deliverables [1]. Among these, the most important key element is the identification of Project Goals/BIM Objectives since BEP is set for meeting those goals [1] [6].

Based on the studies conducted, the importance of BEP in a BIM project was a clear knowledge and thus this research reached the objective of developing the implementation process by proposing the key BEP contents which set guidance for introducing BIM in the Kochi metro rail Project.

3 Methodology

3.1 Discussion with KMRL Project Team

Prior to structuring the BIM Execution Plan contents, it was necessary to conduct discussions with the KMRL project team. For this purpose, a questionnaire was prepared in the form of unstructured interviews and discussions, and their answers were found.

As the studies suggested, if the roles of the sociotechnical elements (i.e., actors, tasks, technology, and structure) are more fully understood, then BIM deployment and the encompassing process change can better be managed [3]. Thus, the identification of the current organisation structure was the first preference. The source and destination of each piece of information throughout the construction process were also other key factors that need to be identified. When it comes to BIM, Why BIM? Was crucial to get an answer. For that, the problems associated with the traditional way of practice in KMRL and the needs and expectations of KMRL through BIM adoption at different stages of construction within this project were also expected to get clarified.

From the responses of KMRL project team members the background of the team was outlined as, the project organization structure and workflow commences with the in-house team from where the concept of the design starts. This conceptual design will then be developed into detailed design with the involvement of a detailed design consultancy. Once the detailed design is completed, the drawings will then be transferred to the execution team which will be a project management consultancy comprising of a project manager with the crew members comprising of engineers of different departments, architects, and interface manager and so on for executing their part of the work.

At present, there is no team for conducting coordination of all the disciplines. The identification of coordination issues and its corrections are carried out at the site itself. Based on this workflow, the organisation structure was framed out with the responsibilities of appointing party (the client) and appointed parties (the design team and the execution team). Apart from the information exchange pattern, the level of information

produced at each stage (conceptual design stage, detailed design stage, construction stage) of the project was also another concern. Combination of all these aspects of information was crucial to frame out the BIM overview map and process map which contains the high level of information exchanges that occur throughout the project lifecycle [6]. As described in the studies related to BIM implementation, the introduction of BIM should not result in a sudden change in the usual practice as it creates a reluctance towards its acceptance. In the preparation of BEP also, one of the key contents is defining the roles and responsibilities of everyone involved in the process. So, through the questionnaire session, it was able to compare the task associated with each team member in the current organisation (other than the BIM team), before and after BIM implementation and thus enabling a smooth transition for the process.

Besides this, the next intention was to find the needs and expectations of KMRL with BIM implementation. For that, identification of the issues associated with the current practice was crucial. Based on the responses, delays affecting the work progress were found to be the more frequent issue and they are listed along with the other issues affecting smooth project execution,

- Drawing mismatches.
- Delay due to lack of information at the site.
- Lack of coordination between the execution team.
- Delay caused due to delayed work of one party.
- Delay in obtaining approval for a design change.
- Lack of accurate estimate of materials in accordance with timely changes.
- Material unavailability at the time of procurement.
- Lack of proper visualization for design review, etc.

When it comes to estimation of Bill Of Quantities (BOQ) and their by the cost, lots of inaccuracies are prevailing as the existing way of practice proceeds by taking measurements manually from CAD drawings. Apart from the incompetence of this traditional method, inaccuracy exists in terms of lack of coordination. For example, the length of any mechanical pipe or duct obtained in terms of a manual CAD based calculation will be different from that of a measurement from a well-coordinated clash free BIM model. Besides, this prevailing method of quantity takeoff does not incorporate design changes happening in a timely manner.

Furthermore, the unavailability of materials at the time of procurement can be avoided by the proper monitoring of procurement status of materials. The need of visualization of construction sequence is emulated here.

3.1.1 BIM Uses/BIM Goals

The findings obtained from this questionnaire session were taken for the development of the BIM process. The

first and most important key content in a BEP is defining BIM uses/ BIM goals. The characteristics of the BIM process depend mainly on the purpose for which it is created as the adjustment of the project management approach varies as per the needs of each project. The identified BIM uses are listed below.

- Clash detection and coordination
- Design review
- 4D construction sequencing
- BOQ along with cost estimates

3.2 Questionnaire Survey with BIM Professionals

Once after finalising the BIM use/ BIM goals, it was necessary to conduct a survey with BIM professionals specifically based on the contents of BEP. As they have the knowledge and real-time work experience with BIM projects, they can suggest the most relevant and effective BIM techniques. Responses were collected from 30 BIM professionals consisting of BIM Managers, BIM Coordinators, BIM modellers, BIM engineers and certain IT specialists. A set of 15 questions were prepared with the expectation to get answers regarding roles of responsibilities played by each person in a BIM-based project. In addition, the level of information required and information exchanges at different stages of the BIM execution process, the relevance of BEP, software and hardware requirements, the relevance of following international standards for the BIM project execution along with the type of Common Data Environment (CDE) adopted for data sharing in the respective projects were the other necessary questions to get answered. The responses were categorised based on the level of experience and level of knowledge about BEP.

4 Results and Discussions

From the responses obtained from the survey, the results are categorised and sorted for formulating the other contents of BEP.

4.1 BEP Contents Based on Survey Results

4.1.1 Roles and Responsibilities

- BIM Manager: Develops BEP standard, participates in the decision-making process, standardize workflow, manage BIM models, works on quality assurance process, Track and control information resources, provides training session, attends client meetings, design review meetings and coordination meetings, develops and implement more precise work process to achieve quality with controlled time under budget.
- BIM Coordinator: Submit RFI reports and clear

coordination issues, attends coordination meeting, design review meeting and BIM team meetings, attend decision-making processes, timely submit discipline models, creates modelling and shop drawing templates, Assures quality of BIM models, confirms naming standards for document management, maintains information exchange logs.

- BIM Modeller: Works on BIM modelling and shop drawing generation, identification of issues and preparation of RFI reports, confirms BIM model and shop drawing quality with clash checks and checklist.

By analyzing the current workflow pattern and BIM goals and expectations of KMRL, the need for certain roles was skipped to avoid the sudden accommodation of a huge team.

4.1.2 BIM Overview map

BIM Overview Map shows the relationship of Model uses on the project throughout the project lifecycle [6]. Based on the responses of BIM professionals about the stages of BIM execution and comparing them with project stages of KMRL, the BIM overview map was prepared for the identified BIM uses/goals that to be expected from BIM implementation in this particular project as shown in Figure 1. An overview of the information required and exchanged is also represented in the BIM overview map.

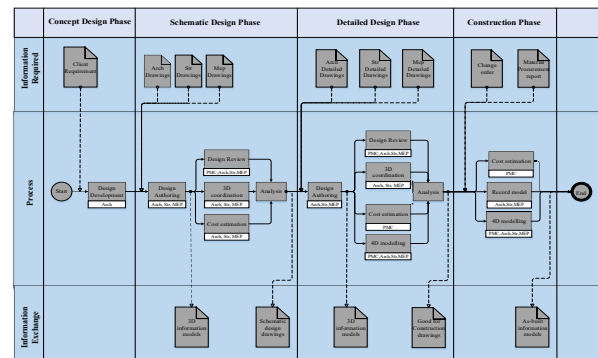


Figure 1. BIM overview map

4.1.3 BIM Process map

BIM Process Maps were created for each identified BIM use on the project to clearly define the sequence of various processes to be performed [6]. The tasks performed by each individual from the start to end of each BIM use with information exchanges taking place in between each task are indicated in the map. Both the overview map and process map are prepared as BPMN diagrams. The process map for one of the identified BIM use, clash detection and coordination is shown in Figure 2. The BIM team was constituted of one BIM manager, BIM coordinators for each discipline (Architecture,

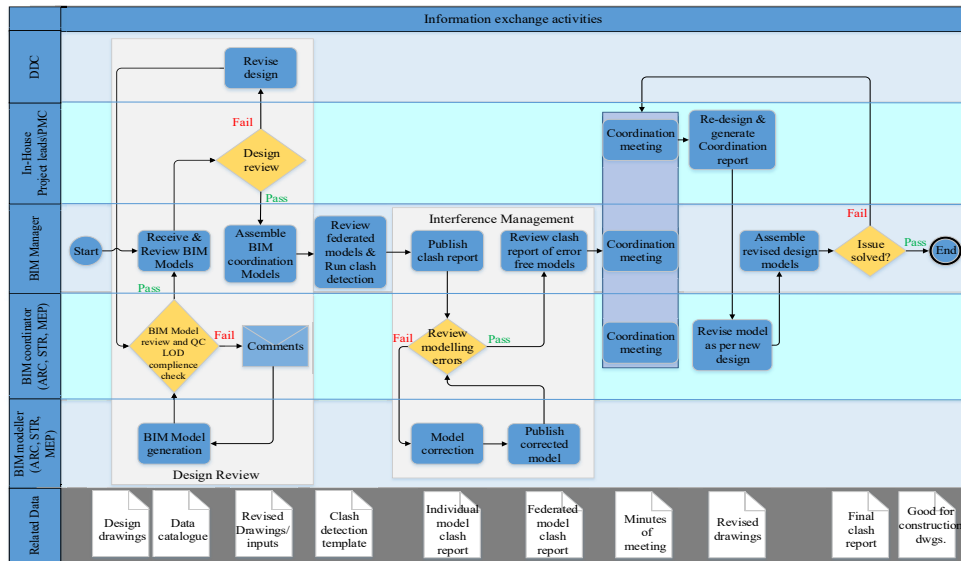


Figure 2. Process map for clash detection and coordination

Structure and MEP) and BIM modellers working with each BIM coordinator. While preparing the process map, one fact i.e., BIM should connect everyone was very important. So, connecting the BIM team with the currently existing project team in KMRL, including in-house project leads, detailed design consultancy and a project manager in the execution team was very crucial. In the process map, provisions for design review and interference management were also included, confirming the model's accuracy and output.

4.1.4 Collaboration Process

Collaboration indicates how communication and information sharing are managed between the responsible parties in the BIM process. Based on survey responses, even though folder structure as per ISO-19650 is enough for internal communication, BIM Collaboration Pro, which is the latest version of BIM 360 was proposed for non BIM team to conduct cloud-based design review.

5 Conclusion

BIM is a revolutionary trend in construction management. Based on the survey and its findings, this paper proposes a BIM implementation strategy by considering the current culture followed in the organization to formulate the key contents of the BIM execution plan such as BIM uses, Roles and responsibility, BIM overview map, Process map, Quality assurance technique and Collaboration process. Since the participants selected for the survey was currently working and experienced BIM professionals, their valid

responses can contribute to the effectiveness of the implementation process.

Meanwhile, the main factor depends on the mentality of the staff members of the organization for accepting the current trend. Since the proposed plan of action is incorporated with the current practices of project participants, the difficulty in acceptance can probably be minimized.

Future expansion for this study is possible for formulating additional contents of BEP.

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