Research and Application of BIM-based Specification-compliant Field Quality Management for Lean Construction

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Abstract. The construction quality is always the focus and aim of a project, and how to control and manage the quality of the project is an eternal theme. With the endless stream of new architectural design, increasingly diversity in functions and complexity in professional system, and massive tedious data information, quality and management are facing stern challenge in the new political, economic, social and technological environment. The emergence and popularization of BIM (Information Modeling Building) not only changed the production tools of practitioners, but also provided a new way for engineering quality management. This paper will conduct research and discussion in aspect of the construction quality management in the time of opportunity and challenge.

1. Introduction

The quality requirements are becoming higher and higher with the large scale, complexity, specialization and internationalization of engineering projects. Quality not only refers to the degree to which the inherent characteristics of the product meet the requirements, but also includes the value of the product or service.

According to the report "The Business Value of BIM in North America: Multi-Year Trend Analysis and User Ratings (2007-2012)” released by McGraw-Hill Construction Corporation of the United States, a survey of 582 construction workers was conducted. The 2012 BIM application rate in North America has been as high as 71%. As an information tool, BIM has been widely used in the construction of engineering projects in the visual progress management [2], dynamic cost management [5], contract requirements disassembly and analysis [3], construction life cycle safety management concept and implementation [7].

However, due to the cost problem [4] and the technical problem of BIM itself [1], there are still obstacles to the application of BIM. At the technical level, a single application of BIM can not solve these problems, but through the introduction of other technologies, it can support the application of BIM in quality management. For example, BIM and RFID can collect information quickly and accurately, thus realizing the real-time tracking of material components and ensuring the authenticity and uniqueness of information. Combined with BIM and cloud, information storage, analysis and processing of BIM model can be solved, and the sharing of resources could be realized at any time or anywhere. So the application of BIM and these technologies in quality management can support quality control to a certain extent, and BIM has shown certain potential in quality management.
2. Lean construction and BIM

By constructing the matrix of lean construction and BIM, we can analyze the correlation between them. The combination of BIM and lean construction can increase the flexibility of schedule and support visual schedule management, and the standardization and visualization management of construction state visualization and instant communication of product and process information [6]. The integrated application of BIM in lean construction refers to the high collaboration degree and deep integration, in design, construction and operation stages to support the BIM application value, as shown in figure 1.

![Figure 1](image-url)

Figure 1 Mechanism of BIM cooperative application in lean construction system

3. BIM-based construction quality modeling

3.1 Quality control point setting

The setting of quality control points must be determined according to the characteristics of the project, the quality standards and requirements, the construction technical scheme, the technological level, the construction experience, the operational proficiency of each work type, and the engineering construction environment, etc.

For the construction process control, the first is to determine the quality control points, clear the construction sequence of each quality control point, and make the construction time and quality acceptance time of each control point according to the progress plan. The second is to control the quality of working procedures and work, which should be measured according to the corresponding national, industrial and local standards and construction requirements of enterprises. At the same time, in the process of construction, the working procedures and work should be checked according to the standard to ensure the quality of the construction process.

3.2 BIM coding

This paper draws lessons from the “Classification and coding Standard of Building Engineering Design Information Model” and the coding rules of OmniClass (The OmniClass Construction Classification System). And the elements are represented by two digit codes at each level. The quality acceptance record table is classified and coded to realize the one-to-one correspondence between the component and the table, so that the quality control points of each component can be managed and queried conveniently. The code of the component is combined with that of the quality acceptance record table. The component code is first, and the acceptance table code is in the back. The middle part is connected with "-", which constitutes the final code. When the corresponding coded inspection
batch is clicked in the database, the quality acceptance record table covering the inspection batch at
the quality control point can be called, and then the scope of the inspection batch can be narrowed
down in turn, finally a more detailed quality acceptance form will appear.

4. BIM-based quality control process

According to the general requirements of quality management, the later process can be carried out
only after the construction of the previous process is completed and the inspection is qualified.
Therefore, it is necessary to integrate the progress information in the quality management model to
form a time-series based quality inspection, such as figure 2.

![Figure 2 Preparation and adjustment of schedule plan based on BIM](image)

The component of the BIM model is docked with the construction schedule corresponding to the
component to define the start and completion time of production for the building. The dynamic growth
process of the building object and the overlapped relationship between the processes are presented
through a visual 3D scene. The dynamic schedule visualization model can be formed by defining the
different colors and transparency of the construction state such as completion and construction, and
visualizing the part that has been completed and the part under construction at a certain time.

5. Conclusion

This paper discusses the definition of quality in the new era, that is, quality is the service value of
products to users. By expounding the application value of BIM technology which the author has
participated in the whole life cycle of the project and combining the above quality definition, the
application value of BIM in quality management is analyzed, that is, the cost is reduced to enhance the
value of the project under the premise of guaranteeing the function. Then, the implementation method
of BIM in quality management is discussed, and the method of information integration and utilization
under the guidance of lean construction theory under BIM environment is put forward. The modeling
method and depth oriented to quality management are put forward, and the 4D construction schedule
model is formed by integrating the construction method and dynamic tracking and checking
construction progress. The implementation method and steps of construction quality management
based on BIM are presented in this paper, which provides a feasible way for this study.

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