Chapter 2
Development of a 4D Visualization Tool for Construction Planning

Takanori Terashma
Miyagi University, Japan

Koji Makanae
Miyagi University, Japan

Nashwan Dawood
University of Teesside, UK

ABSTRACT

This chapter presents the implementation of a system that visualizes the construction process using 3D modeling data and schedule data to analyze construction planning. Previous papers have emphasized the benefits of visual 4D planning that combines 3D modeling data and process schedule data for work progress control. The proposed methodology offers rapid visualization of work performance with scheduled activity and facilitates construction planning and schedule inspection. Consequently, it should increase productivity and reduce rework. However, even major construction companies will not adopt such a work style, because the existing, well-organized way of working would not be readily changed unless the new style is proven to afford benefits that outweigh the effort and cost required to adapt to the style. The advanced CAD system, for example, is able to simulate the assembly process, and the advanced 3D graphic designer is able to animate the arrangement of objects. Even though each software provides multiple functionalities, the applications in practical use are all independent and specific, such as CAD for designing 3D models, and a project manager for scheduling and analyzing. Therefore, a system that integrates all outputs from each application is required to move from the conventional work style to the new one. This chapter, thus, aims to develop a system that integrates several types of data and enables the simulation of the construction progress by gradually showing 3D models according to the activity schedule. It is also possible to attach material data to each object and to display related information.

DOI: 10.4018/978-1-61520-871-5.ch002
1. INTRODUCTION

Previous papers have emphasized the advantages of architectural methodologies that use 4D data that associate three-dimensional modeling data with constructional timing. In recent times, the construction industry has aimed to rationalize the production system by deriving the benefits afforded by the integration of procedures ranging from designing to construction, and therefore, promoting the use of a 3D CAD system. The aim of recent 3D CAD technology is to provide a platform to unify several types of data that project members share, including data related to design, construction, and facilities; earlier CAD technology could only provide data related to the intended design at an early planning stage or a consistent drawing at the final planning stage. Technical issues at the construction stage are considered from the early design stage. Combining design with production in such a manner, called production design, allows the user to rapidly show the work progress and the completed amount of work as well as to reduce rework and redesign at the post-process stage since visualization at an early stage helps identify technical problems. Such a methodology requires various types of applications, including a CAD system, to design, plan, manufacture, and manage the process. However, it should be noted that the interchangeability of shared data between the software is not sufficiently high, and thus, the efficiency of the entire project is not improved considerably. The product model is being developed as a good solution for interoperation among different systems. Product model is a generalized data model that expresses three-dimensional shapes and information about the attributes of each element that composes a structure. The data set can be shared by various systems or applications when it is created as a product model, as shown in Figure 1.

Despite the advantages of the abovementioned method, even major construction companies do not adopt such a work style. In fact, two-dimensional drawings are still widely used for design drawing and construction planning. Although a 2D drawing is sufficient for a designer, it is hardly possible for less-experienced people to visualize the 3D aspect from the 2D drawings, and besides, it is not suitable to simulate or analyze the problems on a PC. It appears that the conventional way of working will not change easily unless the new style can be clearly shown to afford benefits that outweigh the effort and cost required to adapt to this style.