

## Integration of Project Scheduling with BIM Visualization – 4D Modeling

Merve S. Öner<sup>1</sup>, Ahmet Öztaş<sup>2</sup>

<sup>1</sup>BSc. Student, Department of Civil Engineering, EPOKA University, Tirana, Albania

<sup>2</sup>Department of Civil Engineering, EPOKA University, Tirana, Albania

### Abstract

The aim of this paper is to discuss and explain key concepts in new generation Project management software in the construction industry. Building information modeling “BIM” is considered to be one of the major technologies used by construction stakeholders today. New BIM software now adds the time dimension to the traditional three-dimensional modeling, and thus is called 4D BIM. The 4D BIM simulation process adapts each CAD object with its place in the projects schedule and is scalable to projects of almost any size or complexity. This paper surveys four leading 4D BIM programs namely *Synchro*, *Domos/D-studio*, *Vico 4D Scheduling*, and *Innovaya 4D Visual Simulation*; to see how they address the fundamental question asked by stakeholders in construction industry: “Can this project be built on time?”

**Keywords:** *Project Scheduling, 4D Modeling, BIM, Visualization.*

### 1. Introduction

The construction industry has rapidly improved itself and as a consequence the construction technology finds it necessary to advance the methods of project coordination and collaboration. Recently almost all design and construction industries are currently using the *Virtual Building* concept that is the first background stage of Building Information System (BIM). 2D CAD drawings already enable continuous optimization of the project during early design stages by investigating different design alternatives. Thus building models enable the project team to construct a competent choice out of a range of possibilities. Traditional BIM technology started with 2D geometric data that involves the site layout plan with text descriptions such as plan, elevation and section relations and gave the engineers and stakeholders opportunity to better collaborate for the success of a project.

Following this concept, 2D was found to be inadequate for representing the size and complexity buildings, which meant that 2D was not appropriate for industry demands. When the project size increases all requirements are directly influenced and 2D tools are not satisfactory for analyzing. To allow a description of the each element with visualization of product data, a 3D computer graphics system was developed by Retik (1993). Involving 3D visualization made more multifaceted functions feasible, such as modification of numbers using paintbrush techniques, and visualization of the effects in real time. 3D visualization allows customers to see historic preservation and site context with respect to the new project. It also allows the 3D coordination to reduce request for information (RFI), errors and

omissions. One target is to bring the geometrical representation of the project in 3D CAD, the other one is to determine the duration and relationship of duties. 2D and 3D CAD give opportunity to determine manufacturing methods of components, conceptual design and visualization of project objects. They bring the possibility for dynamic and static analysis because each object shows up with 3 components of dimension visualization that consist of width, height and depth (X, Y, Z). On the other hand 3D function brings fundamental accessibility to export and allow such tasks between dissimilar digitized software to design structures and environment and assigning information modified construction, including optimized machine, labor, and managed working. 3D modeling request gives the possibility to increase the speed of construction and to improve the quality of work.

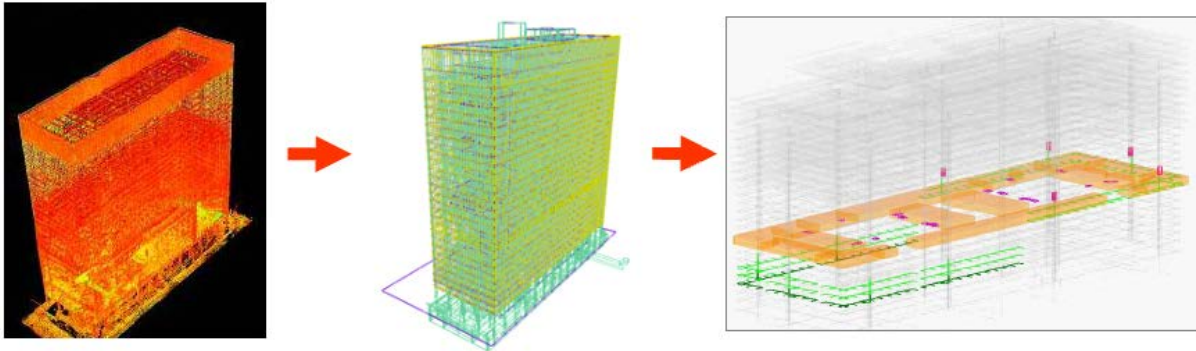


Figure 1 Dirksen Courthouse - 4D model generated from laser scanned 3D model

Despite increasing usefulness, 3D models did not address all user needs, particularly the time dimension. This shortcoming has been addressed with the development of 4D BIM since the early 1990s. 3D models were integrated with the construction schedule, thus giving 4D models showing the construction progress over time. 4D models can be created to various levels of detail, from high-level zone analysis during the design phase, to detailed subcontractor coordination during construction. The same model can be updated and maintained throughout the project based on the updated schedule and 3D model. As an example in figure transitions of the Dirksen Courthouse animation, has more progression with respect to timeline and graphics. 4D modeling gives opportunity visualize 4 different aspects of construction in order such as to improve communication among the stakeholders, constructors and owner, detailed analysis of visualization and discussing effectiveness of project life cycle.

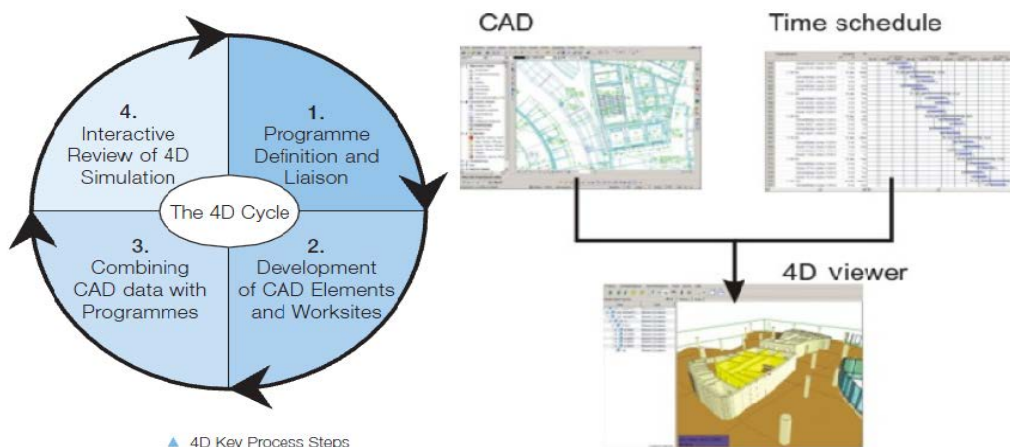


Figure 2 Involved software packages in today's 4D simulation approach.

## 2. Overview of 4D BIM

The key concepts of 4D BIM modeling component are 3D CAD and scheduling. The models involve each specific construction activity which can show up, appear or disappear over time according to the scheduling. It gives user an opportunity that for each temporary step they can modify the new step's requirement.

“While it's possible to create an image of a building in your mind, to see it take shape on screen, in sequence, creates much more effective shared understanding with the entire delivery team” (Seliga 2007). Since 1950s the critical path method (CPM) has been the acknowledged technique for developing the construction schedule, but it is not satisfactory nowadays because of difficulty to communicate each main activity and interdependencies (Hales & Anderson, 1986). The main purpose of teams and stakeholders communication is to make a clear visualization of the construction plan, range of work and project feedback.

The construction sector profits in many ways from 4D modeling of all the dissimilar phases of the project schedule. The project cycle is very strict so the planning phase should give different alternatives for stakeholder evaluation.

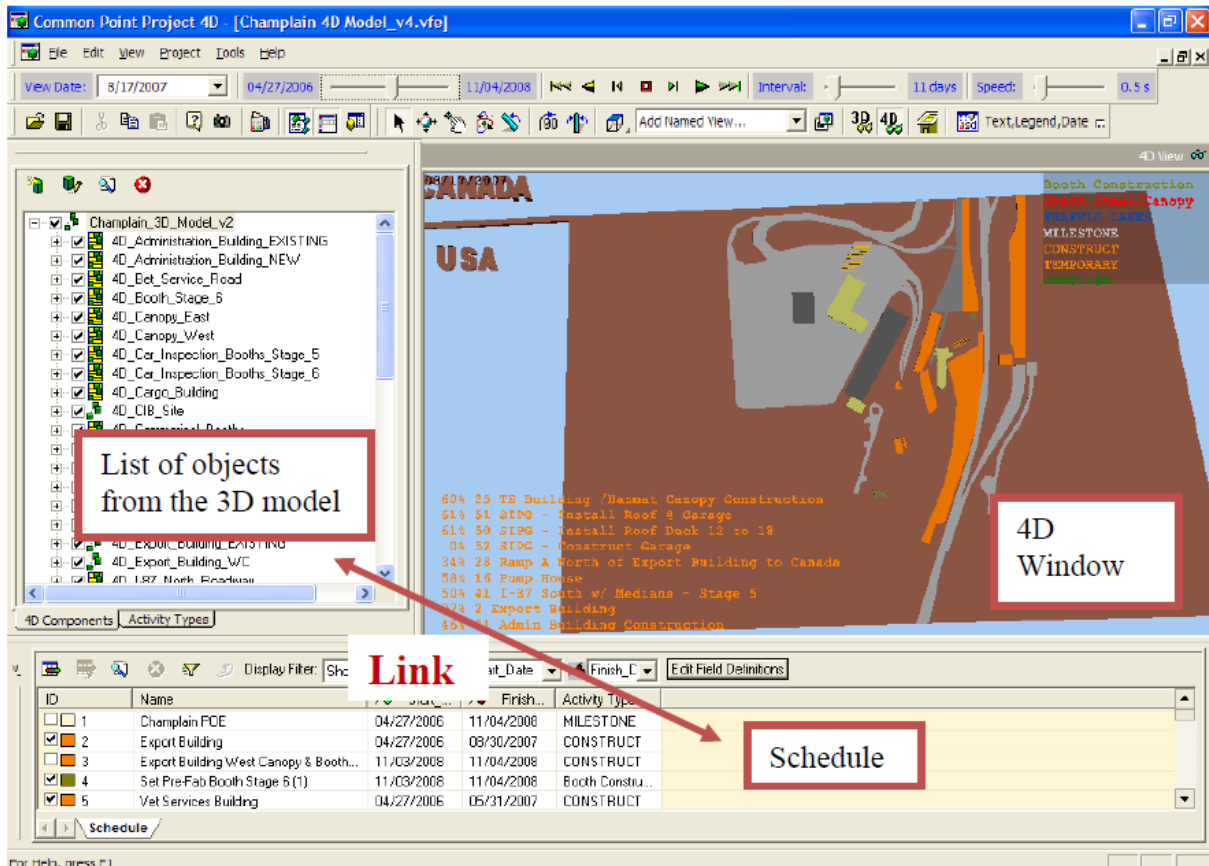


Figure 3 Snapshot of a 4D software interface showing how schedule is connected to objects

## 3. 4D Modeling Software

To better understand the features of the leading 4D modeling software, a literature survey on 4D BIM programs namely *Synchro*, *Domos/D-studio*, *Vico 4D Scheduling*, and *Innovaya 4D Visual Simulation* has been done. Each program will be explained briefly in the following sub

sections based on the documents found in the literature and training videos available from each producer.

### 3.1.SYNCHRO –A 4D Modeling Platform

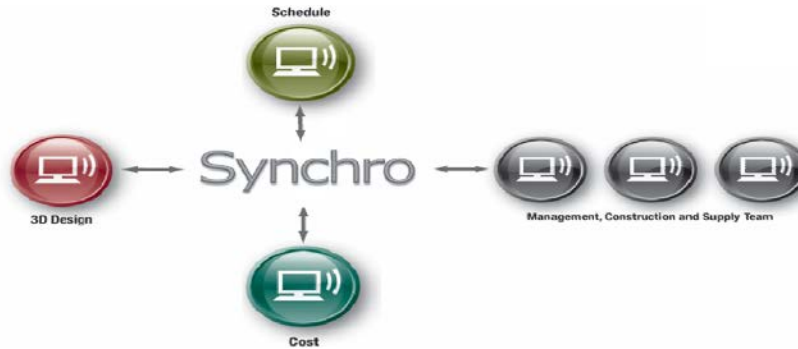


Figure 4 the delivery process of Synchro

Synchro has had 4<sup>th</sup> generation products such as 3D/4D/5D since 2010 which offers to consist of synchronizing design, scheduling, supply chain management, risk management, earned value measurement for users (Synchro, 2012).

The brand new concept has also provided system interoperability, advanced data management and reporting in time. First advantages of Synchro have advanced visual capability hence all construction team rapidly understand accurate project baseline monitoring and risk identifications. Synchro allows compatibility with other scheduling software tools such as Asta Power Project. Furthermore Synchro has agreements' with Autodesk, Oracle Primavera, Google SketchUp, Bentley Systems, Objectivity, Asta, Design Data, and TechSoft3D (Synchro, 2012). Also user can import from 3D CAD file types and export 4D models to DWF and IFC. 4D BIM has a great application field such as infrastructure, road, and industrial process involving oil, gas alternative energy and mining.



Figure 4 snapshot of 4D BIM software program Synchro

### **3.2. Domos 4D Suite Software**

The 4D Suite from Domos provides visualization of a building project and 4D modeling which consists of 3D representation with a project schedule. Furthermore, 4D Suite includes 2 software packets one of them is the 4D Builder another one is application which means component of planning and graphical data are linked and exported (Viane, 2004). Users can monitor planning and progress directly and share the visualization with their stakeholder partners so as to better identify and resolve misunderstanding, be clear, make fewer mistakes, and reduce time losses. The program makes it possible to predict modifications of every action and users can resolve problems on time. 4D Suite can work with AutoCad, DesignCad, and Star. Also the company provides training sessions, hence users comprehend each functions with both applications. 4D Builder has also similarity with MS Project.

### **3.3. Vico Office 4D Manager**

Vico Office 4D Manager has developed a different viewpoint of visualization. The company was invented a kind of trial run or simulation video for projects. This trial involves everything from the first labor crew to the last activity. Users can communicate each task and also moderate each resource within the schedule and in real time. The movie has more than words and owner can see thousand activities coordinated easily. Visualization has addressed fundamental questions of project management, which are timely completion and cost reduction.

### **3.4. Innovaya 4D Visual Simulation**

According to Innovaya vendor, the software's performs "drawing" DWG format of 3D design and either Primavera or MS Project scheduling tasks. It gives alternative options to users (engineers, architects, owner, and other stakeholders) to analyze the project (Innovaya, 2012). Checking all preconstruction phases with Innovaya, user can optimize the project interactively and reflects the results over the simulation. Clear visualization provides understanding logical mistakes easily and resolves the scheduling hence users can see all regulations over the screen. This simulation gives different color to each element that help user to make decision rapidly.

## **4. Conclusion**

The purpose of this paper is to explain key concepts of new generation construction technology the strong relationship between CAD and 4D BIM. Traditional construction planning aspects started with integration 2D CAD modeling. The summary all concept of 3D BIM is coordination that of 4D BIM is planning. The overarching concept of these modeling programs is to give stakeholders the opportunity to release consistent drawings, scheduling, clash detection and also to provide feedback during the designing process. Without these programs, each duration estimation and plan would take much more time to create. As our aim is to give the possibility of monitoring and reliable project management in the short term, these programs meet a very important need. Because BIM is not just a CAD packet, but is a process, it enables us to meet our design, timeline objectives.



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