

BIM and Project Planning

This white paper explores how the Revit® building information model (BIM) can be linked with project planning systems to enable 4D construction planning.

Gantt charts have long been a staple of project planning, but they leave something to be desired when it comes to visualizing a project schedule.

Most builders invested in their first project planning system more than a decade ago and they've become a vital tool for project management services. BIM solutions on the other hand are relatively new. Rich with information, building information models provide architects a wealth of design-centric tasks – energy analysis, sun studies, and specification management, to name a few.

Given the success of BIM in the design realm, building firms are now turning to building information models for their own uses – constructability analysis, trade coordination, quantification, cost estimating, and so on. One of the most obvious building applications for BIM is where design and construction first come together: construction planning. This white paper focuses on how BIM and project planning solutions can be linked to better present and analyze a building design throughout its construction.

4D Construction Phasing

Construction planning is an ongoing effort to manage the progress of a construction project and react accordingly – dynamically adjusting to the “situation on the ground.” Of course, a building's design is at the core of its project plan, and by adding schedule data to a 3D building information model (i.e., the building design) you can create a 4D building information model, where time is the 4th dimension.

4D models include planning data such as the start and end date of a component and their criticality or slack. As a result, a 4D building information model provides an intuitive interface for project team and other stakeholders to easily visualize the assembling of a building over time. It enables 4D construction simulation, a key planning tool during pre-construction to evaluate various options. 4D storyboards and animations make BIM a powerful communication tool – giving architects, builders, and their clients a shared understanding of project status, milestones, responsibilities, and construction plans.

Teams usually start out developing 4D models by *manually* mapping the schedule dates from the project plan to the model components. That effort helps them improve the plan and improve how they communicate the plan to the whole team. Later, as they advance their skills, they *programmatically* link the schedule to the model, to save time and increase their ability to evaluate various construction sequence options.

Below are two representative approaches for linking a building information model to a project plan. The first example features a direct link between Revit and Microsoft® Project (MS Project), developed by Autodesk Consulting. The second example is a tool from Innovaya that exports a Revit building information model and displays it in a specialized 3D/4D visualization environment linked to a project plan from either MS Project or Primavera® technology.

Direct to MS Project

Our first example features a software tool, developed by and available from Autodesk Consulting, that uses a bidirectional link between Revit and MS Project to keep the project up-to-date when changes are made in either program.

The tool includes a new “Export to MS Project” Revit function that exports applicable building components to a MS Project file, pre-sorted by level (e.g., floor) and category (e.g., wall, window, column, etc.) for rapid project scheduling and resource tasking.

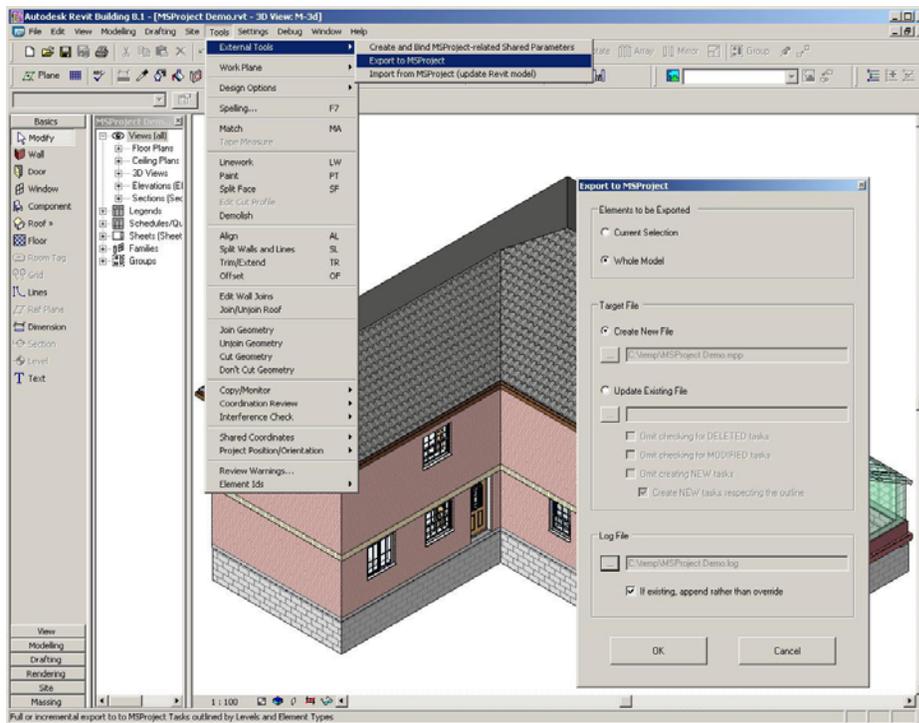


Figure 1:

Autodesk Consulting’s “Bidirectional Link with MS Project” tool links Revit Building components to a MS Project for schedule creation and resource assignments.

In turn the MS Project plan can be saved (as a standard MS Project “.mpp” file) and used to update the building information model via a new “Import from MS Project” Revit function. This updates the attributes of affected Revit components with the start dates and finish dates from the MS Project plan. [Note: the tool can be customized by Autodesk Consulting to include any other MS Project variable as need]. Planning information can then be visualized in Revit by filtering on this attribute data. For instance, a user can ask Revit to show all the building components which are scheduled to be installed by June 1st, or all components that will be worked on in October.

In addition, the phase information of Revit model components can be updated from the MS Project file, allowing Revit phase assignments to be automated via MS Project. For those readers unfamiliar with Revit phases, they represent distinct time periods in a project's life: “existing conditions”, “first floor new construction, Phase 1”, and “first floor new construction, Phase 2”, for example. Each building component can be assigned to a phase. To have a visual of how a project appears during the various stages of work, a

user toggles phases on or off. For example, the user could ask Revit to show only “existing conditions” and “first floor new construction, Phase 1” components. Or show all components in all phases, but highlight in red “first floor new construction, Phase 2” components. A component’s phase is passed to MS Project during the export process, and if that phase is changed (or added, if the original phase was blank) in MS Project, the

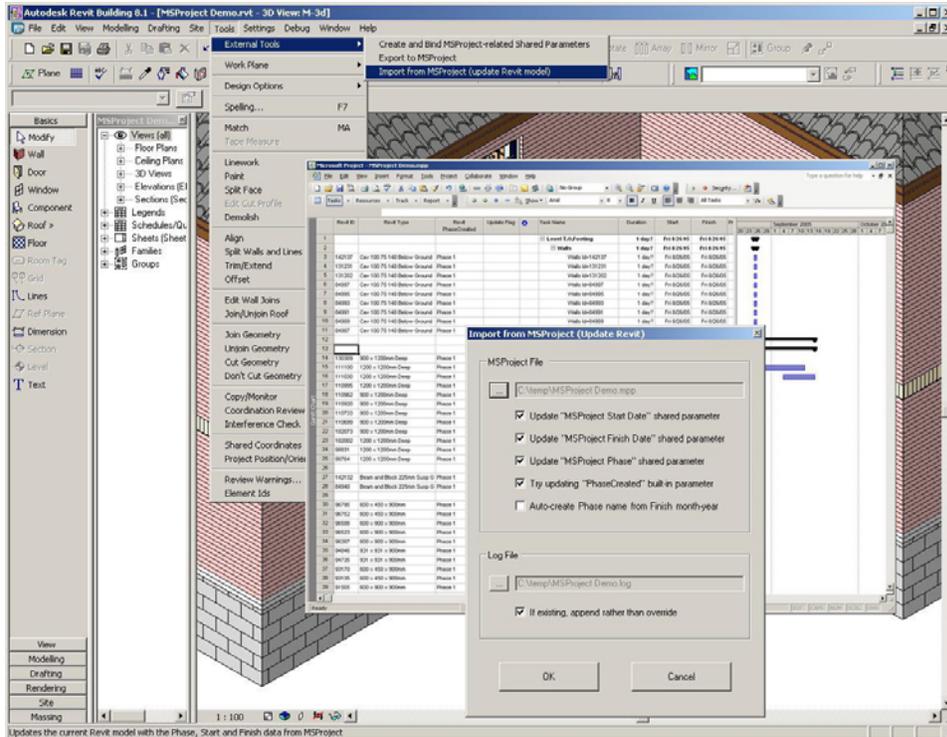


Figure 2:

The bidirectional Revit to MS Project link enables Revit components to be updated with MS Project details.

Revit model is updated during “Import from MS Project”.

Project Planning for an Integrated Workforce

Not surprisingly, one of the first customers to use the Revit/MS Project tool was a firm with a keen interest in planning and scheduling for their integrated design/build workforce.

Dal Pos (www.dalpos.com) is 30-person architectural firm located in Syracuse, NY. An experienced Revit user, Dal Pos began using the Revit/MS Project link on a high-end multi-million dollar custom home slated for construction in 2007 – both for the benefits it would bring to that project and as a test bed for future high-profile commercial projects.

According to Scott Bloss, Senior BIM Technologist at Dal Pos, “We began by exporting our Revit design model to MS Project and developing an initial project schedule. Now we regularly update the project plan from our design model, and in turn push our planning data from MS Project back to Revit.” The bidirectional integration between design and planning has improved communication for the whole team. This is particularly evident at their weekly project meetings, where the team can now ‘see’ their upcoming construction tasks. “We use scope of work filtering techniques within Revit to visualize the project plan,” explains Bloss. “For example – I’ll display all work items scheduled to be installed next week, or all components in a tight area color coded by trade, or highlight in blue all the items that are scheduled to be installed by a particular fabricator.”

Dal Pos’ use of the Revit/MS Project link has certainly improved their design and construction coordination, but it’s just one piece of a bigger strategy – to create a

completely digital job site with a building information model as the centerpiece. As Bloss puts it, “4D BIM is a must-have tool in our digital gangbox.”

4D Visualization

Our second example features a product from Innovaya (www.innovaya.com) called Visual Simulation, a 4D planning and constructability analysis tool that allows a building information model created in Revit to be integrated with either a MS Project or Primavera project plan. Visual Simulation uses the Revit application programming interface (API) to export the Revit model to the Innovaya file format. The model can then be imported into Visual Simulation. The product includes a specialized 3D/4D environment for both standard 3D building model navigation as well as 4D visualization.

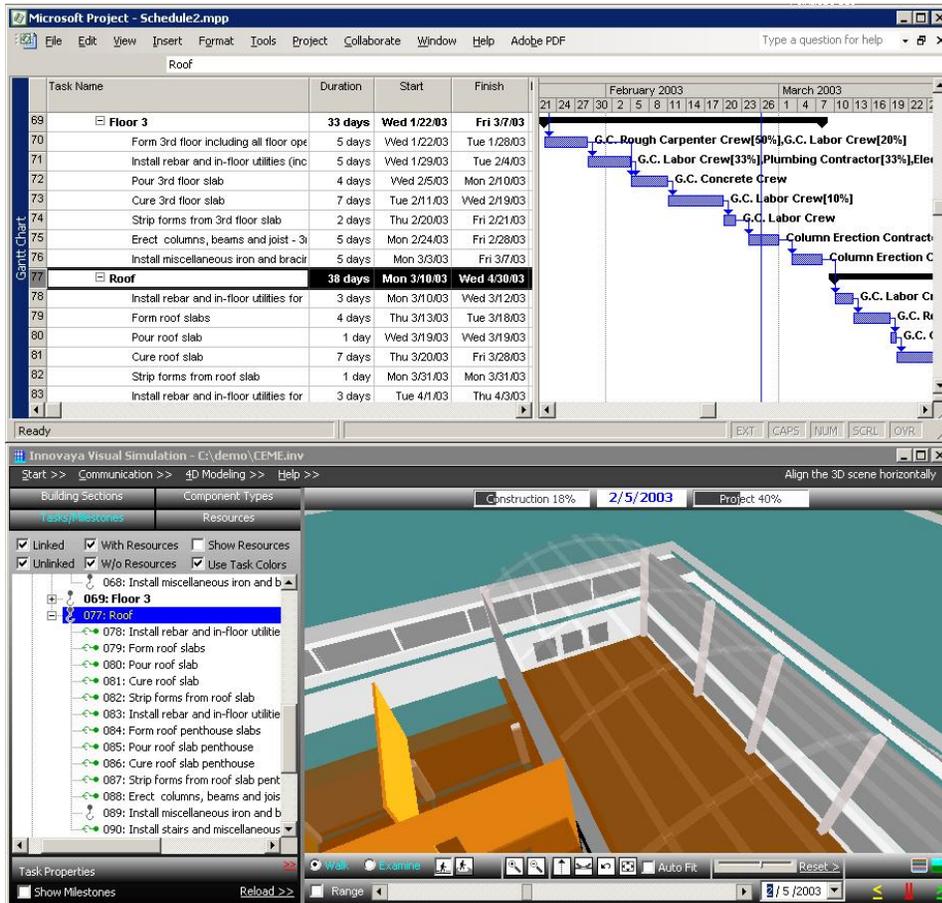


Figure 3:

Visual Simulation from Innovaya is a 4D planning and constructability analysis tool that allows a Revit building information model to be integrated with either a MS Project or Primavera project plan.

Early project plans can be developed directly in Visual Simulation by using Revit phases to generate construction-sequenced tasks based on hierarchical building components. Tasks created by this approach are automatically linked with the building information model components, and this process can be completed very easily and quickly without requiring a schedule. This is particularly useful in the early stages of design, when project planning is rudimentary with perhaps just a few key milestones established.

As the project moves forward and the need for detailed project planning arises, the product also features a link to both MS Project and Primavera, with import, export and synchronize functions. When a project plan is established in Visual Simulation, a user can visually associate model objects and scheduled tasks. For example, a user can click on a building object in the 4D visual environment, and see its associated task highlighted in the

Gantt chart or vice versa. Users can explore scheduling “what-ifs” by changing the start date of a task in the Gantt chart and see the ripple effect in the 4D model.

The 4D visual environment includes a variety of time/schedule filters for viewing building components based on construction type (e.g., new, temporary, existing, etc.), resources, start/finish dates, criticality, linked/unlinked tasks, and so on. This allows users to do things such as highlight potential installation issues (“show in red any building objects that are linked with two tasks on the same day”) or create installation sequences of building components that can be animated and saved, then played back like a movie to show project teams or clients how the project or a particular area will be built.

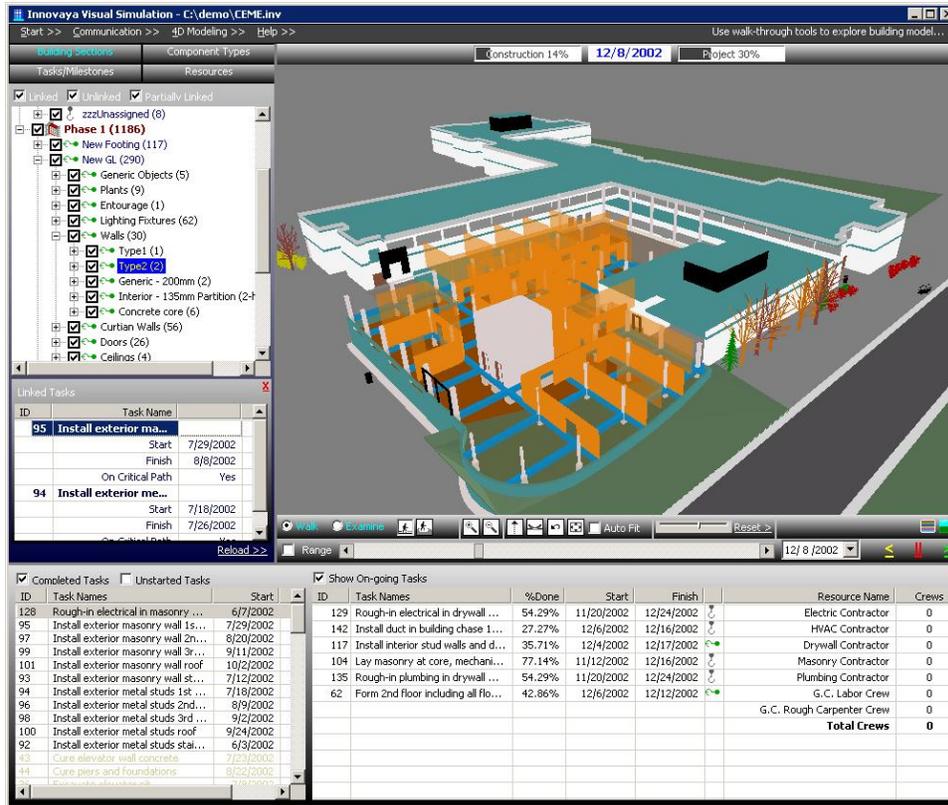


Figure 4:

Visual Simulation’s 4D environment allows users to visually associate building model objects and tasks.

Summary

When firms begin to use 4D BIM, they usually start with the phasing capability inside of Revit – which can be used quite effectively for broadbrush construction visualization. As their expertise with 4D modeling grows, they tend towards direct links between the building information model and their scheduling system, using some variation of the approaches presented above.

Whatever the path taken or technology implemented, 4D building information models containing detailed schedule and resource data from the native project planning software are now a reality – and can lead to a more engaged team, more informed decision making, and better coordination between designers and builders.

About Revit

The Revit platform is Autodesk's purpose-built solution for building information modeling. Applications such as Revit® Architecture, Revit® Structure, and Revit® MEP software products built on the Revit platform are complete, discipline-specific building design and documentation systems supporting all phases of design and construction documentation. From conceptual studies through the most detailed construction drawings and schedules, applications built on Revit help provide immediate competitive advantage, better coordination and quality, and can contribute to higher profitability for architects and the rest of the building team.

At the heart of the Revit platform is the Revit parametric change engine, which automatically coordinates changes made anywhere — in model views or drawing sheets, schedules, sections, plans... you name it.

For more information about building information modeling please visit us at <http://www.autodesk.com/bim>. For more information about Revit and the discipline-specific applications built on Revit please visit us at <http://www.autodesk.com/revit>.

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