

BIM and Cost Estimating

This white paper explores how the reliable information held within a building information model can be used to support cost estimating. The paper outlines approaches used to link BIM and costing solutions, and then provides examples of firms who are using Revit® software products in conjunction with various cost estimating solutions, offering insight as to how information from BIM is benefiting architects, quantity surveyors and cost estimators, and builders - as well as their clients.

Model-based Estimating

A purpose-built BIM solution like Revit features *computable* building information that enables a model to be understood by a computer as a building. A wall for example, "knows" what it is and how to react to the rest of the building. As such, it can be scheduled or quantified as a wall: a building assembly made of real materials. Computable building information supports numerous building design and construction activities: structural analysis, MEP system modeling, building energy analysis, and specification management, to name just a few.

Cost estimating is yet another aspect of the building process that can benefit from computable building information. Designing a building is the responsibility of architects, whereas assessing the cost to build it is the domain of estimators. In general, the architect's scope of work doesn't extend to material takeoffs or cost information. That's left to the estimator.

When preparing their cost estimates, estimators typically begin by digitizing the architect's paper drawings, or importing their CAD drawings into a cost estimating package, or doing manual takeoffs from their drawings. All of these methods introduce the potential for human error and propagate any inaccuracies there may be in the original drawings.

By using a building information model instead of drawings, the takeoffs, counts, and measurements can be generated directly from the underlying model. Therefore the information is always consistent with the design. And when a change is made in the design – a smaller window size, for example – the change automatically ripples to all related construction documentation and schedules, as well as all the takeoffs, counts, and measurements that are used by the estimator.

The time spent by the estimator on quantification varies by project, but perhaps 50-80% of the time needed to create a cost estimate is spent just on quantification. Given those numbers, one can instantly appreciate the huge advantage of using a building information model for cost estimating. When you do not require manual takeoffs, you can save time,

cost, and reduce the potential for human error. In fact, a common complaint from estimating firms is how much they hate paying estimators to simply count or quantify when they bring so much more expertise and experience to the table.

By automating the tedious task of quantifying, BIM allows estimators to use that time instead to focus on higher value project-specific factors - identifying construction assemblies, generating pricing, factoring risks, and so forth - that are essential for high-quality estimates. For example, consider a commercial project slated for construction in northern Minnesota in the winter. The estimator will realize that winter heating and dewatering will be needed for a portion of the concrete substructure. This is the sort of specialized knowledge only professional estimators can factor in to the cost estimate accurately. This construction wisdom, not "counting," is the real value professional estimators bring to the cost estimating process.



Image courtesy of Ryan Companies

Figure 1:

Using a building information model for quantification leads to faster, more accurate cost estimates and updates.

Many Paths from BIM to Costing

There are a variety of ways of getting quantities and material definitions out of a building information model into a cost estimating system. Broad categories of integration approaches include:

- **Application Programming Interface (API)** to commercially available estimating programs from vendors such as U.S. COST or Innovaya (which then integrates with Sage Timberline Office Estimating). This approach uses a direct link between the costing system and Revit. From within Revit, a user exports the building model using the costing program's data format and sends it to the estimator, who then opens it with the costing solution to begin the costing process.
- **ODBC connection** to estimating programs such as CostX or ITALSOFT - popular Australian and Italian cost estimating solutions, respectively. ODBC is a tried and true standard, useful for integrating data-centric applications like specification management and cost estimating with building information modeling. This approach typically uses the ODBC database to access the attribute information in the building model, and then uses exported 2D or 3D CAD files to access the dimensional data. Part of the integration includes a reconstitution of the building data within the costing solution – linking cost geometry, attributes, and pricing.
- **Output to Excel.** In comparison to the approaches outlined above, quantity takeoffs done within Revit and output to a Microsoft® Excel® program may seem lackluster, but the simplicity and control is perfectly suited to some costing workflows. For instance, many firms just create material takeoffs in Revit, output the data to a spreadsheet, and then hand it off to the cost estimator.

There are no right or wrong approaches – each integration strategy is based on the estimating workflow used by a specific firm, the costing solutions they have in place, the pricing databases they use, and so on.

To illustrate these approaches, four customer examples are presented below, each one detailing a different BIM-to-costing workflows: an API integration between Revit and Innovaya’s estimating solution; another API integration between Revit and U.S. COST; a BIM to costing solution link using ODBC; and outputting data from Revit directly to spreadsheets, which are then used as input for costing.

Better Numbers

Ryan Companies (www.ryancompanies.com) is a leading national commercial real estate firm offering integrated design-build and development as well as asset, property and facilities management services to its customers. With offices throughout the United States, Ryan uses the power of BIM to accurately coordinate building information within the documentation set, and provide their estimators and construction team with solid, up-to-date building information.

As a design/build firm, Ryan was an excellent candidate for adopting a model-based approach to estimating; design and costing are done under one organizational roof, which minimizes scope of work issues relating to takeoffs. Established Revit users, they have just started to use Innovaya’s Visual BIM and Quantification products, which enables estimators to visualize the Revit building model in a costing-oriented 3D environment (for example, get a 3D view of structural slabs with concrete columns and shear walls), perform quantification, and add construction assembly data. For pricing information, Visual Estimating can be linked to Timberline or information can be output to Excel for use with other pricing solutions, as is the case with Ryan Companies.

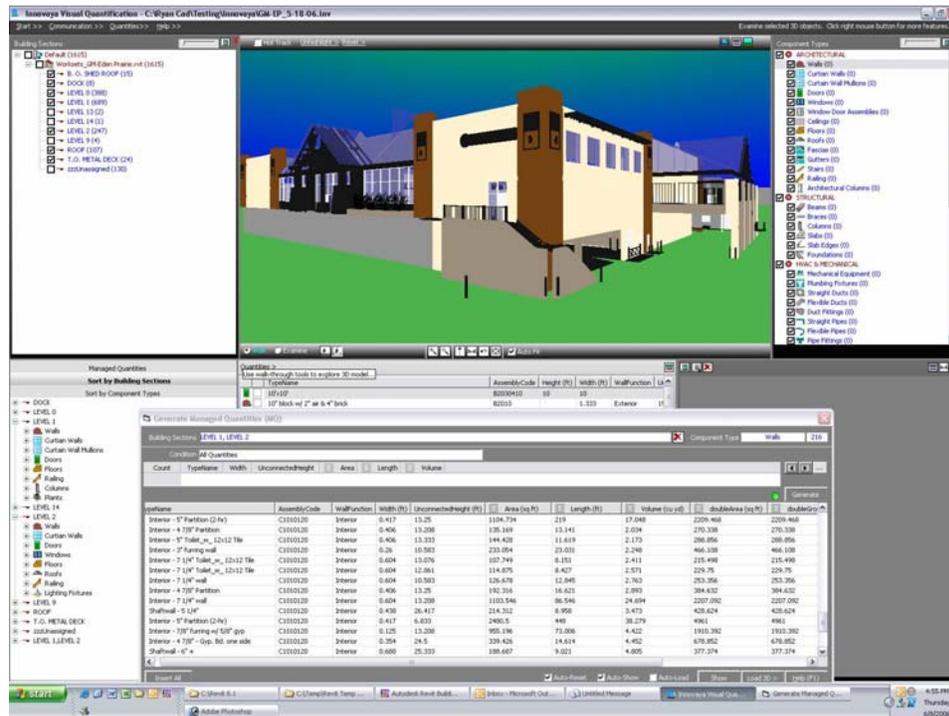


Figure 2: An API integration with Revit enables the Innovaya estimating solution to count and calculate materials directly from the Revit building information model.

Image courtesy of Ryan Companies

Dick Bates, Ryan's CAD Manager, uses this example to explain the difficulties associated with quantification from a design model. "For any given wall, we need to calculate three numbers to get a price: the gross area of one side of the wall to get material quantities totaled for each wall type, and then the double gross and net areas to quantify finishes." The programmatic link between the two solutions means that Innovaya's solution can count and calculate materials directly from the Revit building information model. The quantity extraction methods are easily customized (for instance, calculating the three wall areas cited in the example above from a single design element) and are reusable for multiple projects. Quantities are extracted based on building element types and their dimensions. Once the quantification is complete, Ryan's estimator outputs the data from Innovaya to an Excel spreadsheet for entry into their in-house pricing program.

And with the API link, the quantities are automatically associated with the Revit building, so they "remember" where they came from. This means that the Innovaya software can easily detect design changes from the Revit model, which allows the estimator to validate previous quantities against the new design, and then automatically update those quantities. As Bates explains, "In the past, our estimators had to manually check design revisions for cost implications. Now we just re-export the Revit model to Innovaya, and let the costing software figure out what has changed."

According to Bates, "We're very excited about the integration between Revit and Innovaya. All the data we need for high-quality costing is in the Revit model. With this integration, our estimators are getting better numbers from the building model, and we can continue to use each program for its intended purpose: Revit for building design and Innovaya for construction estimating."

Linking Design Decisions to Costs via an API

Oculus Inc. (www.oculusinc.com) is a 30-person architectural, strategic facility planning, interior design, and move management firm with offices in St. Louis, Dallas, and Chicago. Since their 1994 inception they've been committed to meeting voids in the offerings of traditional firms; helping their clients maximize the value of their investments by linking architecture to master planning, long range forecasting, space planning, and interior design. Integral to that commitment is the concept of architectural design linked to cost: informing their design decision making process.

A longtime Revit user, Oculus immediately recognized BIM's potential for data-intensive applications such as facilities management and costing. According to Ron Reim, Oculus principal and co-founder, "BIM enables us to get better information about our projects, so we can give better advice to our clients."

They recently started to use Revit in conjunction with estimating software from U.S. COST (www.uscost.com), an Atlanta-based company that provides cost management and project control services and software. Oculus was already quite familiar with U.S. COST's estimating software, Success Estimator, as many of their outsourced cost estimates are developed with it and Oculus routinely (but painstakingly) checks those estimates against their design model – verifying the estimate for their client. So they were closely tracking the API integration between Revit and Success Estimator (the commercial product is called Success Design Exchange), looking forward to replacing those manual checks with programmatic ones. Once the API link was complete they sent an architect, with a background in specifications and costing, to a U.S. COST training class and they've recently begun using Success Estimator and Design Exchange themselves.

According to Dave Liddle, quantity surveyor and principal of Turner & Townsend Rawlinsons, “Scope management requires tools to analyze change over time. We’re constantly updating cost estimates during the design process - comparing and evaluating pricing changes due to design changes.” The Revit-to-CostX integration ties costs directly to dimensions: *Cost Geometry*[®] business management software, to use Exactal’s terminology. “We don’t have to manually compare drawings and re-takeoff materials. The link between Revit and CostX automatically detects the changes and graphically displays the results, which allows us to easily see the areas that have changed and quickly re-cost the model,” states Liddle. “The time savings allows us to do a better job estimating and reduces scope creep – to the delight of our clients.”

[Note: In July 2006, Exactal released a second Revit integration based on Autodesk’s DWF™ technology, built to distribute CAD files and 3D models so intelligence of designs can be communicated even more easily and securely.]

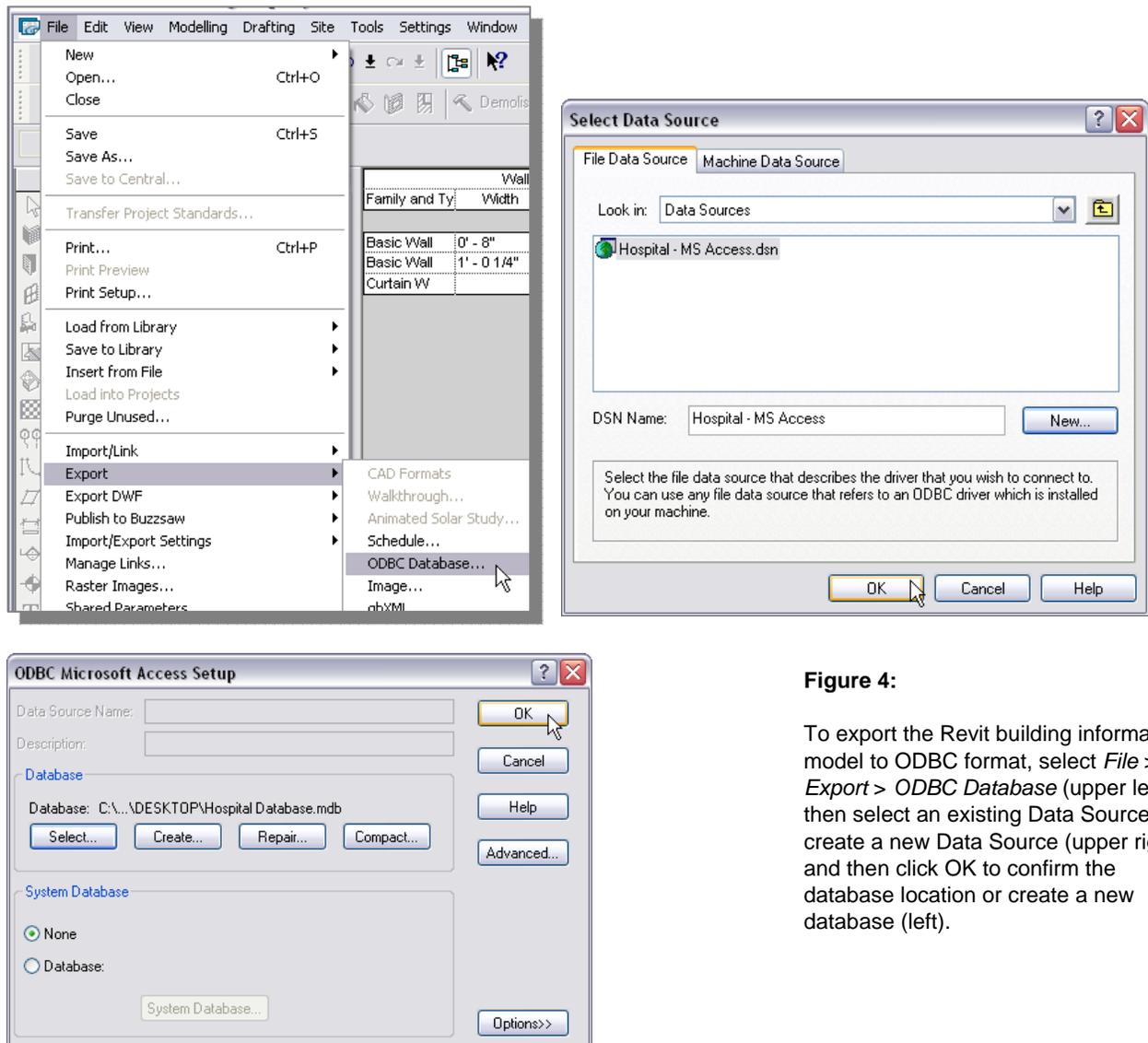


Figure 4:

To export the Revit building information model to ODBC format, select *File > Export > ODBC Database* (upper left), then select an existing Data Source or create a new Data Source (upper right) and then click OK to confirm the database location or create a new database (left).

Accurate Quantification with Revit and Excel

Founded in 1885, Parsons Brinckerhoff or PB (www.pbworld.com) is one of the oldest continually operating consulting engineering firms in the United States. PB's St. Louis office offers professional services in architecture; civil, structural, mechanical, electrical, plumbing, fire protection, environmental, and geotechnical engineering; landscape architecture; planning; and program/construction management. With a staff of more than 70, PB's St. Louis office provides services throughout the United States and are supported by the specialized expertise of PB's national service groups who are available as needed to assist the local staff.

PB's St. Louis office was an early adopter of BIM and have been using Revit for all facets of building design for more than five years. They're committed to achieving their client's cost objectives and vigilantly heed the cost estimating adage: the one who gets the low bid is the one who left something out. Thus, they rely on getting accurate quantities for accurate cost estimates: extracting quantities from the Revit building information model, outputting them to a text file, importing that to Excel, and then sending the spreadsheet to their estimators for costing.

They typically produce at least two cost estimates: at the end of schematic design and a complete estimate at the end of detailed design. The first estimate used to be quite general, usually based on standard 'rule of thumb' square footage costs. "By using the quantities from Revit, we get detailed estimates much earlier in the process," reports Tom Brooks-Pilling, Director of Architecture for the PB St. Louis office. "For example, the initial estimate may have included only allowances for finishes, but with the level of detail in Revit we can often replace allowances for actual quantities - even during schematic design."

"We pride ourselves on preparing realistic solutions that fit our clients' needs as well as their budget," explains Brooks-Pilling. "The quantification capabilities of Revit allow us to generate cost forecasts for decision-support, making it easier for us to meet our clients' design and cost expectations."

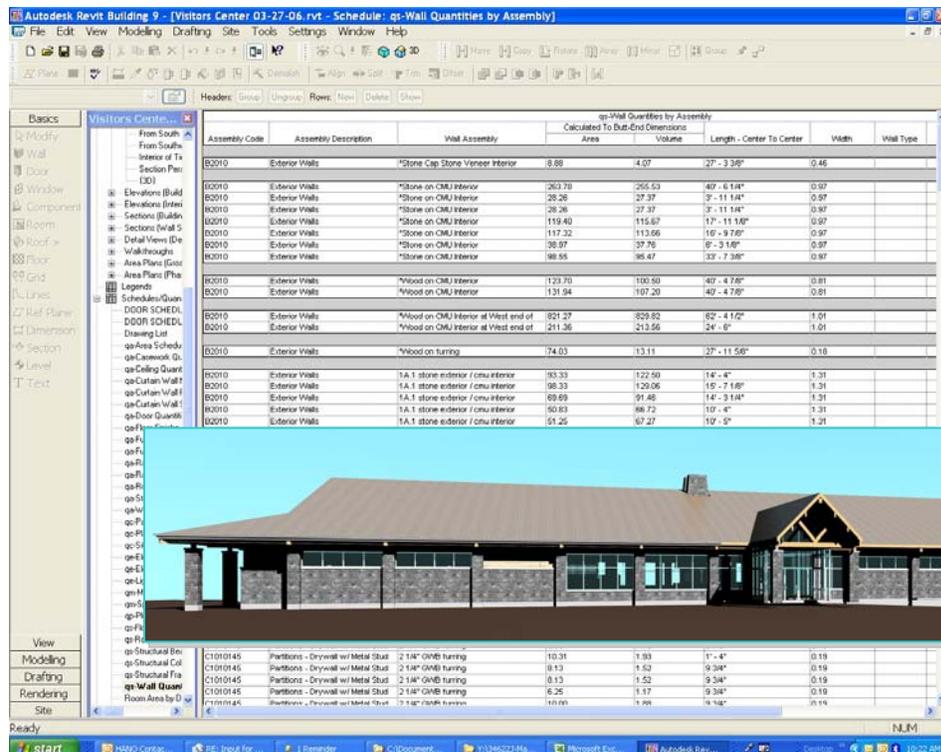


Figure 5: Parsons Brinckerhoff uses Revit to get accurate quantities much earlier in the design process.

Summary

The first step of cost estimating is quantification - and the computable information at the heart of a building information model makes quantification effortless. BIM solutions don't generate automatic cost estimates by any means, but they offer significant advantages over traditional drawing-based systems by minimizing manual takeoffs. More accurate quantities of materials results in more accurate cost estimates. Reducing the quantification effort means estimators can more effectively apply their time and knowledge to higher value estimating activities. And architects can use the information within their design model to easily double check estimating quantities - facilitating concurrent estimating during the design process.

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 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>.



Autodesk, DWF, DWG, and Revit are registered trademarks or trademarks of Autodesk, Inc., in the USA and other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product offerings and specifications at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document. Computer aided design software and other technical software products are tools intended to be used by trained professionals and are not substitutes for your professional judgment.

© 2007 Autodesk, Inc. All rights reserved.