

High-Quality Product Models— Powerful New Capabilities.



Manufacturer-created building product models are rapidly catching up with the demands and capabilities of Building Information Modeling (BIM)—helping architects, engineers, and contractors accelerate the design process and deliver high-quality, as-built drawings to project owners. This white paper summarizes the benefits of creating and using these models and describes how building product manufacturers (BPMs) and AEC professionals can incorporate them into their workflows using Autodesk® Seek.

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Executive Summary

In the past decade, Building Information Modeling (BIM) has transformed the architecture, engineering, and construction (AEC) industry by helping project teams collaborate more effectively to deliver higher-quality projects faster and for less money. Initial BIM adoption efforts focused primarily on integrating BIM into everyday workflows, a time-consuming process that involved numerous challenges, including hardware upgrades, retraining personnel, and significant adjustments to the bid process and contract management. At that time, many firms utilized BIM as nothing more than a 3D-collision detection tool.

More recently, advancements in BIM authoring software—including Autodesk® Revit®—have accelerated the pace of change and transformed how the AEC industry interacts with BIM content. These advancements have opened up a range of new capabilities that go far beyond 3D representation of a product into sophisticated visualization, collaboration, and analysis. These new capabilities rely heavily on intelligent, data-rich models containing vital data points that can be exported to complementary software tools, such as Autodesk® Navisworks® or Autodesk® 3ds Max® Design.

In this new environment, information is king. The more architects and engineers have, the more accurately they can represent a project and its components—whether they're creating photorealistic visualizations, analyzing a building's acoustics, or estimating project cost. The trick is selecting which information to include and which to leave out, as well as how to properly format the data so that it can be easily integrated into project designs and workflows.

BIM has achieved widespread adoption among architects, engineers, and contractors. In recent years it has also begun to make significant inroads among other professionals, including building product manufacturers (BPMs), who recognize that they must evolve with the changing needs of industry if they wish to remain competitive. As a result, many have started to create powerful new building product models that are easy to integrate into the AEC workflow and help AEC professionals take full advantage of the new capabilities of BIM. To facilitate this process, many industry professionals—including manufacturers, AEC professionals, government agencies, and private companies—are spearheading the development of industry-wide standards governing how building product BIM models are created, distributed, and used. The resulting new, standards-driven building product models help architects and engineers more accurately integrate data about building products into building performance and cost analyses early in the project. This early integration facilitates building optimization, reduces project costs, and increases the odds that the manufacturer's building products will be specified—a tremendous competitive advantage.

Intelligent Models—Better Projects

Before exploring building product models in greater detail, it is important to understand BIM. Unlike Computer Aided Design (CAD), which uses software tools to generate digital 2D and/or 3D drawings, BIM facilitates a new way of working: creating designs with intelligent objects. Regardless of how many times the design changes—or who changes it—the data remains consistent, coordinated, and more accurate across key stakeholders. Cross-functional project teams in the building and infrastructure industries use these model-based designs as the basis for new, more efficient collaborative workflows that give these stakeholders a clearer vision of the project and increase their ability to make more informed decisions faster.

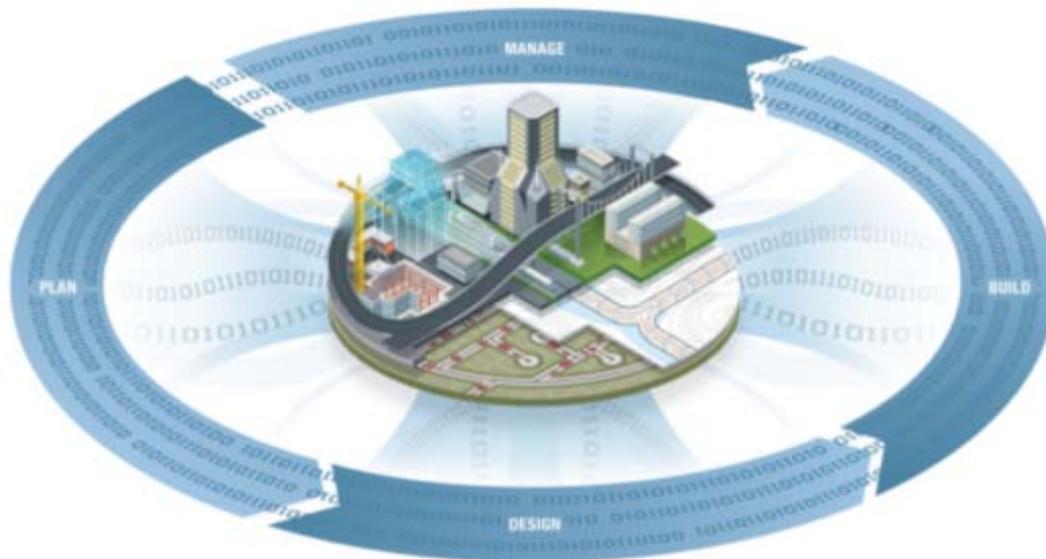


Figure 1. With BIM, cross-functional project teams share intelligent models to better plan, design, build, and manage projects. © 2012 Autodesk, Inc.

Models created using BIM software are “intelligent” because of the relationships and information that are automatically built into the model. Components within the model know how to act and interact with one another. A room, for example, is more than an abstract concept. It is a unique space contained by other building components (such as walls, floors, and ceilings) that define the room’s boundary. With BIM, the model is actually a complex database and the room is a database element that contains both geometric information and nongraphic data. Drawings, views, schedules, and so on are “live” views of the underlying building database. If designers change a model element, the BIM software automatically coordinates the change in views that display that element—including 2D views, such as drawings, and informational views, such as schedules—because they are views of the same underlying information.

HIGH-QUALITY PRODUCT MODELS—POWERFUL NEW CAPABILITIES

It is important to remember that BIM is not a particular software tool, such as Revit, nor is it a suite of products. Rather, it is a methodology to help eliminate waste through better communication and better coordination of documents between all key stakeholders involved in designing, constructing, and operating a building. According to the National Institute of Building Sciences, that amount of waste is no small matter; each year, poor communication and interoperability among architects, builders, and owners costs the industry approximately \$16 billion. The data-rich BIM environment fosters collaboration and communication, making it easier for AEC professionals to eliminate much of the wasted time spent on coordinating and exchanging design drawings.

The Path to Quality

As mentioned above, architects, engineers, and contractors have made the switch to BIM in large numbers. Building product manufacturers (BPMs) that wish to remain competitive must follow suit. They need to find a way to build product models that are more geometrically accurate, analytically powerful, and streamlined for performance on large projects. Only those types of building product models will differentiate a manufacturing firm in the marketplace and increase the likelihood of its products being specified in design projects.

Early Challenges

Before the development of manufacturer-created building product models, architects, engineers, and contractors who wished to incorporate a particular building product into their designs had to create their own generic content from scratch—a painstaking, time-consuming, and costly process. Such in-house content, still common even today, has the advantage of being consistent, but lacks the depth of information required by today's architects and engineers. Consequently, it has severe limitations in today's competitive market.

AEC firms that did not have enough time to build generic, in-house building product models from scratch were often able to download free models online or trade for them with other firms. These solutions had many drawbacks, the chief of which was the lack of consistency among the generic models—a problem compounded when designers included models from numerous sources. Most of these early attempts at creating BIM content resulted in simple geometric representations of building products that rarely contained much additional information beyond the manufacturer name and part numbers.

When building product manufacturers first began creating content for inclusion in the BIM process, they faced many challenges. One of the most significant was their lack of specific knowledge about how AEC professionals would actually use their models in real-world designs. As a result, they sometimes missed the mark, learning the hard way—along with architects, engineers, and contractors—that providing a highly detailed fabrication model actually impeded the designers' progress and degraded project performance. Under-modeling, on the other hand, was almost not worth the effort, mimicking, as it did, the limited functionality of generic content produced in-house by architects and engineers.

New Standards and Improved Quality Control

Fortunately, AEC firms, BPMs, government agencies, and private organizations have begun to drive the creation of exacting standards for building product BIM models. These standards will help draw a clear line between BIM-ready building product models and non-compliant content.

Non-Compliant Models	BIM-Ready Building Product Models
Poor understanding of how models are used by architects, engineers, and contractors.	Purpose-built to meet the needs of architects, engineers, and contractors.
Limited incorporation of Metadata.	Contains a complete list of manufacturer-specific Metadata and applicable organizational standards.
Over-modeling or inclusion of complete fabrication models degrades performance within projects.	Modeled for high performance within projects.
	More accurate geometry.
	Highly customizable; contains multiple design options in one model.
	Preset visibilities to enhance file performance.

Table 1. The characteristics of non-compliant vs. BIM-ready building product models.

Some of the organizations involved in this effort include:

- **Federal Government**

- The United States Army Corps of Engineers
- The U.S. Navy
- The General Services Administration
- The Veterans Administration
- The Smithsonian Institute

- **State Government**

- The State of Louisiana
- The State of Texas
- The State of Wisconsin
- The State of Wyoming

- **Universities**

- Georgia Institute of Technology
- Florida University
- Indiana University
- University of Southern California

- **Private Organizations**

- American Institute of Architects
- National Institute of Building Sciences
- Building Industries Consulting Services International
- Building Smart Alliance
- Food Service Industry Taskforce
- Autodesk

HIGH-QUALITY PRODUCT MODELS—POWERFUL NEW CAPABILITIES

Manufacturers interested in understanding the nuts-and-bolts of developing content can refer to the Autodesk Revit Model Content Style Guide and the companion resource, the Autodesk Seek Metadata Style Guide. Seek is an online source for product specifications and building product models for use in a variety of software, including Revit and 3ds Max Design. The guidelines in these documents represent an accepted minimum standard for building product model creation and geometry. Manufacturers that wish to distribute their content on Seek must meet these standards. Other organizations are developing standards that govern the creation of the rich metadata contained in BIM-ready building product models. Used properly, these standards can help manufacturers create high-quality models that meet the standards listed in Table 1.

Included in the standards is a set of best practices for developing fully compliant building product BIM models. One of the most important of these practices is the careful study of the environment in which the model will be used, as well as the design process and workflow of the architects and engineers who will use it. This approach takes more work than the approach used for generic building product models, but is well worth the investment; architects and engineers should be able to integrate the resulting building product BIM models into their designs almost effortlessly.

Enhanced Performance

These new building product models have numerous advantages, especially in today's competitive marketplace, where efficiency and productivity are paramount. Engineers can plug these standards-compliant models into the different analysis and visualization applications used by today's engineers, who must carefully analyze and optimize a building's active systems. With help from properly designed models, architects and engineers can then perform:

- **Daylighting/Shadow Analysis**

By exporting model data from Revit to Autodesk® Ecotect® Analysis, Autodesk® Project Vasari, or IESVE software, engineers can perform complex daylighting/shadow analysis calculations and then import the results back into Revit, providing a data-rich model.

- **Lighting Calculations**

Provide foot-by-foot candle calculations. Export the entire model to 3ds Max Design for analysis. Without standards-compliant building product models, the engineers would have to input building product data manually into 3ds Studio Max Design, wasting valuable time.

- **Heating and Cooling Load Calculations**

Perform quantity takeoffs from Revit, export the quantities to HVAC load calculation programs, and then import the results back into Revit.

- **Fan and Pump Static Calculations**

Avoid using traditional, spreadsheet-based methods that involve time-consuming calculations, especially when any design changes occur. This approach often leads to the production of sub-optimal designs that include larger pumps than necessary and wasted energy.

- **Quantity Takeoffs for Contractors**

Quantify a full Bill of Materials without increasing the modeling workload for the architects or engineers. Newer BIM models may include nested families for other components or products—such as mounting brackets or couplings—that are too tedious to piece together in the BIM project environment.

- **Security Zone Calculations**

Traditional 2D plan sets can show an outline of the viewable range of security cameras. Using BIM, security professionals can see near-photo-realistic, 3D images of a building interior and easily identify blind spots or obstructions.

- **Fire and Life Safety Calculations**

Calculate egress takeoffs automatically based upon square footage and occupancy per zone.

- **Adaptive Components for Panelized Surfaces**

Automatically conform the shape and information of individual parts to the surface onto which they are placed using adaptive components. These components build upon the conceptual massing environment of Revit. As designers manipulate the nodes that define the shape of the surface, adaptive components are automatically updated, which facilitates quantity take-off and fabrication shop drawing creation, structural load analysis, and identifying when allowable tolerances have been exceeded. The automatic updates also force architectural design and fabrication realities to come together in a practical way, because architects can more clearly discern building product limitations, particularly with curved surfaces.

Autodesk Seek Helps Enforce Standards, Ensure Model Quality

Autodesk Seek is one of the leading online sources for product specifications and Revit models. Seek not only serves as a repository for building product models, but also serves as a gateway helping to ensure that content posted on Seek meets high standards for inclusion in design models. At the start of 2012, Seek contained more than 60,000 different building product models. To be available for download on Seek, new models must pass a rigorous, recently implemented 36-point quality assurance (QA) test. Models available on Seek before implementation of the new QA process must pass this test by mid-2012 or face removal. Thus, architects, engineers, and contractors can download building product models that are more accurate, reliable, and streamlined for high performance in projects of any size.

To simplify the building product model selection process, Autodesk has created a series of badges (Figure 2) within Seek. These badges identify a variety of characteristics associated with different product families and help design professionals select which information to include and which to leave out, as well as how to properly format the data so that it can be easily integrated into project designs and workflows.

-  Manufacturer is involved with the publishing of the product information and design files. Seek works with the manufacturer to confirm information is up-to-date.
-  This family is hosted by a FACE.
-  MEP connectors are present for this family.
-  This family includes MATERIALS.
-  This family includes SHARED PARAMETERS from the Revit Master Parameter list.
-  This family includes COMPLETE MANUFACTURER METADATA.
-  This family contains geometry that is CONSTRAINED TO REFERENCES.
-  This family contains views that are 2D READY.

Figure 2. Autodesk Seek includes a series of badges that identify the characteristics associated with different product families.

BIM Product Model Myths and Misconceptions

Although manufacturers only began creating BIM-ready building product models a few years ago, many myths and misconceptions have arisen—some of which are untrue and some of which were once true but no longer apply as manufacturers have responded to growing demand for standards-driven building product models.



MYTH: File Size Degrades Performance



FACT: Extensive performance testing by BIM experts has revealed that it is not file size, per se, that affects model performance, but the modeling techniques used to create the building product model. For example, a typical large commercial building may include a dozen or more variable frequency drives, or VFDs, in their mechanical rooms. Using traditional methods, an engineering team would create a separate model for each VFD. Using today's latest modeling techniques, designers could include a single instance of an intelligent building product model and then reference it in all other locations—keeping overall project file size to a minimum even though the individual product file is relatively large. Some building product models can contain more than 1,000 possible configurations within a single file, each of which can be referenced from the single file.



MYTH: Manufacturer-Created Models are Low Quality



FACT: Early models lacked sophisticated content and were suitable mainly for 3D collision detection. Today's data-rich, intelligent models contain valuable building product data and information that architects, engineers, builders, and owners can use in complementary visualization and analysis applications.



MYTH: BIM is Only for Architects and Engineers



FACT: Contractors are very involved with BIM. According to the 2009 SmartMarket Report, the use of BIM among U.S. contractors almost quadrupled the previous two years, with half of all contractors using BIM at that time. The 2010 SmartMarket Report on BIM in Europe reports that 52 percent of contractors in Western Europe found BIM to be of high or very high value during the construction phase. Typically, contractors use it to make detailed models for project owners. Adoption of BIM within the contracting community is increasing at a steady rate.



MYTH: 3D Fabrication Models are Good Enough



FACT: Many manufacturers have highly detailed fabrication models. Although well-suited for the fabrication process, they contain more information than is necessary for the design process and, because they were not designed to work within a BIM environment, can often severely degrade project performance.



MYTH: Masking Regions Improves Performance



FACT: Masking regions only improve performance within views because you can turn off the 3D (fewer vertices). In a recent test, BIMAdvent—a content creator—tested 10,000 geometric boxes against 10,000 masking regions. The time taken to open and pan views were identical. There are many more effective ways to increase large project performance through the use of worksets or view filters.



MYTH: Arrays Don't Affect Loading Time



FACT: Avoid arrays in families. They don't affect project file size, but do have a significant impact on project and family loading times. In a recent test, simply adding an array of reference lines to a single family increased the project load time from 10 to 38 seconds.

The Benefits

When created in accordance with the new standards, manufacturer-created building product models can be a powerful complement to the designer's traditional toolkit, and beneficial to all key project stakeholders.

- **Owners**

Ultimately, owners benefit the most from the inclusion of well-designed building product models in their projects. After building completion, they can host the as-built models in the cloud and integrate them with Building Automation Systems and Building Management Systems for use by facility management teams, who will have complete access to all project information at the touch of a button. By contrast, facility managers using paper-based systems must often spend hours poring through 3-ring binders to find the information they need.

- **Architects**

Producing photorealistic renderings has never been easier for architects. As more and more render-ready, manufacturer-created building product models become available on Autodesk Seek, the time to populate a building with the actual products being specified is vastly reduced. Architects can now produce near-photo-realistic project renderings and video walkthroughs that can help their clients visualize projects like never before in a fraction of the time of more traditional methods.

- **Engineers**

Engineers require content that they can insert into the active systems that they design and then forget about, confident that the data they contain is accurate, reliable, and easily exchanged with the analysis and visualization tools they rely upon. By using manufacturer-created models, they are able to avoid the time-consuming process of creating their own, in-house models from scratch.

- **Contractors**

By using manufacturer-created building product models, contractors can provide better, more accurate estimates earlier in a project, perform collision detection analysis to help find clashes virtually rather than in the field, and, through 4D simulations, coordinate the logistics of manpower and material throughout the project construction timeline.

- **Building Product Manufacturers**

In today's market, building product manufacturers must produce standards-compliant building product models to remain competitive and stay in the running for specification. Manufacturers benefit from the models by greatly increasing the likelihood that designers will specify their products—a tremendous competitive advantage. The models can also serve as powerful marketing tools.

Conclusion

Since manufacturers first began creating building product models for inclusion in project designs, much has changed. Where early models lacked sophisticated content and were suitable mainly for 3D collision detection, today's data-rich, intelligent models contain valuable building product data and information that architects, engineers, builders, and owners can use in complementary visualization and analysis applications.

Get Involved

The building product model industry is evolving rapidly and standards are still taking shape. There is still room for new input. Manufacturers and AEC professionals alike have an opportunity to shape standards development as the field matures. Ultimately, well-crafted building product models are capable of relaying valuable feedback about building product selection to architects, engineers, and contractors, blurring the line between design and analysis. This feedback can actually guide the engineer in the selection and configuration of building products for specification.

Stay Competitive

In today's competitive marketplace, early specification in projects can mean the difference between a sale and loss of potential business for a BPM manufacturer. The reason is simple. Architects and engineers are more likely to specify high-quality BIM-ready building product models that will approximate their normal specification workflow than will generic content. Once they have done so, it becomes increasingly difficult to swap out that product for another as the design progresses—even if the quality of the actual product is better than the already specified product. At a certain point, it is not worth the cost in time, labor, and money. Thus, manufacturers that do not create their own high-quality building product models run the risk of being locked out of future specifications and, therefore, losing sales. One of the best ways to create such models is to partner with an organization that understands how your clients will use the building product models—and how to create them in a timely, standards-based manner.

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