




THE BIM REVOLUTION

THOUGH NOT
YET PERFECT,
'SMART' 3-D
MODELS PROMISE
TO BE THE
FUTURE OF
CONSTRUCTION

BENTLEY'S BE AWARDS OF EXCELLENCE PROGRAM

A model of the interior of the SBA Group office building in Vilnius, Lithuania, as designed by Denmark-based PLH arkitekter.



BY JOANNA MASTERSON

T I O N

BUILDING INFORMATION MODELING. By now, many contractors know these three words are poised to revolutionize the construction industry. Even more important is the effect BIM can have on business operations. It promises to save time on grunt work, allow for more design iterations, streamline quality control, reveal interference issues, reduce errors and omissions, provide more accurate cost estimates ... and the list goes on.

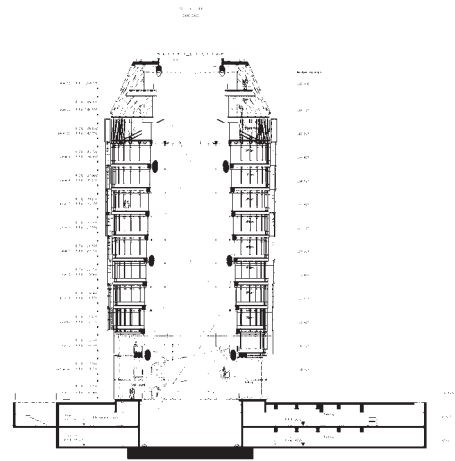
Of course, BIM doesn't come without challenges—whether legal, technical or financial—but the move from 2-D to 3-D and beyond appears to be here to stay. Many industry members already immersed in the technology are reaping the rewards, including enhanced profitability and a competitive edge.

The last big design shift—from manual drawings to computer-aided design (CAD)—took about a decade to become mainstream. Huw Roberts, global marketing director at Bentley Systems, Inc., sees BIM adoption happening exponentially faster.

“Five years ago only the leading-edge, sophisticated companies were using it,” he says of BIM. “Over the last couple of years, it's been a tidal wave of activity, and it's accelerating. Everybody's seeing competitors using it. Everybody who's using BIM is doing projects faster, better and more profitably. It's not a cost or burden. You're going to be better off no matter which way you measure the results.”

BIM is well-suited for complex projects, such as the ongoing renovation and modernization of the Herbert C. Hoover Building, a historic National Landmark in Washington, D.C. Backed by the U.S. General Services Administration (GSA), the project involves restoring the exterior façade and installing new building systems, life safety systems, utility connections, security upgrades and flexible office space. Starting in 2007, all major projects receiving design funding from GSA will require some level of BIM technology.

BIM can be applied on a much smaller scale as well, whether through a pilot program or on one part of a whole project. Roberts even used BIM to renovate his home basement.



BENTLEY'S BE AWARDS OF EXCELLENCE PROGRAM (3)

“In the long term,” says Noah Cole, senior communications manager of building solutions at Autodesk, “we believe BIM will be adopted across the industry, from design to construction and operation.”

UNDERSTAND THE BASICS

BIM started gaining ground after a 2004 National Institute of Standards and Technology (NIST) study reported nearly \$16 billion is wasted in the U.S. capital facilities industry due to inadequate interoperability among software systems and paper records. Because almost every decision about a building’s construction can be made in the design phase of the project, BIM serves as a way to reduce this waste.

NIST’s National BIM Standard Committee defines BIM as “a digital representation of physical and functional characteristics of a facility. As such, it serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle, from inception onward.”

Essentially, the model knows all, including how its physical components

A series of building information models show the exterior of the SBA Group office building in Lithuania.

look (3-D), when each part of the building will be constructed (4-D) and how much each element will cost (5-D).

Marty Hedlund, project director for Sundt Construction, offers this explanation: In 3-D, the design simply shows a group of lines shaped like an object—a chiller, for example. In BIM, that object is considered a “smart object” because it knows it’s a chiller. It knows what its properties are. It knows how much power it needs. It also can be told what its predecessor and successor are in the project. It can become a scheduling model because the objects know in which order they go.

This information became invaluable to Hedlund on a project in which he and his superintendent had two different theories on how to sequence the building. The pair built separate 4-D models, ran simulations and stopped to figure out problems and compare results. “We could make an intelligent decision as a team because we had a 4-D model,” Hedlund says.

SAY GOODBYE TO SILOS

According to the NIST BIM committee, “A basic premise of BIM is collaboration by different stakeholders at different phases of the lifecycle of a facility to insert, extract, update or modify the information in the BIM to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.”

In short, it’s a team effort, and no room exists for fragmented, silo-like work. In order to allow collaboration, though, interoperability must first be present. The International Alliance for Interoperability (IAI) describes interoperability as “the exchange of information among project participants throughout the lifecycle of a facility by direct communication between software applications.”

Because not every team member uses the same software, a means for exchanging the information must exist. The IAI established Industry Foundation Classes (IFCs) to help fulfill this need. IFCs allow the complete model to be passed from one participant’s computer application to another with no loss of information.

IFCs are similar to what Hedlund called smart objects. The model-based standards specify how real things (e.g., doors, walls) and their properties (e.g., size, cost) can be represented electronically in the model.

IFCs are not able to solve all data exchange problems, so interoperability remains a concern for BIM users. But, the National BIM Standard Committee is working to improve data exchange by setting a standard for typical processes and computer-based exchanges of information used during the conception, creation and operation of facilities. (A draft of the United States National Building Information Model Standard was released at press time.) NIST's standard is intended to ensure information gathered throughout the lifecycle of a building is collected in a standardized manner so it is useful to all parties involved.

"In concept, it's one conglomerate model that serves all people's purposes," Roberts says. "In practice, it will never be in one file or in one type of software. You have a shared model that is made up of a collection of different files and databases that are linked and understood together."

"The important thing for

"You want key decision makers at the table at the same time," says Scott Simpson, president and CEO of The Stubbins Associates, a design firm in Cambridge, Mass. "Under the old paradigm, you do the design and the construction documentation, and then the contractor would come in and do bidding and pricing. With BIM, everyone has a stake in the outcome. Everybody has a voice in the process."

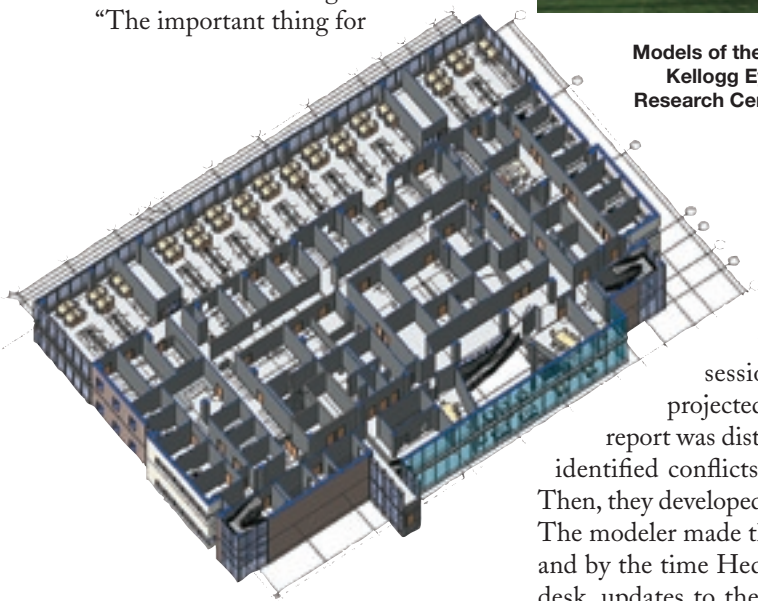
MAKE AN INVESTMENT

Most industry members are satisfied with the theory behind BIM: New technology allows building information to be stored, shared and analyzed, which in turn allows fewer translation errors and a faster, cheaper design process. Paying for and applying that technology, though, can be a concern for executives deciding whether to go forward with BIM.



THE STUBBINS ASSOCIATES (2)

Models of the University of Michigan Kellogg Eye Center and Diabetes Research Center in Ann Arbor, Mich.



For Hedlund, the process required team clash detection sessions. The model was projected on the wall, a clash report was distributed and the team identified conflicts among the designs. Then, they developed solutions as a group. The modeler made the necessary changes and by the time Hedlund returned to his desk, updates to the model were already being made.

Simpson says this process both enhances results and lowers risk. "Any time you can get people around a table with different points of view, you're going to get better results," he says. "Individuals will make mistakes, but teams rarely do. If you have experts make decisions as a team, your risk of making mistakes goes down."

construction executives to remember," he continues, "is that if you're working on a project and you want to exchange information, make sure the project specifies it is in open standards so the contractor isn't held hostage by any one software company."

This process requires a joint effort from all parties involved—architects, contractors, engineers, owners, fabricators—right from the start.

Executives should start by inviting a few vendors to explain their software and then evaluating which program is the best fit. Simpson estimates it costs up to \$50,000 to outfit a modeler with the appropriate hardware, software and training. Also, because many companies have some CAD solution in place, vendors usually can offer upgrade pricing on software.

For a staff already familiar with CAD, Roberts and Simpson agree the learning curve is manageable. Both say it takes about a week to train an employee, and up to eight months for staff members to really feel comfortable with the process.

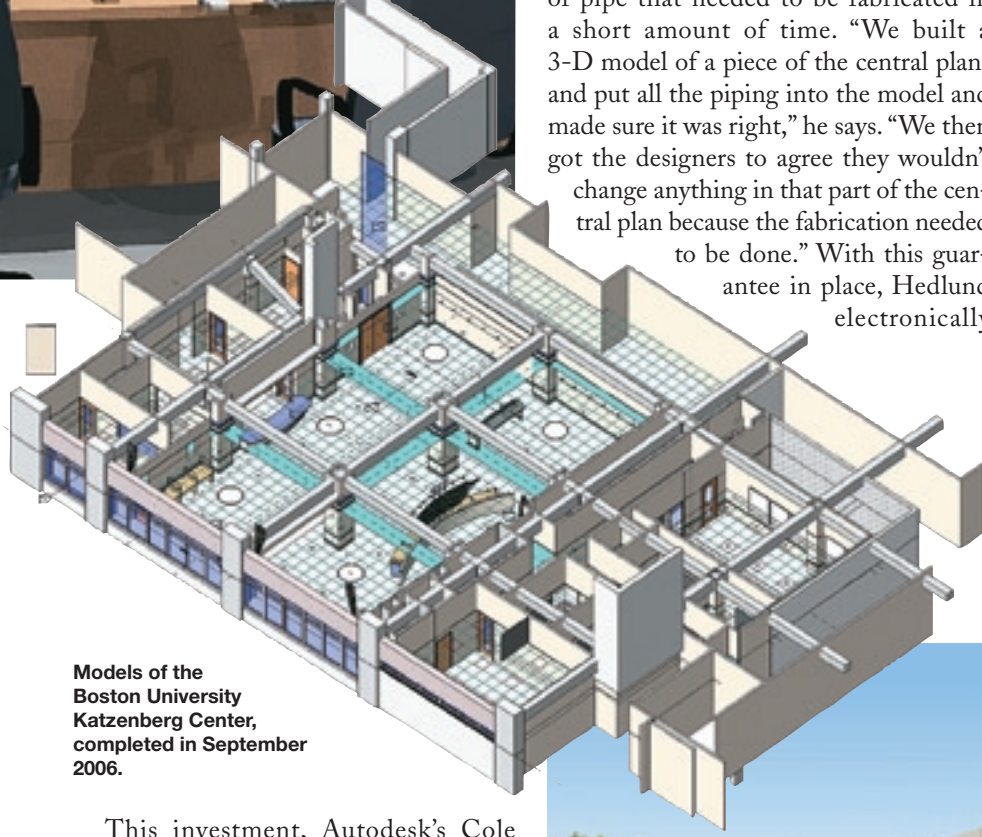
"It wasn't painful, but it wasn't without pain," says Simpson, whose firm has completed 4 million square feet of BIM projects. "It's like switching instruments in a family of instruments ... like from an oboe to a clarinet."

With one successful BIM usage, Roberts says the upfront software and training costs will seem like a valuable investment. For example, BIM can reveal if a steel beam interferes with another element in the design, so finding just one of those steel beams before it's on a crane can replenish the cost of software.



THE STUBBINS ASSOCIATES (2)

Hedlund recalls a fast-track project in which he was concerned about the amount of pipe that needed to be fabricated in a short amount of time. “We built a 3-D model of a piece of the central plant and put all the piping into the model and made sure it was right,” he says. “We then got the designers to agree they wouldn’t change anything in that part of the central plan because the fabrication needed to be done.” With this guarantee in place, Hedlund electronically



Models of the Boston University Katzenberg Center, completed in September 2006.

This investment, Autodesk’s Cole notes, is only worthwhile if executives also are willing to change the way they work. “There has to be an openness and willingness to reevaluate existing workflows and processes,” he says. “You can’t just bring in the software and BIM and expect it to work with your existing process.”

START SMALL

One of the best ways to get started using BIM is by implementing it in stages. Rather than doing an entire BIM project right off the bat, use the technology to help solve isolated problems.

sent the model to a fabrication plant that automatically made the pipes at the right size and shape, resulting in savings to the owner and an accelerated schedule.

With successes like these, Sundt felt confident enough in the BIM process to build its own headquarters using the technology. “What better way to try and demonstrate a new way of doing stuff than to do it on our own headquarters where we can control it better,” Hedlund says. “It’s not a horribly complex building ... but it was perfect for trying something new.”

The three-story, 67,400-square-foot headquarters—which will feature exterior tilt wall construction, a structural steel frame, interior raised access flooring with under-floor air distribution, an exercise room and a common lunchroom and kitchen—broke ground about two months ago and is expected to be complete in October 2007. Sundt also has six other projects under way using fully integrated BIM.

Along the way, Hedlund and Simpson encountered speed bumps, like software bugs and personnel averse to change, but those issues don’t seem to be enough to deter companies from investing in BIM.

Says Simpson: “3-D going into the future is going to be much more efficient than 2-D. We have to get over the hump, but once you’re on the other side, you’ll never go back.”

Joanna Masterson is staff writer for *Construction Executive*.



SUNDT CONSTRUCTION/SMITH GROUP

Sundt Construction is using BIM to build its future headquarters in Tempe, Ariz.