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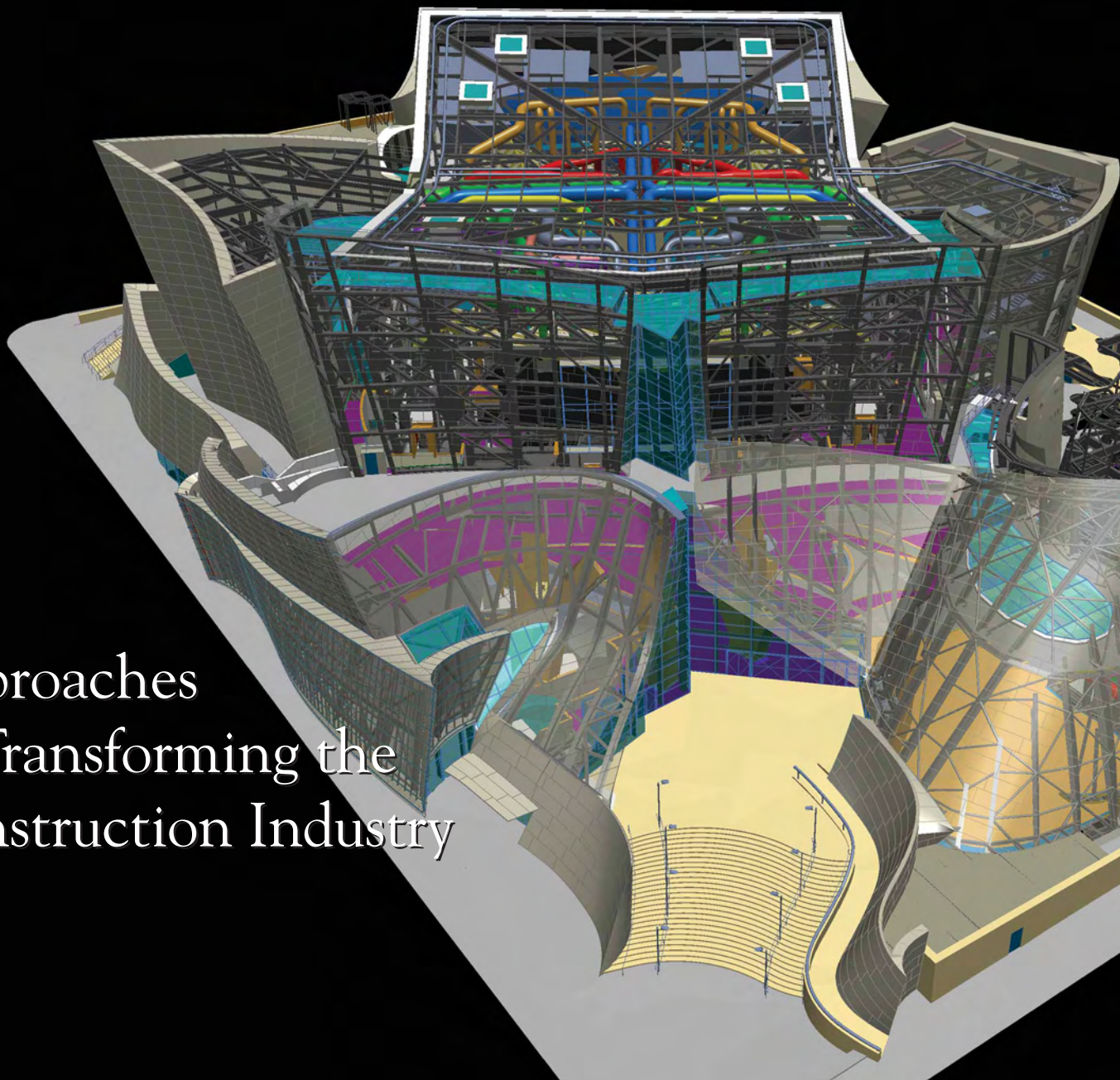

Approaches to Transforming the Construction Industry

An Introduction to Building Information Modeling (BIM)

By Deke Smith, AIA

A BUILDING INFORMATION MODEL is a digital representation of the 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 life-cycle from inception onward. A basic premise of the model is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the modeling process to support and reflect the roles of that stakeholder. The model is a shared digital representation founded on open standards for interoperability. The model may be a database made up of a set of interrelated files and not just one entity.

The concept of Building Information Modeling is to build a building virtually, prior to building it physically, in order to work out problems, and simulate and analyze potential impacts. The heart of Building Information Modeling is an authoritative building information model.

The reality is that all information for a building already exists electronically is the catalyst which makes implementing BIM a possibility. Our challenge therefore is to pull all the information together for the specific building being developed. The creation of a building information model begins with the first thoughts of the project. From that point forward the model is used as the authoritative source for information about the building. The model should be complete in every way prior to construction and all conflicts or clashes between building systems have been worked out prior to physical construction beginning.

This means that all the products that go into the model will have been selected and the fabricators will have participated providing the connection details. Each party will do their same job, simply more rapidly in a more collaborative environment. Once conflicts have been eliminated the model is locked. Detailed analysis can be run on the model at all stages to determine the optimum energy usage, the most sustainable and lowest lifecycle cost and the most environmentally friendly facility possible. The model also links to the geospatial world which provides it real world context. It also is in sync with the real property community so that the information is usable by all parties involved with facilities.

The construction contractors and sub contractors will build from the model without deviation. If something is not in the right place then the sub-contractor who deviated from the model will go back and make it right. The model will not be adjusted. As the building is assembled detailed information about the products being installed is collected from invoices and other delivered product information, items such as serial numbers, who installed it, and when the warranty period runs through can be collected and stored. What preventative maintenance is required will also be stored in the model and later used to generate work orders.

The work site is safer because more items will be pre-assembled off site and trucked to the site keeping the on-sire trades to a minimum. Waste will be minimized on-site and products will be delivered when needed and not stockpiled on site. Fabricators will also reduce waste because optimization of tasks such as cutting of sheet metal and pipe can take advantage of all scrap. More things are built and pre-assembled off site in controlled environments. When complete the model will be delivered to the operator and sustainer of the facility and any modifications or improvements will be recorded in the model. The model is the authoritative source and it will be used to plan and

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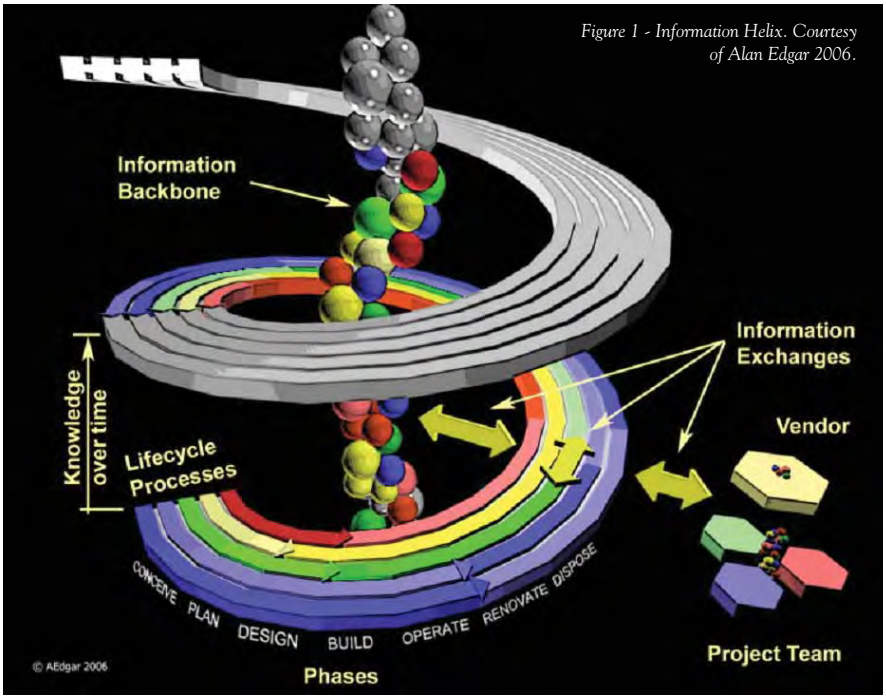

Figure 1 - Information Helix. Courtesy of Alan Edgar 2006.

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execute changes throughout the life of the facility. The work order supporting those changes will be tested for effect on the rest of the model and will not be closed until the model is updated and validated to be in compliance with the original design intent and energy usage plan. This continuing collection of data and building of knowledge at various stages is depicted in **Figure 1**.

Is this vision a long time in the future? No, actually there are some early adopters doing major parts of it already, although no one has implemented the entire vision. General Motors, for example, is on its sixth major project and they have saved nearly 25 percent over conventional design-build approaches. The United States Coast Guard has also implemented major aspects of BIM and is leading in the operations and sustainment aspect as they are linking facilities to mission requirements. There are many other examples of profound changes to the historical business processes used to build facilities.

This effort is not limited to the United States. Twenty-five other countries are participating in the buildingSMART® effort. Each is learning from and contributing to the advancement of this business process re-engineering effort. The key to success is in fact changing your business practices, not simply buying software. In fact software is the least cost investment in developing a BIM approach and that decision should be made after you determine your requirements.

Getting started is actually not as daunting as some perceive and it is predicated on knowing what functions you want to implement first. The first step is to simply decide that the building information model is going to be your authoritative source for all information about the facility. This decision can apply to new, as well as existing facilities. Your long term view must focus on the data and not the tool, if you plan use this model for a hundred years or longer—the life of the facility. This is critical so that you are not bound to the success or development schedule of a single tool vendor.

You may want to start with 3D visualization and conflict resolution, and then add various design and analysis tools once you have a basic model. Structural engineering and energy modeling are some of the typical next additions. Code compliance checking is maturing and will be ready in the United States within a year. The challenge with that is getting local municipalities to adopt the new approach. In time you will implement a complete collaborative, virtual and integrated design and construction approach so that you are achieving the first part of the vision described above. We need to ensure that facility managers are aware of the level of information that we have the potential to pass to him so that he adjusts his business processes to accept and sustain the information with little or no additional effort.

Building Information Modeling is much more than the building information model itself, it is truly the re-design of a whole industry. The National Institute of Building Sciences, a non-government non-profit organization established by congress to coordinate government and private sector construction entities has taken on this larger more holistic vision of BIM with the launching of the buildingSMART alliance™. The buildingSMART alliance™ is focused on incorporating the necessary business process changes, business case development, return on investment models along with the standards and the educational coordination required to profoundly and substantially improve the industry.

It is our hope that this magazine provides you with the information needed to help you launch and build your understanding of Building Information Modeling and learn from the many talented people working on this international effort to transform the construction industry. ■

Dana K. "Deke" Smith, AIA is the Executive Director of the buildingSMART alliance™. While working for the Department of Defense he founded the Facility Information Council, the home of the National CAD Standard and the National BIM Standard. Smith retired from the government after 30 years of service, in December 2006. In addition to his NIBS duties he has an information consulting firm and is a senior analyst for Cyon Research and the International Centre for Facilities in Ottawa. As well he is writing a book on the strategic planning for implementing BIM.

What is BIM?

Building Information Modeling (BIM) is a digital representation of the physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.

A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder.