# BIM (Building Information Modeling) Update

Dianne Davis, president, AEC Infosystems

BIM is what we all expected computer-aided design (CAD) to be, but now we know it requires information standards to be productive. Fortunately, we now have both information standards and software companies that support and empower them.

Today, after much education on the part of the AIA, the International Alliance for Interoperability (IAI), the National Institute of Building Sciences (NIBS), industry consultants, and technology companies, we have a term coined by Jerry Laiserin, that we all can use for this process: BIM, or Building Information Modeling.
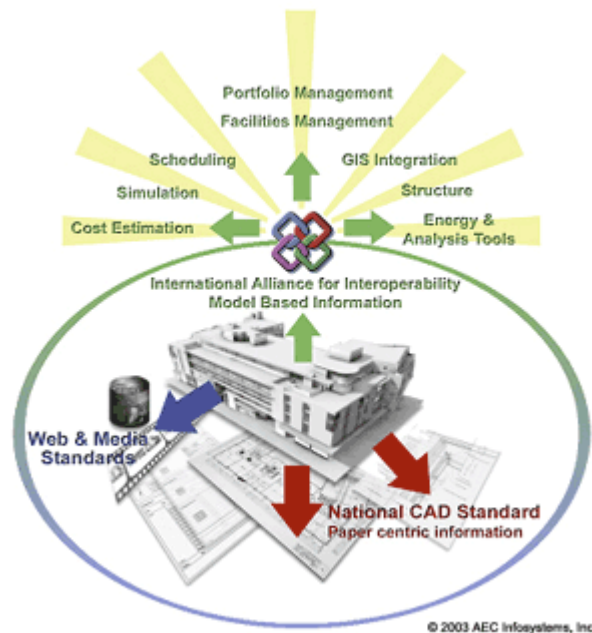
The U.S. Information Foundation of BIM

What Is a BIM Process?
First, it's significantly more than transferring electronic versions of paper documents. It's more than pretty 3D renderings with construction documents as a separate function. It's about information use, reuse, and exchange, of which electronic documents are just a single component.

When integrated 3D-2D model-based technology is linked with information, design firms have a faster, higher-quality, richer design process. Risk is reduced, design intent is maintained, quality control is streamlined, communication is clearer, and higher analytic tools are more accessible.

Lower-level tasks such as drafting, view coordination, document generation, and schedule creation are automated. Drawings that represent different views of the same

building object are automatically updated when modified.

We finally can harness the power of computers in a real value-added design process that doesn't just mimic drafting.

Benefits and Returns of the BIM Process
With all the benefits of a BIM process, why are some firms hesitant to change from electronic drafting to a model-based process? It may be the software they use. Certainly the software a firm uses defines and shapes its process

Different standards, but they don't compete.
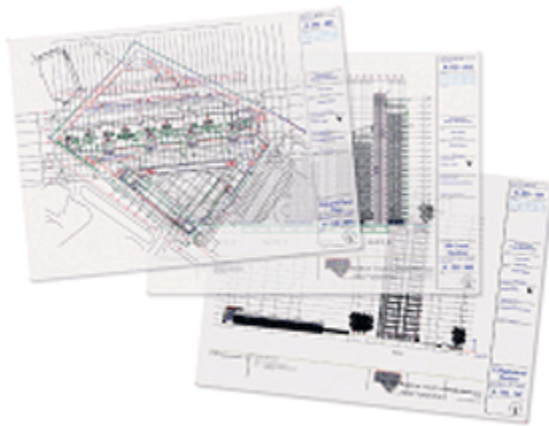
options. Other firms may have a painful recollection of transitioning from paper to CAD without information standards and support from the CAD companies.

Fortunately, we aren't condemned to repeat that history. Some software companies have already been incorporating accepted graphic and information standards into their software.

The U.S. Coast Guard (USCG), now a part of the U.S. Department of Homeland Security, was one of the first organizations to move to U.S. National CAD Standard (NCS)/IAI-compliant software. The USCG's model-based standard is Graphisoft's ArchiCAD. Through the work with NIBS, the NCS, IAI, and the USCG, Graphisoft shows us the blend of these standards and the productivity gains when information standards are supported in BIM software.

NIBS supports U.S. standards. NIBS is the overarching organization supporting NCS and the IAI in the United States. It supports the construction industry committees defining the construction process. These committees then work with IAI and NCS technical groups that create the standards. Committees meet regularly on different aspects of construction data.

The NCS defines standards for many aspects of electronic building-design data, including:

- CAD layers
- Organization of drawing sets
- Drawing sheets and schedules
- Drafting conventions
- Terms and abbreviations
- Graphic symbols

- Notations
- Code conventions
- Plotting

The National CAD Standard. The NCS is a product from the cooperation of the AIA, CSI, and NIBS. The NCS represents a consensus among architects, engineers, and experts from the construction industry about how to classify building design data and streamline communication among owners and design and construction project teams based on paper-centric information delivery. After several years of informal teaming with technology companies, NCS has developed a more formal program for technology companies. For more information, see the Web site at www.nationalcadstandard.org.

The IAI IFCs (Industry Foundation Classes)
More than 10 years ago, after BIM processes were already in use, IAI groups began creating model-based standards to avoid repeating our 2D CAD history. The knowledge in the IAI is the defined information and workflow valuable to any firm.
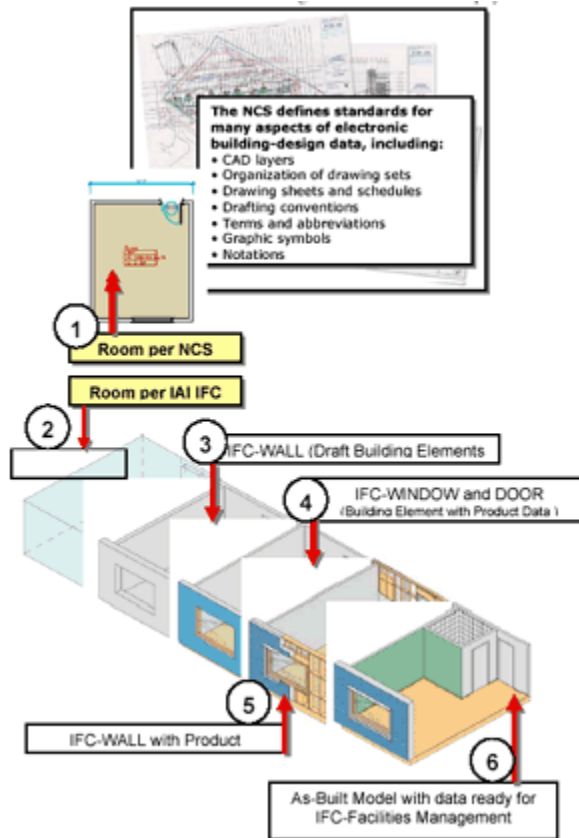
The intention of the IAI is to specify how "things" that could occur in a constructed facility (including real things such as doors, walls, and fans as well as abstract concepts such as space, organization, information exchange, and process) should be represented electronically. These specifications represent a data structure supporting an electronic project model useful in sharing data across applications. The 2D graphics represented by the NCS is a subset of this model information.
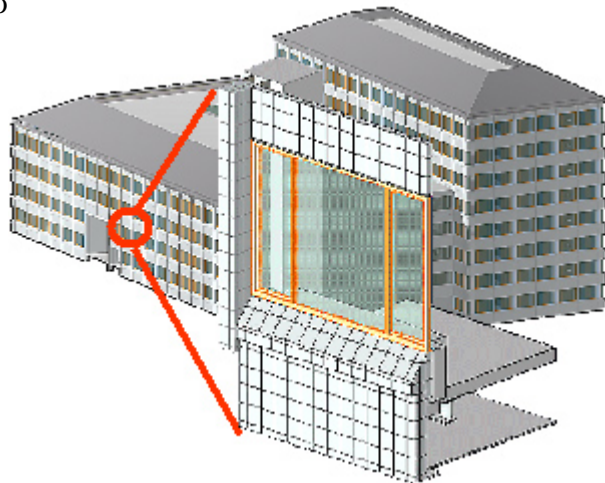
Each specification is called a "class." The word "class" describes a range of things with common characteristics. For instance, every door has the characteristics of opening to allow entry to a space; every window has the characteristic of transparency so that it can be seen through."Door" and "window" are names of classes.

The classes defined by the IAI are termed Industry Foundation Classes (IFCs) for the following reasons:

- IFCs are defined by the AEC/FM **industry**.
- They provide a **foundation** for the shared project model
- They specify **classes** of things in an agreed-upon manner that enables the development of a common language for construction.

The NCS defines standards for many aspects of electronic building-design data, including:
• CAD layers
• Organization of drawing sets
• Drawing sheets and schedules
• Drafting conventions
• Terms and abbreviations
• Graphic symbols
• Notations

1 — Room per NCS

2 — Room per IAI IFC

3 — IFC-WALL (Draft Building Elements)

4 — IFC-WINDOW and DOOR (Building Element with Product Data)

5 — IFC-WALL with Product

6 — As-Built Model with data ready for IFC-Facilities Management

The IAI IFC is the only construction information standard recognized by the International Standards Organization (ISO). For several years, Graphisoft has played a leadership role, working with NIBS and NCS committees, to blend the power of ArchiCAD's parametric objects with the model-based open standards of IAI IFCs.

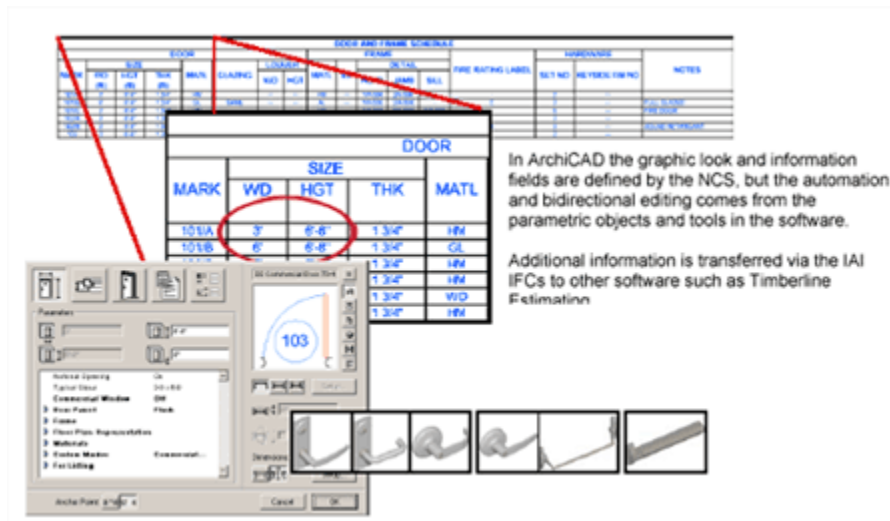*How Do These Standards Fit Together in Software That Benefits the Designers?*

Some people believe that a BIM process represents more work, with the benefit going to the client and not to the architect. If the architect is using electronic drafting tools instead of an integrated parametric object-based system, then this may be the case. But firms that use intelligent tools will see the payback in their design process through improved productivity, reduction of error, and faster production through automation. The example below explains the use of NCS, IAI IFCs, and intelligent objects in production.

1) We'll start with a client needing a room and establishing some general requirements. In 2D electronic drafting with NCS, we would show a floor plan, walls as polylines on a CAD Layer, a door symbol, a room stamp, and notations. When it is time to place our drawings on paper for plotting, we would use the NCS to organize the construction sets. Other information would be handled separately and not integrated into our CAD file.

2) With IAI IFC-compliant software, the model can support not only NCS standards but also integrated data that support design decisions. We can start with an IFC-SPACE that not only carries a plan view but also carries its geometric size, square footage, and volume. We can create and do reports on stacking diagrams and the like.

3) As the design progresses, we can use an IFC-WALL for quantity take-offs, thermal or energy calculations, and other analysis. This is the same wall used in our construction document views and our rendering. Even at this level, we can more fully determine whether our design meets our client's needs.

DOOR AND FRAME SCHEDULE

DOOR

	SIZE			
MARK	WD	HGT	THK	MATL
101A	3'	6'-8"	1 3/4"	HM
101B	6'	6'-8"	1 3/4"	GL
			1 3/4"	HM
			1 3/4"	HM
			1 3/4"	HM
			1 3/4"	WD
			1 3/4"	HM

In ArchiCAD the graphic look and information fields are defined by the NCS, but the automation and bidirectional editing comes from the parametric objects and tools in the software.

Additional information is transferred via the IAI IFCs to other software such as Timberline Estimating

4) Product objects such as an IFC-DOOR or WINDOW allow a higher refinement to our design. Calculations and costing, which used to happen only after construction sets were more complete, can be done in the first days of a project.

5) Walls or objects can automate the creation of details, schedules, and levels of structure and provide product-specific installation needs. 4D construction scheduling can be tied to objects for construction sequencing.

6) Our design complete, the model information, including traditional CAD views and product data, is ready to automatically populate IAI IFC-compliant facility management software. Clients that manage buildings want these models, and architects have a value-added product once the design is complete.

7) The benefits of object intelligence enhance NCS in other ways. What were simple graphic elements have been given intelligence to help automate the task they represent.

8) This Drawing Title is now an intelligent object that automatically shows the scale of the drawing it supports. If the scale of the drawing changes, so does the indicator on the graphic. This type of automation greatly reduces construction document errors and coordination.

C2 **DRAWING TITLE**
SCALE: 1/4" = 1'-0"   0   2'   4'   8'

BIM Isn't BIM without the NCS and IAI IFCs
In integrated model-based software, the NCS and IAI IFC represent the graphic and model foundation for BIM to work as a design process. BIM without these standards is proprietary and ultimately not interoperable.

The BIM process is both vision and reality for many organizations and firms. In 2002, .dwg was taken out of the NCS, and the USCG modified its software to support NCS/IAI-compliant software. Its model-based software became Graphisoft's ArchiCAD.

"ArchiCAD is thus far the only CAD product to incorporate support for both the NCS and the IAI IFC in the same program," Jerry Laiserin stated in the April 2002 issue of *Architectural Record.*

More software companies should explore how to make their software support these standards. If they want to provide maximum productivity and align with design's changing business models, they will make the evolving IAI and NCS standards part of their core systems.

Dianne Davis is president of AEC Infosystems and Object Model Leader for the U.S. Coast Guard Regional Strategic Plan. She is a founding member of ShiP. In addition, Davis has participated for several years on both NCS and IAI committees and cochairs the Futures and Trends Committee at NIBS. Her clients include: U.S. Coast Guard, U.S. Army Corps of Engineers, the National CAD-GIS Technology Center, National Park Service, Army Research Lab, NIST, and many private-sector firms. Davis can be reached by e-mail at d.davis@aecinfosystems.com.